The role of place in science learning among urban middle school students: Science as a Context and Tool

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Abstract: An important conundrum that the science education community faces is "why is it so difficult to bridge everyday science with school science?" Drawing upon sociocultural perspectives on learning and critical ethnographic research methods, we examine students' changing participation within middle school learning science. Our findings reveal the importance of "place" in how and why these youth pursue science learning. We argue that one way in which place shapes their learning is in how the youth take up science as both a context and a tool for change. We look at two interrelated kinds of changes within the classroom: crafting new forms of participation and new points on entry into the science learning community, and redefining the purpose of science activity. We also argue these instantiations of place in learning serve to connect the worlds of youth with the worlds of school science.

Introduction

The students in Mr. Nader's environmental statistics class were involved in the "pigeon project." The pigeon watch project, inspired by Cornell University's Pigeon Watch Project (http://www.birds.cornell.edu/programs/urbanbirds/ubs_PIWMainEN.html) was a 3 week investigation, with the goal of supporting students in learning to recognize the different color morphs of pigeons and pigeon behaviors, and to use this information to learn how to classify animals and to produce simple environmental statistics.

The teacher selected the pigeon unit precisely because he wanted his students to connect to the content of environmental statistics. Students in large urban centers, like New York City, are around pigeons and have a great deal of experiential knowledge about them that can be tapped to support them in "connecting" with environmental statistics.

By standard measures, the pigeon project was a success in Mr. Nader's classroom. The students demonstrated their learning about pigeons morphs, classification, and graphing through their coursework and end of the unit KWL activity. For example, in the initial class "KWL discussion" of "what students knew about pigeons" and 'what they wanted to know" students talked about how pigeons were dirty, carriers of disease, and rats with wings. At the end of the unit, the "What we have learned" column was populated with comments like they "follow each other, there are many types or morphs, the majority of pigeons [in our neighborhood] are bluebars and checkers, they get along together although they are different types, and pigeons don't attack (not aggressive).

Yet, interviews with students after the unit revealed, surprisingly to us, that their ideas about the pigeons themselves did not change, and several students in the class did not see the purpose or importance of the project. Take, for example, what Jameer, a student who performed quite well in the unit had to say about the project:

Researcher: What did you think about the pigeon study?
Jameer: It was stupid.
Researcher: Why?
Jameer: I don't know why I would want to learn about pigeons.
Researcher: What would you change about it?
Jameer: I wouldn't have studied pigeons in the first place.
Researcher: What would you study instead?
Jameer: Neighborhoods or something, not pigeons. It doesn't affect, what we are we going to do change the way pigeons look or something. It really didn't help me with anything. I didn't really like it.
Researcher: How much do you remember about it? Do you remember what we did?
Jameer: We went to the Cathedral and we looked at pigeons, and we wrote down how they looked. I didn't really see the point. I don't know why.

Jameer was not satisfied with the purpose of the pigeon project and challenged it critically in her interview with us. Jameer argued that she would rather study rats or garbage instead of studying pigeons pointlessly:

Jameer:	*I would choose a rat or a mouse or mice because there's a lot of them.*
Researcher:	Really. Where do you see them?
Jameer:	*On the way to school they be running across the street, you see dead rats on the street.*
Researcher:	So you'd rather study mice than pigeons?
Jameer:	Yep. There's a lot of information about mice. You see them on train tracks; you do not see pigeons on train tracks.
Researcher:	Why would you choose rats?
Jameer:	Because rats are everywhere, they're in people houses. I'm dead serious. I'd choose garbage. *It don't even have to be an animal because you see garbage all over the street on Amsterdam like they don't pick up the garbage or something, and then on Broadway it's just not there.*
Researcher:	That's true I never see garbage. If we had more time to study pigeons how would you like to continue the pigeon study?
Jameer:	I would go to other neighborhoods, not just where we are. Let's say to a cleaner neighborhood to see how many are there because pigeons don't really do anything they just eat and that's it. To see where pigeons like to live, in dirty neighborhoods or clean neighborhoods.

We believe that Jameer's interview suggests that Jameer had a deep awareness of how learning science in class might make a difference in her life. Jameer indicates that she has a strong desire to use science as a tool to make better sense of her neighborhood and perhaps to even make some changes within her community. While she could talk about what she learned about pigeons, she did not claim any connection to or ownership of her learning.

Learning science in the pigeon study involved many different practices – epistemological (i.e., learning about pigeon morphs and their importance), investigative (i.e., the skills of classification and how to appropriately apply them to defining birds in a neighborhood), and communicative practices (i.e., learning how to manipulate environmental statistics to explain local phenomena). And, as these brief descriptions indicate these practice were indeed local. All of the environmental statistics, for example, the students prepared around the pigeon project emerged from their class-built data set. However, *the point of the pigeon unit was to use these practices towards the goal of science learning rather than something more encompassing.* We noted a critical juncture in which the students' sense of place and science as goal worked against shared goals and movement towards learning. That is, the pigeon unit ignored how students *felt* about pigeons. The focus of the unit was on "where" students lived – i.e., they lived around pigeons and would therefore be interested in them – but not on how pigeons might matter to students. As the teacher made decisions about the unit, "how" students lived in the city did not matter as much as the fact they lived in the city.

We begin our manuscript with Jameer's story because it raises two questions:

- In what ways do urban youth engage in learning science in place-based ways?
- What is the relationship between place-based science practices and meaningful participation in science class?

Conceptual Framework

In this section we discuss two bodies of literature – cultural historical activity theory and sense of place – and its implications for science teaching and learning.

Cultural-historical perspectives

We draw upon Rogoff's definition of learning as changes in forms of participation and the ways in which such participation is culturally mediated and historically developing, involving cultural practices and tools (Rogoff, 2003). Central to her thesis is that idea that culture is dynamic and activity-based. Gutierrez and Rogoff (2003) argue that such an activity-oriented understanding of learning suggests that culture can only be understood through its context development, and never as a set of definable, measurable traits. As they cite Cole and Engstrom, "Culture is experienced in face to face interactions that are locally constrained and heterogeneous with respect to both 'culture as a whole' and the parts of the entire toolkit experienced by any individual" (Cole and Engstrem, 1993, p. 15).

More specifically, we are drawn to cultural historical approaches to understanding learning and cultural activity precisely because of its focus on cultural practices (Gutierrez & Rogoff, 2002; Gutierrez, 2002; Lee, 2002). Sociocultural theories, broadly speaking, have pointed out how classrooms are replete with a multitude of practices which are culturally grounded, and foster many microcultures. These theories also point towards how changes in forms of participation are the products of both shifting cognitive and social functions. Cultural historical approaches point towards how such education practices are "are constituted through the junction of cultural artifacts, beliefs, values and normative routines known as activity systems" (Gutierrez, 2002). Equally as important this framework intertwines the role and importance of cognitive, social and emotional processes in sense-making. For example, Lee and Majors (2003) argue that "Success and failure in school is contingent upon one's ability to regulate and situate identities, utilize culturally-developed semiotic tools and negotiate models of meaning in shared social activity." (p. 49).

To make sense of activity from cultural historical perspectives, we draw specifically from cultural historical activity theory, which underscores the importance of the norms for talk, artifacts, the goals and social/cognitive resources of participants, the roles assumed, together interact to constitute the activity (Engestrom et al, 1999). Engestrom's model of mediated action (fig 1) is based on Vygotsky's foundational work which highlights that human agency and actions are mediated by cultural tools, signs and signals. Cultural historical activity theory has since been refined to reflect three levels of interactions as shown in fig 1. In this model, the subject refers to the individual or group (e. g. science student) whose point of view is taken in the analysis of the activity. The object (or objective) is the target of the activity. Tools or instruments refer to both internal and external mediating artifacts which can be utilized to achieve the outcomes of the activity. The community (e.g. 6th grade science class) is comprised of people who share the objective with the subject. Rules regulate actions and interactions within the activity system. The roles, or division of labor, describes how tasks are divided horizontally between community members as well as alludes to any vertical division of power and status.

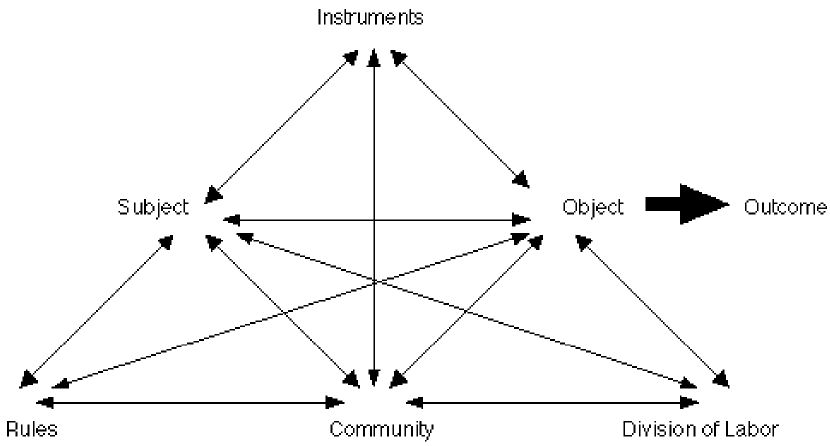

Figure 1. Engestrom's model of mediated action.

Thus, from cultural-historical perspectives learning is conceived of as a process occurring within on-going activity and not divided into separate characteristics of individuals and contexts. Cultural historical approaches are particularly helpful in moving researchers beyond cultural regularities and the assumption that general traits of individuals are attributable categorically to ethnic group membership, by paying attention to variations in individuals and groups histories of engagement in cultural practices. (Gutierrez & Rogoff, 2003).

Lee (2002) argues that cultural historical perspectives can powerfully support research into learning and participation among students of color. In particular, she argues that more work needs to be done that focuses on race and ethnicity in order to keep attention on the regularities of cultural practices by groups that tend to get buried through normalizing discourses and to uncover the ways in meanings of practices are constructed and demonized by others. In her theory of cultural modeling she draws upon these regularities to support the design and enactment of curriculum that draws upon the social and cultural strengths that students bring from their home and community experiences while also recognizing how these practices develop in context driven ways. Similarly, Nasir and Hand (2006) have called for more attention to the ways in which sociocultural perspectives, and in particular cultural historical perspectives can inform issues of equity in learning in racially diverse contexts by arguing that it is important to consider how culture, power and development shape each other at both the local and global levels.

The centrality of race and culture within a cultural historical activity theory makes it a particularly productive framework for understanding the hybridity and heterogeneity inherent in cultural activity, cultural artifacts, and their participants. For example, Gutierrez (2002) reports on how high school students from migrant farm worker backgrounds often use hybrid language practices in sense-making activities designed to promote critical reflection about their course subject matter as well as about their life experiences as migrants. Moje and her colleagues (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" (Lee, 1993; New London Group, 1996) 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 (e.g., Calabrese Barton, 2001; Hammond, 2001; Moje et al., 2001). 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). 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 (Moje et al, 2004). Brokering for such hybrid spaces in science class is therefore imperative when envisioning a science education that draws from students' out of school knowledges and expertise.

Sense of Place

Although place has been a popular topic of inquiry in diverse disciplines such as philosophy, psychology, architecture and urban-planning, it has not been a part of education discourse until recent years (Gruenewald, 2003a). As Sanger (1998) reports, standard school practices "teach students that their relationship with their place is marginal, uninteresting, and unimportant and the quality of the environment demonstrates this marginalization" (p. 5). Gruenewald (2003a) similarly critiques the current western education system for its disproportionate emphasis on accountability and standardization, leaving little room for diversification of educational concerns or discourses including a concern for a sense of place.

For example, today's education follows an "anywhere and anytime" general approach by establishing national (if not globalized) standards and subsequently developing curricula which can be applicable anywhere and anytime (Arenas, 1999; Pinar, 1991; Smith, 2002). Gruenewald (2003a) argues that the idea of focusing on and including local places and its attributes in education is radical "because current educational discourses seek to standardize the experience of students from diverse geographical and cultural places so that they may compete in the global economy. Such a goal essentially dismisses the idea of place as a primary experiential or educational context, displaces it with traditional disciplinary content and technological skills, and abandons place to the workings of the global market" (p.7). Arenas (1999) also points out that the current education system which is based on standardization and universalization disregards local histories, knowledge, stories, and languages in favor of the powerful national ones. Therefore, the importance and values of learning local knowledge and skills have been nearly eliminated in the current education system.

We value a sense of place framework in our work from cultural historical perspectives because of how it helps us to understand the importance the relationship between the local and the global as indicated by Nasir and Hand. As they state:

> A central idea in linking individual trajectories and broader social structures is that of history. We have access to sets of roles and resources that are necessarily constrained (though not defined) by the history of individual in practice within these contexts. Sociocultural theories view these histories as critical to understanding how the sociopolitical arrangements of power and access in which individuals were situated came to pervade the practices they established. This is not to imply that contexts are static or handed down, but that things within them (practices, values, identities, beliefs, artifacts, etc.) are constantly indexing their own development. (p. 465).

In other words, part of understanding how roles and rules are mediated culturally and historically developing, is to understand how structures and trajectories interact in place-based ways.

There are many examples that address the dangers of marginalizing the role of place in education (Bowers, 1998; Gruenewald; 2003a, 2004; Sanger, 1996; Sobel, 1996). We believe that marginalizing place removes practice from the cultural – historical realm, reducing culture to a static set of attributes and activity only through subject – object terms. As pointed out earlier, several studies have shown that utilizing student's social and cultural experiences promotes engagement in science among urban youth (Calabrese Barton, 2003; Elmesky, 2003; Seiler, 2001). Hammond (2001) offers a particularly compelling example. In her research with Hmong-American families, she shows us how family members whose cultural practices were once understood as different from school knowledge at best, and scientifically wrong or detrimental at worst, have helped to transform an elementary science curriculum when that curriculum *critically* emerged from their lived experiences. The result was that students and their family members were much more highly involved in school science. From an international perspective Thomson (2003), likewise demonstrates how the centralized and standardized national education policy has damaged a sense of place education in Kenya. Thomson, a science educator in Kenya, has argued that since the beginning of European influence and control of education system through colonial exploitation, indigenous African knowledge in natural science and mathematics in Kenya has been ignored, underestimated, depreciated and held in contempt. National standardized curricula and tests that are insensitive to local knowledge have desensitized students' knowledge and value of their immediate local environment.

In short, science education has deprioritized the importance of place and its relationship to culturally mediated trajectories of practice to accommodate the push towards standardization and universalization of "what" students need to know and how they can best demonstrate that knowledge (Sanger, 1998). The result is that that whether a child lives in a rain forest in South America, in a hardwood forest in North America, in an island in Japan, or in West Harlem in Manhattan, children tend to get similar education which stereotypes places e.g. pollution in urban environment, deforestation in rainforest ecosystems and endangered species in Africa. In many cases, education seems to have lost its intimate and unique connection with the local community (Sobel, 1996). "Here and now" seem to hardly matter in science education.

However, because place has been silenced in the current education climate does not mean that children's sense of place is absent in classrooms. Since children's sense of place is an important part of children's identity affecting who they are and how they learn, it would be logical to expect that children *leverage* their sense of place when they learn at school. The point of the question is then, in what ways does a sense of place play a role in a child's science learning.

Methods

We draw upon ethnographic case studies conducted during the 2003-2005 school years. A case studies approach was employed because it is well suited to take into account the contextual and relational nature of complex issues and processes (Donmoyer, 1990; Yin, 1994). Research was conducted in two different New York City public schools. The first school, The Inquiry School [TIS], is a new small science-focused public school within a larger comprehensive middle school in the south Bronx area of New York City. 45% of the student population is African American and 55% is Hispanic. 90% of the students participate in the school's free lunch program. Since it has a science focus, each class (except the bilingual class) receives five 45-minute science periods each week. Our collaborating science teacher has five years of teaching experience. The second school, the Union School is a neighborhood public school in upper west side of Manhattan in New York City. The school served students who are from ethnic minority groups including 46 % of the student population being Hispanic and 42% being African American. Also about 76% of the student population was eligible for free lunch. The data for this study came from Mr. Nader's environmental statistics classes which met twice a week throughout the semester.

In-depth, year long, case studies were conducted with 12 students across the two schools. The case study youth were selected purposefully collaboratively among the researchers and classroom teachers to reflect a range of interests and achievement in science as well as ethnic backgrounds. To construct the case studies, multiple sources of qualitative data were collected. These included twice a week participant observations, field notes, two individual and group interviews lasting about one hour each per student, one 45 minute content-based think alouds focused on urban ecology, reflection notes, student artifacts, such as science class journals, projects, papers, and other written work, and out of science class and out of school informal conversations, observations and hanging out.

Data were analyzed using a grounded theory approach (Glasser & Strauss, 1967; Strauss 1997). Our data were coded primarily by the three authors and discussed at weekly research meetings. If disagreement existed on the meaning or application of codes, we debated differences until consensus was reached. We coded our data for how and when youth seemed to purposefully changed their participation in the world (or in their figured worlds) *through* science. Such changes might be noted in the tools they use to understand something, in the talk they have about events or experiences, or in the questions they seek to understand or answer. We then analyzed those events where we noticed students' participation in and with science changing and began to try to discern what was the nature of that change and how "science" mattered.

This coding process resulted in two primary coding trees: The first tree developed nuances around how participation changed, with special attention paid to how the roles and rules for participation within their communities shifted, how participation occurred in ways that were "outside" the typically endorsed students identities-in-practice in their learning community, and when participation seemed to be more animated or frequent. The second coding tree looked more specifically at how the youth's practices framed participation in science, showing how the youth ultimately authored hybrid spaces where they engaged science as a context, supporting deeper engagement and learning in science, and their ability to use science as a tool for personal and community change.

Findings

Science as Context

As we indicated in the opening vignette about Jameer and the pigeon project, science in the classroom has traditionally been framed as a goal, or in other words, the object of participating in science class is to be successful in learning about science ideas. As Jameer's experiences illustrated, however, even in a science classroom where students' lived experiences are valued and integrated, science can still be mainly framed as a goal in the classroom when place matters only in what students learn not how or why they learn.

Drawing upon the activity theory triangle, the explicit classroom emphasis in the pigeon project was primarily on the subject, tools, object triangle, with the outcomes of learning focusing solely on performance indicators of content mastery (see Figure 2a). While these outcomes are certainly mediated by Jameer's classroom community and the rules and roles which shaped practice in that community, these were left uncontested within the framework of traditional science education. Jameer's role as a member of her community and how that shaped her understanding of the value of studying pigeons was not considered in how she was expected to take up pigeons in her classroom.

Jameer's experiences with the pigeon project seemed much like a missed teaching opportunity. We noticed, however in both her classroom and in the other classrooms in which we participated instances where students did seem to deeply invest in science class where their participation appeared to be qualitatively different. In these instances we noted that students seemed to more deeply engage in classroom activity, when classroom practice placed value on the multiple communities in which they participated and the meanings these communities carried to doing science in the classroom. In these instances, the ways in which rules and roles mediate activity in the classroom and how these rules and roles are informed by both the learning community and the multiple figured worlds to which students belong, become *points of contestation or challenge to traditional science discourse*. Unlike the episode of Jameer and the pigeon project, *students' place-based experiences mattered not just in what they learned but why and how they learned.*

We refer to these instances as "science as context" because such classroom practices frame engagement in science activity through the ways in which place-based experiences and relationships mediate the purposes and nature of activity. In science as context, science plays a "deeply situated but supporting role" to make sense of the place-based experiences of youth. Furthermore, when science emerges as a context, the ways in which rules and roles mediate activity in the classroom and how these rules and roles are informed by both the learning community and the multiple figured worlds to which students belong, become points of contestation or challenge to traditional science discourse. In science as context, therefore, the object of science is expanded to value the multiple communities in which students participate and the resources, roles and expertise that come along with those communities.

The idea of science as context draws significantly upon how participation in science is placed-based, meaning that how and when students enter into science activity, the expertise they share, and the tools they co-opt reflect both the science activity and their simultaneous inhabitation of multiple figured worlds, including figured worlds outside of school science (Figure 2b). As these figures suggests, the community of practice in question expands to be inclusive of non-science school based communities such as the students' neighborhoods, the school neighborhood or any other salient students' lifeworlds. When students draw from personal experiences that are related to science (however tenuously) to frame their participation in school science, the figured worlds that are recruited in school science expand to become more inclusive of communities outside of school science. Out of school communities are grounded in the lived experiences, knowledge and ways of being students possess from being members of various figured worlds that matter to students, such as the neighborhood where they live as well as the school community.

We argue that when science is brought in as a context in addition to a goal, students have a wider base of resources to draw from and multiple roles with which to engage. With science framed as a context, students are no longer consigned to just the role of a "learner of science facts" in a classroom. They have a wider repertoire of roles available from which they can participate in a school science activity and the connections between school science and lifeworlds are made bolder and more explicit. In these familiar roles, they are positioned as experts rather than novices, and therefore more empowered to exercise agency in their science learning. Thus positioned, teacher and students can collectively broker for hybrid spaces in science class that foster student agency and meaningful participation and deeper engagement in school science. With science as a context, students are proffered a more direct link between science and their lives, thus increasing the likelihood of students viewing science as a feasible tool with which they can utilize to shape their out of school lives. We take up each of these points individually in the following sections – Creating hybrid spaces, Fostering deeper engagement and Science as a Tool.

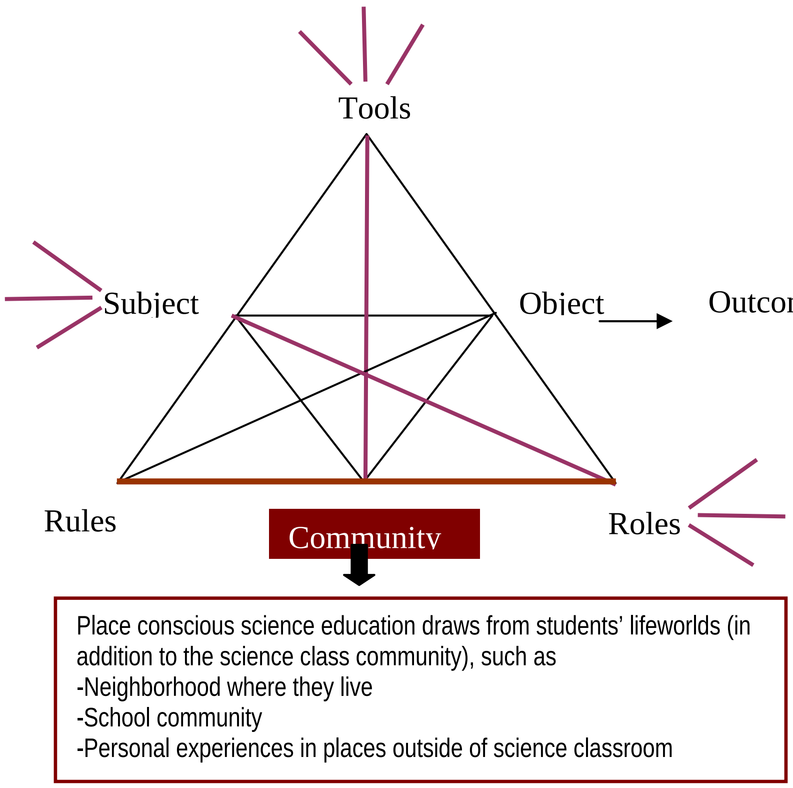

Figure 2a. Place conscious science education expands the community of practice to be inclusive of out-of-school figured worlds salient to students' lives.

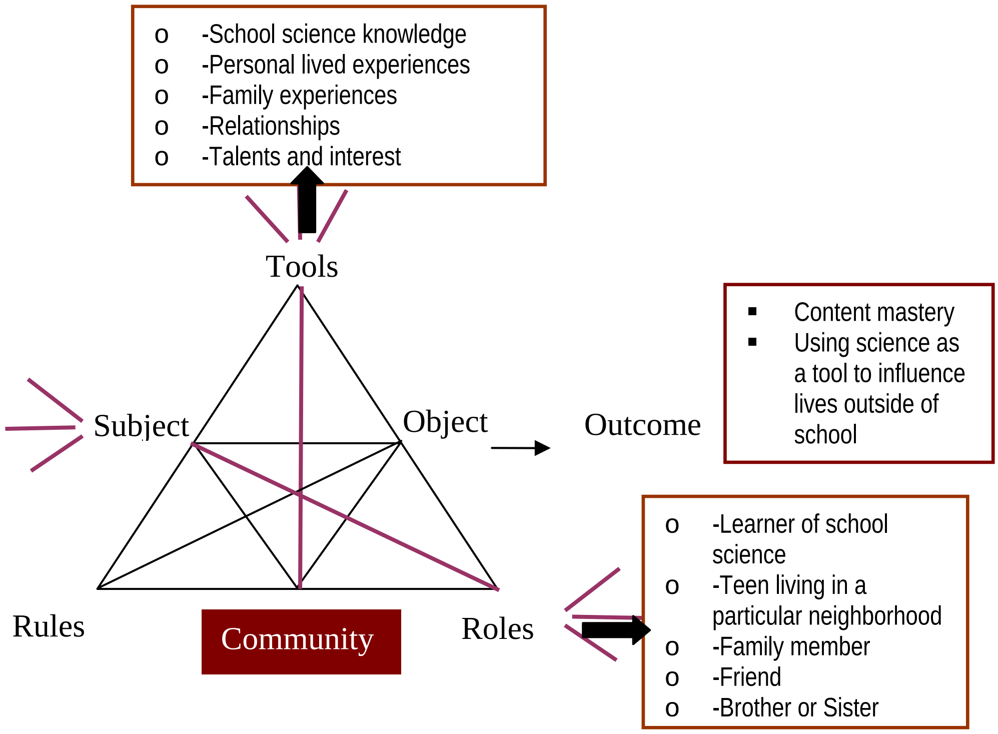

Figure 2b. Expanded roles and tools that are recruited into science learning with place conscious science education. Outcome of science education also expand to include more than just content mastery when science can be leveraged as a tool by students in their everyday lives.

Creating New Hybrid Spaces

In this section, we present two classroom narratives to show how Mr. M's science class used science as a context to create new hybrid spaces for meaningful science learning.

Healthy Snacks. In a 6th grade lesson following the "healthiest snack competition" where students worked in teams to buy the healthiest snack from a corner grocery store with two dollars, Mr. M, the teacher, wanted to review the students' choices and asked for each group to share why they thought their team had the healthiest snack. The conversation was slow and halting, with Mr. M asking several probing questions to urge student discussion:

Mr. M:	Jessica. Do you think your team was the best? Came up with the best snacks? For two dollars?
Jess:	No.
Mr. M:	You don't? Does anyone disagree with her? [one student to mr. m's side raises her hand, but he doesn't see her. Most students are quiet looking at mr m or looking around the classroom.] I don't know if we have all the time enough to share. I want to quickly review and move on.
Mr. M:	Janine do you think your team had the best snacks? Maybe not everyone there. Janine, what are your thoughts? Janine refresh our memories, what did you buy for two dollars?
Jane:	Cheese cracker and peanut butter. [Mr. M. Yup]. Cereal and orange juice.
Mr. M:	Cereal and orange juice. That all sounds pretty good. Jim what did your team get?
Jim:	Orange juice. Uhm and bananas.
Mr. M:	Bananas. Alright. Nadia. What did you team buy?
Silence	
Mr. M:	Nadia, do you remember?
Nadia:	Sun chips.
Mr. M:	Sun chips. What else was that?
Nadia:	*Inaudible *
Mr. M:	Raise your hand if you thought your team definitely had the best snack. [a few students raise their hands] Jeff?
Mr. M:	Melina, read to us what you wrote for your homework. Tell us whether you agree or disagree, or your team will. If you could share with us.
Melina:	(reading) I wrote that I thought our snack was a good snack because
Mr. M:	stop right there. There is shuffling and it is distracting to what she is saying.
Melina:	I wrote that our groups snack was the healthiest because it had like less calories, and [inaudible].
Mr. M:	OK, so calories is a factor. Good. How many calories should a snack be? In a day if you have two? Do you remember? Kenisha?
Kenisha:	*inaudible *
Mr. M:	Nope. Franklin?
Franklin:	200 calories per person?
Mr. M:	About 2 to 300 calories per person per snack. Good, (Melina) keep going.
Melina:	And…we didn't buy chips…
Mr. M:	Why didn't your team buy chips?
Melina:	Because, we thought that wouldn't be healthy.
Mr. M:	What about chips wouldn't be healthy? As a snack? Janiba?
Janiba:	'cause of the way its done? Like oil…
Mr. M:	So they're prepared in oil, which if you eat too much…
Student:	Not good for you.
Mr. M:	… it's not good for you. Ok. You have another point Melina?
Melina:	*shakes her head while looking at notebook *
Mr. M:	That's it? Franklin do you agree with her? [Franklin is on Melina's team]
Franklin:	*nods *
Mr. M:	You have the same points? In your reflections? Carmen?
Carina:	Yeah, the calories, and to see which would have the most sugar, and which would have no sugar… *writes in notebook *

At this point in the conversation, Mr. M switched his focus on the school science assignment worksheet and asked if any of the students had gone back to the corner stores over the weekend. The students had learned, during the previous lesson on the healthiest snack competition, about the more nutritious options that the corner stores offer and that are 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. Indeed, many hands went up in the classroom at this question, and a lively discussion ensued:

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 learnt 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… but what could you add to that to get a balanced snack?
Cindy's teammate:	*Whispers to her * orange juice!
Cindy:	*nods at teammate * Yeah, a small container of orange juice. *two of Cindy's teammates, including the one who whispered to her, high fives *
Mr. M:	Good. Alright. Lonnie?
Lonnie:	I went to the store this morning.
Mr. M:	This morning? Raise your hands if you went to the store this morning? *students start to chatter *
Mr. M:	I'm not gonna ask you what you got, I just want an idea of how many students hit that store this morning. *hands go up all over the classroom *
Student:	I didn't go to THAT store…
Mr. M:	Not necessarily that store but I mean the stores around the school… alright hands down. Lonnie what did you get?
Lonnie:	I got a blueberry poptart and um… an * inaudible*
Mr. M:	Do you always get a poptart or was it because of this experience [referring to last lesson]?
Lonnie:	I always get a poptart.
Mr. M:	Was that breakfast or a snack?
Lonnie:	Poptart was breakfast, and the *inaudible * was a snack.
Mr. M:	Ok. If that was your breakfast there are a lot of essential vitamins and minerals you are not giving your body, right? That you can't get back.

Comparing this segment of transcript with the first segment we can see clear shifts in the level of student participation and engagement. Students were calling out. They were talking to each other, offering suggestions for what to say, and commenting on each other's experiences and ideas. They were laughing.

This transcript also begins to reveal how the focus of the classroom discourse shifted to the student's personal experiences. Classroom talk became centered on the students' out of school funds of knowledge and the students were positioned with more narrative authorities since they all were sources of this knowledge.

The students were also quick to support their peers' "wrong answers" – their seemingly bad choice of snacks – by emphasizing their experiences in figured worlds outside of school science. For example, Shernice's snack choices are cast in more complex shades of a limited budget, undesirable school lunch and teenage preferences instead of a black and white application of a school science lesson to everyday decision making. In other words, what students were learning in science – what constitutes a healthy snack and why – became part of the larger mosaic for how students made sense of their choices. Cindy who both supported her peers' choice of potato chips for snacks does so while explaining that one bag of chips is better than two, and that when accompanied by orange juice might offer some nutritional value.

We are compelled by this episode because of the clear shifts in not only the level of student engagement, but also the *place of science*. The initial classroom discourse focused on using the healthy snacks competition to demonstrate knowledge gained about healthy snacks. The teacher, Mr. M. tried to make this conversation enjoyable and relevant by insisting that students compete with each other for having purchased the healthiest snack! The "place of science" was as an object to be learned onto which student experiences could be read. However, after Mr. M. asked the students if they went to the store over the weekend, the focus of the discourse i.e., the place of science in the class shifted. In the latter half of this episode, science plays a "deeply situated but supporting role" to the sense making of place-based experiences of the students. Cindy and Mabel, in particular, placed value on the multiple communities in which they participated and the meaning this carried to doing science in Mr. M's classroom.

<u>Antismoking Skit</u>. After teaching the students about the respiratory system, Mr. M wanted to increase student participation by having each team write and enact a short skit with an Anti-Smoking theme. In the skits, community funds took center stage providing the plotlines of several skits. Street culture and ways of speech were also showcased in many skits and students' everyday lives in their neighborhood became the core content of a science class.

An example of the dialogue in such a skit is as follows:

Chantelle holds up a sign that says "In a corner" to set the scene. There are four actors in this skit, Chantelle, Tricia, Lionel and Tom.

Chantelle:	*saunters in holding imaginary newspapers" Newport! Newport! Newport! Who wants Newport??
Tricia:	*saunters up to C with enthusiasm and the two greet with elaborate hand shaking ritual* HEY CHANTELLE! How you doing GIRL?!!
Chantelle:	Whassup whassup whassup?! *while engaging in hand ritual with Tricia *
Tricia:	This is my friend, this is Lionel, that's Tom… *gestures to both boys*
Chantelle:	Whassup whassup whassup… *grips the hands of both boys in turn as if to arm wrestle * You guys wanna smoke? *holds up bunch of imaginary cigarettes *
Tricia:	Yeah!
Chantelle:	*hands out imaginary cigarette to Tricia, Lionel and Tom and mimes lighting each cigarette, Tom throws his cigarette to the floor *
Chantelle:	*to Tom * Why you don't wanna smoke? You a wussy?
Tricia:	You're a WUSSY!!!
Chantelle:	Get out of here, get out of here! *pushes Tom away* You're wasting my money, get out of here man!
Tricia:	Yeah, we don't want you!

Tom tries to get Lionel and Tricia to leave with him but was unsuccessful. Tom leaves. Chantelle turns her attention to Lionel and Tricia as they continue "smoking".

Chantelle:	Yeah yeah yeah, so whassup whassup whassup…

Lionel starts to cough violently while "smoking".

Chantelle:	* pats Lionel on the back * Yo yo yo!!! That's not how you do it yo, that's not how you do it! Slowly, softly, softly… *gestures to Lionel*

Skit ends with Tom coming back and inviting everyone to his house where he shows them from the internet the biological consequences of smoking and the smokers all shocked and "going into rehab"!

The four students utilized several aspects of community funds of knowledge and Discourse in this short skit (Moje et al, 2004). By having Chantelle appear as a newspaper girl, the students allude to having contact with working youth who occupy another figured world, likely with concerns very different from youth who are in school but who are no less important figures in the students' lives. The language and body gestures enacted also illustrated the unique code of conduct that is part of the street culture among youth in this specific neighborhood. Peer pressure featured largely in the skit along with the painful consequence of public humiliation with disparaging name-calling and outright rejection should a youth choose to go against the crowd. The four student actors convincingly showed the gritty side of urban living and the acute force of peer influence. As Chantelle's character alluded, taking up smoking from peers can be made desirable when a youth is faced with choosing between suffering immense social pressure and gaining acceptance through free cigarettes and guidance from the tutelage of expert friends who can coach one to inhale the first puffs of smoke “slowly” and “softly”.

On first glance, this skit seemed to be more about “a day in the lives of urban youth” than a skit centered on scientific concepts. However, it is precisely because it is so grounded in community funds and Discourse that a hybrid space was fostered both in its enactment and in the class discussion that ensued. These hybrid spaces are important because as Moje remind us, they brings together the different knowledges, Discourses, contexts and relationships one encounters in ways that collapse “oppositional binaries,” allowing them to “work together” to generate new knowledge, discourses and identities (Moje et al, 2004, p. 42). They “disrupt” normative rules, roles and tools for mediating participation in a community of practice (Gutiérrez, Baquedano-López, & Tajeda, 1999).

Enacting such a skit then is an example of the instantiation of a “place conscious education” that “enlist[ed] teachers and students in the first hand experiences of local life and in the political process of understanding and shaping what happens there” (Gruenewald, 2003, p. 620). Science became a context in addition to being a goal, and this science context is powerful precisely because it is experienced as a reality in the students’ everyday lives with the attendant identities germane to them.

When science is taken up as a context, students can recruit real life experiences grounded in their “sense of place” to be legitimate and important science content to be discussed in science class. Students’ street discourse with its attending valences of power were dramatically woven into science classroom discourse. The audience gave these four actors riotous applause and showed their appreciation with calls of “that’s hot, that’s cool”. They related to the skit throughout its enactment, laughing at Chantelle’s antics but falling silent in those moments when Tom was ostracized, suggesting that they empathized with his situation inspite of it being only an act. It was an act that mirrored personal experiences. Mr. M asked the audience for feedback and some students shared their own experiences in struggling against peer pressure. Another student pointed out a local grocery store that would not bat an eyelid selling cigarettes to minors. Instead of concentrating solely on emphysema and carcinogenic ingredients in cigarette smoke, the class talked about how smoking is prevalent amongst their peers and discussed the options open to them. Mr. M facilitated the discussion with sensitivity and thoughtfulness, reminding the students what they have learned to reinforce the message on the dangers of smoking as well as suggesting ways students could deflect peer pressure. In so doing, Mr. M made clear that the students community funds and discourse were welcomed in his classroom space and the 6th grade community-of-practice as a whole inhabited a hybrid space where a new classroom discourse is created through the integration of students’ community funds and discourse with the disciplinary texts and discourse of school science. Place-conscious education took place with this example where students’ lived experiences in their neighborhood were foregrounded in the science classroom and both teacher and students had the change to participate as engaged, informed citizens around the localized context of student experiences with the issue of smoking.

Fostering Deeper Engagement

When science is framed as a context, hybrid spaces can be created to offer opportunities to deeply engage in science learning. In what follows, we present narratives where students participate and deeply engage in science learning by taking up multiple roles creating hybrid spaces for science learning.

Exchanging the role of student for that of expert: Melanie as Jane Goodall. When science is framed as a context rather than a goal, there is a wider platform from which students can participate. Students can take on more roles in addition to that of a learner and the different types of roles afford students multiple entry points into a school science activity.

Consider the case of Melanie, a shy and timid 6th grade student who for the first three months of the school year actively sought for invisibility in the science classroom. When Melanie was required to give a presentation as part of the individual assignment Animal Project, she took a very different approach from the rest of her peers. The students were supposed to report on their chosen animal, paying attention to such details as lifespan, life cycle and the animal’s habitat. The project consisted of two sections, a written report and a presentation and was part of the 6th grade science exit project. Students could utilize the material resources in the science classroom library as well as the school library.

While most of the students researched on big cats since information on these animals were readily available in the classroom library, Melanie chose the gorilla. She completed both the report and a poster board on the gorilla. During her presentation, Melanie took on the role of gorilla expert, the female scientist Jane Goodall. She gave her report on gorillas as Jane Goodall the primatologist giving a talk on gorillas to an audience. Melanie changed the context of her presentation. To her, she was not Melanie the student giving a science report in the 6th grade science classroom. She was Jane Goodall the scientist giving a talk to an audience interested in hearing her.

Apart from meeting the requirements reporting on pertinent biological information such as the habitat, food and life-cycle of the animal, she also enlisted the help of two friends, Pat and Chantelle, to act as gorillas while she "taught" them sign language in the person of Jane Goodall. By taking on the role of a well known expert, Melanie was able to shed her identity-in-practice as a "weak and timid" student and present herself to the audience as an authoritative primatologist. The Animal Project, apart from being an important school science assignment, became a platform for her to showcase another side of her identity – one that is funny, creative and authoritative. This is only possible when she could "enter" into this activity as "Jane Goodall" instead of as "weak science student Melanie". Taking on the role of Jane Goodall imbued Melanie with the authority and agency she lacked in the role of Melanie the learner of 6th grade science. Equally significant was the response of the community of practice to Melanie's taking on of this role. The teacher and her peers gave Melanie enthusiastic applause and she earned 100 marks on both her report and the presentation. This is a much higher level of engagement and achievement in school science from a student who last scored 23 out of 100 for her science test and was deemed a liability to peers in group work.

Farming Debate: Taking up multiple roles and perspectives

The students were learning a unit on Farm to Store which traces food supply and its impact to the environment. We worked with the teacher to try out a new pedagogical approach where students took on the specific roles of stakeholders from different farming practices and engaged in a debate presenting the merits of their respective farming practice. To increase participation, students were grouped in threes or fours where one group member is the speaker and the others are questioners who helped the speaker make her/his point. On the side of the regional organic farming community, there were the roles of a cow, a family farmer, and a ladybug. On the opposing intensive industrial side, the roles were that of a food bank president, a truck driver and a mechanical engineer. Physically the layout of the classroom was rearranged to resemble that of any debate – with two tables sitting the speakers from each side facing an audience sitting in rows of chairs. The questioners of each group made up the audience.

There was a palpable sense of excitement when student speakers were taking their seats with their labels i.e. cow, ladybug, mechanical engineer etc. The audience quickly brought their chairs and audience sheets, questions and formed 2 rows in front of the debaters. The teacher Mr. M explained the sequence of debate and his role as the moderator and how questioners are to stand when they ask the questions, the sequence of speakers and when the audience can pose questions and challenge each speaker after each panel has spoken, and then again after both panels have spoken.

Science learning in this example was not a narrowly defined epistemic fact but a broad, overarching issue fraught with dilemmas and conundrums based on one's point of view. The students had multiple entry points into this discussion based on their roles.

We share some transcript of the debate below:

Organic Cow

Q1: What is the difference of intensive cows and organic cows?

Cow: The reason why organic cows is different is because organic cows is healthier, their body system is healthier, their food that they produce and the milk that they produce, is healthier.

Q2: Would you rather choose intensive farming or organic?

Cow: The reason why I would choose organic farming because its easier, because they not all stuck in a cage, and when they produce their food, they're not, they're not injected with all the types of medicine that they give them…

Q3: Are cows healthier now they can walk around and eat food?

Cow: Yes, because now they're free and they can eat whatever they want and they're healthier.

T: Good, is there a fourth question?

Q4: How would you feel if you were free? In an organic farm?

Cow: I would feel, like free, I would feel happy cause I'm not messed up in a cage…and not getting sick, like if one gets sick I won't get sick from the others….

T: Good, excellent. Is there a next? Ok last question.

Q5: How often do organic cows get sick?

Cow: Not usually cause they not stuck together and they not on top of each other, like intensive cows.

T: Excellent. Well done. Now we're gonna turn to the family farmer representative. First question please stand.

Mechanical Engineer

Q1: what do you do?

M.E:	I'm a mechanical engineer. I design machines for intensive farmers, my machines help intensive farmers get their food faster.
T:	Fantastic.
Q2:	How do your job apply to everybody else?
M.E:	My job applies to everyone else because I help people get jobs, money and their food faster. Also because I need people to help me, like technicians, so I can build my machines.
T:	Good.
Q3:	Do you sell your machines to organic farmers?
M.E:	No I cannot sell my machines to organic farmers because they do not like to use the big machines that I actually build, they like small machines and I don't… build small machines, and I won't be making money.
Q4:	What will happen if there is no intensive farmer?
M.E:	What I think will happen if there is no intensive farmer, is that I will run out of a job, and everyone else that work for me, and there will be no new machines.
T:	Is there another question? Ok, well done, mechanical engineering. Now I'm going to open up the entire audience to both panel, I want you to come out with a question, that challenges the people on the panel.

Almost every student participated in a very public role in the classroom because of the way the debate was set up with the roles of the speakers and the questioners. Although the prep sheets called for 3 arguments, many groups came up with more than three arguments for their role, which implied interest and student ownership. The questions that came up were taken up and linked by the teacher to other content areas that the students had covered recently, e.g. food chains, pollution to the environment. Audience impromptu questions were not lacking. This implied that the students listened and were interested and looking out for points to reinforce the strength of their own group's roles.

The speakers had to be on their toes to answer impromptu questions and the students did well in drawing from personal knowledge to answer questions (e.g. the food bank president talked about insurance and the small likelihood of people getting sick from the hormones and injections of intensive farm animals when an audience member criticized the heavy use of chemicals in intensive and industrial farming). The students also formed camaraderie within their panel and used each other's arguments to bolster their positions.

After the teams went back to their tables, the discussion was still fast and furious and teams were still arguing across their tables. The students enjoyed the debate and asked the teacher for another debate soon at the end of class. Some students who were in the audience voiced their desire to be a panel speaker in the next debate.

The debate provided a student-centered platform to learn and discuss a content area that is potentially difficult to grasp (comparing intensive and organic farming) for city kids. Due to the set-up of the debate where science is foregrounded as the context rather than a goal, with roles of speakers and questioners, almost every student had a very public role in which to participate. Many students asked the teacher when the next debate will take place. The format of the debate with the assigned roles, non-human and human, and different occupations, allowed students to leverage on their imagination, and outside resources to bring their characters to life. The students were able to embody these different identities in this mode of participation while concommitantly, the traditional identity of student learner of epistemic science knowledge receded into the background.

The debate was successful in terms of getting the students engaged in the material and having them consider the merits and limitations of both points of view. The teacher was very pleased with the adaptation and impressed with how this class (usually more rowdy and disinterested) had risen up to the occasion so well and asked many good questions.

Science as a Tool

When science was framed as a context, it seems to better offer opportunities for students to more explicitly view and use science as a tool since the link between science and their lives are made more explicit. For example, while studying about nutrition, the students in Mr. M's class observed that the school cafeteria served foods that they deemed unhealthy. As they described it, school cafeteria food was "nasty, [with] fake cheese, fake meat, fake lettuce... Always a piece of hair in your food". As most students of the school were on the free lunch program, this was a legitimate concern for them. Students motivated by what they have learned in science class, wanted to voice their concerns in the school community. However, when the students suggested writing a letter or registering their concern in some way with the school principal to petition for better quality food, the science teacher cautioned against this move since the cafeteria served another larger school who shared the building with TIS. Mr. M also alluded to the potentially detrimental bureaucratic and administrative ramifications that could result from such a student-initiated petition. Although truncated, the story present their desire to use science as a tool to voice and participate in the decision making process regarding their school lunch, When engaging in practices that framed science as a tool, the youth placed value on activity which foregrounded science, but did so in ways where the outcome of the subject object relationship is more inclusive than just science as goal. In particular, with science as a tool, the youth used the mediating tools of science to attend to particular issues and concerns that mattered to them and their place-based experiences. What distinguishes science as context and science as a tool is how science is foregrounded or backgrounded to the values and experiences of their communities and the rules and roles that they take on in those communities. When youth use science is a tool it redefines the relationship between object and subject meaning that the students' positions themselves differently (i.e., as more than a learner) and they also position science differently (i.e., as more than content mastery).

We share two other examples of how students repositioned science as a tool for participation in their community and redefined object subject relationship.

Anti-smoking poster. In another of Mr. M's classes, the students made Anti-Smoking posters as a class project to be tacked up around the school corridors and stairwells. Many posters featured large graphic pictures showing diseased lungs and cancers of the throat and mouth that students had cut out from magazines or downloaded from the internet. When asked to explain their choice of pictures, many students replied that smoking is so prevalent amongst their peers and considered a "really cool thing" that such lurid pictures are necessary to "scare" their peers into quitting or to resist peer pressure in taking up smoking. The students showed that they understood the ways of their audience very well by how they took pains to ensure that their posters were visually arresting and able to grab the attention of their intended audience - teenagers - instead of being merely passed off by the student body as another academic assignment tacked up on school grounds.

Thus, a science class assignment that leveraged on community funds i.e. understanding the ways of their peers, was in turn utilized as a resource to render a form of community service in the school. This was possible because the students were cognizant of and intimately bound with the different elements of their local contexts. In other words, the students had a deeply grounded "sense of place" manifested in their understanding of the perceptions, challenges, ways of being and priorities of the rest of the students in their school community. They participated in this school science activity of making an anti-smoking poster from the position and identity of an "insider" of this school community and neighborhood that is borne out of a deeply rooted sense of place.

Figure 3. Anti-smoking poster.

Another way in which some of the students manifested place-conscious participation was in including pictures of young pregnant ladies on their poster with warnings on how smoking can harm a growing foetus. During our informal interviews with some girls, they shared with us stories of their friends or relatives having children from as young as 13 years old. Youth pregnancy is thus something that is not entirely unusual in these students' communities and they purposefully used this knowledge in the design of their Anti-smoking poster. In addition, some posters included information on programmes with quit-smoking hotlines complete with slips of paper bearing hotline phone numbers intended for the public (Fig 3). One student, Ciara, even took the community service another step further. On her own initiative, she made more anti-smoking posters and posted them in her apartment building. According to Ciara, the anti-smoking poster was her favorite piece of work in science because of its direct relevance to an issue in her community. She explained to us that “people shouldn’t smoke, and it affects my life because there are people in this community that smokes… so, I like that [the poster] very much”. In order to reach the audience in her apartment block, Ciara made another six posters. As she tells us, “So many people live there… I put one in every floor, there are six floors so I put one in every floor, where the, where you open the elevator? Right there”. Throughout the process of her participation in the antismoking poster school science activity, Ciara showed that she was reflexive of how this school activity could be useful in the context of her residence neighborhood. She showed that she was intimately connected with the physical layout of her apartment building by the right number of posters she made – six, one for each floor of the building – and where she wanted to position them – right next to the elevator where there was possibly the highest level of human traffic in the apartment building.

In this example, Ciara epitomized what place-conscious science education can look like. Her actions displayed what Casey (1996) meant when he wrote, “[t]o live is to live locally, and to know is first of all to know the places one is in” (p. 18). Three months after the science unit on respiratory systems, Ciara gleefully informed us that the posters were still in her apartment building and suggested that nobody had taken them down yet probably due to the effects of the “scary pictures” she included in her posters which included “a picture of this woman with cancer, she has mouth cancer and her lips are really big”! A deep sense of place resulted in Ciara’s personal involvement in this school science project that went far beyond what the teacher intended in both space and time and allowed Ciara the opportunity to display her agency in shaping both her participation in science class and actively impacting her residential community by taking on roles (in addition to a 6th grade learner of science content) as both a citizen who cared about her living environment as well as an advocate of non-smoking practices. These roles offer alternative routes of entry into participating in school science that resonate more soundly with students’ salient out-of-school identities.

In sending an anti-smoking message to her residential community, Ciara directly applied her science knowledge to her life. In this narrative, we witness almost the full promise and workings of a place-conscious hybrid space in the science classroom. Community funds and Discourse were thoughtfully woven into science disciplinary text to create a student-driven school science artifact borne from a composite of these funds. This artifact, which bears the signature and unique insights of the students, was then deployed as a science educational document aimed at the community these students care about, both the school community, and in the case of Ciara, her residential community. In these moments, science is no longer “another world” (Costa, 1995) to these students as they display competent and meaningful scientific literacy in applying scientific knowledge to their local communities, their daily living as well as broader societal issues (AAAS, 1993; NRC, 1996).

<u>Anna and the Playground</u> Anna, an 8th grade Puerto Rican student, is well known among her peers and teachers for being smart, successful, and popular in school. While her school serves a high poverty population (75% of students on free lunch), Anna’s family is stable financially and she does not participate in the free lunch program. Ann has a keen sense of right and wrong, of differences between rich and poor, and she uses this knowledge to frame decisions around what she believes is fair. She also carries with her a keen “sense of place” meaning that she is strongly rooted in her neighborhood, openly caring for how it looks and its safety, and she knows where everything is from general grocery stories to specialty shops, often describing those stores as “my corner store” and “my hair salon”. And, her knowledge does not discriminate: She is as articulate about what is available on the Hispanic side as well as on the White side of her neighborhood.

During the Spring 2004, Anna’s class had been involved in a six-week playground study. The purpose of the playground study, according to their teacher, Mr. Nader, was to help students to develop a sense of what makes a good playground through survey and then to use the knowledge to develop their own design and model playground. Prior to the playground study, the students were involved in a pigeon study where they investigated pigeon biology: its morphology and behavior through activities like mapping when and where students observed pigeons and what the pigeons looked like. Like most inquiry-based approaches used in middle schools, Mr. Nader presented the students with the question for investigation and carefully laid out scaffolded methods the students would employ to conduct their investigations. While he created open spaces for students to share their developing ideas, test out theories, and make claims, he also approached teaching with a clear sense of what he wanted his students to learn and how he might help them to do so. Mr. Nader was also widely liked and respected in the school, and known both for his ability to manage his classroom well and keep the students interested in science and math.

At the beginning of the playground study unit, the class was to conduct a playground survey, where they would visit playgrounds in the school neighborhood, try the equipment, and evaluate the playgrounds applying several criteria developed in class. For the first playground visit, Mr. Nader had planned to take his students to the same playground he had used with other classes in the past. On the walk to the playground, Anna challenged Mr. Nader’s decision asking if they could go to a different playground that she had in mind – one that was “closer and nicer.” Eventually Mr. Nader takes her up on her suggestion, leading her class to study the playground recommended by Anna. Later on in the investigation, Anna added several evaluation criteria to her playground (in addition to safety issues), including the presence and locations of: sprinklers, benches, picnic tables, bathrooms, and trees. Furthermore, she adds questions about change, including what the study revealed about what should be added to the playground or how the students could make the playground safer.

We were curious about with the confidence and passion by which Anna raised her challenge about changing the playground under investigation and in her later revisions to the evaluation criteria, in part because Anna worked hard at being a good student and pleasing the teacher.

When we look more closely at what happened, it appears to us that Anna positions herself as knowledgeable and powerful with respect to the playground study. Anna initiates the decision making process to change the playground under investigation even though the teacher did not intend to involve his students in this decision. She also expands the scope of the project to include criteria outside of the safety concerns originally discussed in class. In doing so, she draws from a range of resources, some of which are not traditional to the figured world of her science-math class: In addition to her understanding of what the design project entails, she also draws upon her knowledge of neighborhood playgrounds, her belief that safe playgrounds are important, her desire to have a real impact on her neighborhood, and her experiences using a variety of playground equipment as a both a child and a babysitter.

Anna also strategically adapts her resources to utilize the norms of the figured world of her class to her advantage. She believes in the importance of the playground study, and uses her experiences as evidence for why the class ought to investigate a different playground, and she situates her evidence within the structure of classroom activity and expectations, in order to position her knowledge in terms of what her teacher might care about.

In addition to positioning herself as knowledgeable and powerful, Anna positions herself as both an *agent* of the project (someone helping to make important decisions which frame the project) and a *subject* (someone who will directly benefit from the outcomes of the school based project). While it seemed to us that her initial focus was on changing “how” they were studying playgrounds, her efforts directly impacted “what” they were studying as well, in the sense that she worked to give the project more utility. It is also interesting to note that while Anna individually volunteers a design change in the project, she does so with the desire to impact both her whole class’ investigation and eventual community empowerment.

Discussion

In our findings we discussed how science classrooms, by framing science as a context, were able to work to create hybrid spaces for connected science learning and how the youth in our study used science to further their participation in their science learning community as well as the different figured worlds which make up their lives. We showed that when they, along with others be it their peers, teachers or family members, re-positioned what it means to know, do, and learn science from being only about a goal to also being a context and/or a tool, they were able to find multiple and meaningful ways to participate in their communities. Here we reflect on the implications that this study has for a science classroom that attempts to frame science as a context, and in so doing, provide connected and participatory science learning opportunities for students.

Expanded boundaries of science class through hybrid spaces

First, by framing science as a context, boundaries of science class can and will expand. We saw that when science was taken up as a context, the students were fostered in bringing in their multiple figured worlds to bear on learning science, thereby including and inviting multiple communities outside of traditional science class and expanding the rules and roles of students in their science learning community of practice.

Science as context opens up science learning opportunities by expanding the communities that are welcomed in the science classroom, allowing new and disruptive third spaces to emerge. By including multiple communities in science class, students were allowed to take up multiple roles and utilize multiple tools or resources from the communities. In other words, as science became contextualized, the place of science became clear within the expanded context of science learning. Students were able to see how science connects to their figured worlds, thus it opened up multiple entry points for science learning in the class and students took up multiple roles and got engaged in science practices in class. These sorts of hybrid or third spaces in science classrooms can collapse the distinction between “academic *and* everyday literacies or knowledge,” (Moje et al, 2004) by showing how both can work together to support meaningful science learning. This is the basis of her more extended analysis of how youth draw upon their funds of knowledge to generate third spaces in support of scientific literacy learning.

One thing we need to note about the multiple roles that students took up is how the role enabled the girls to embody not only who they are but also who they can be or who they can become. As we saw in the healthy snack and anti-smoking skit examples, students positioned as urban youth in science class brought deeply situated understandings of their own culture into science learning which reflected the immediate identity of urban youth. On the other hand, in the stories of Jane Goodall impersonation and farming debate, the roles students took up and engaged in were not necessarily an immediate reflection of "who they are". Rather, they reflect students' understanding and consideration on who they can or who they can potentially become in the multiple and broader communities to which they belong.

Shifting the position of science

Secondly, when science is framed as a context, it not only expands the boundaries of science but it also shifts the position of science in a class. As science gets situated as a context, science then can take up multiple positions in science class. Due to this flexibility in the positioning of science, new hybrid spaces can be created in science class. As science steps aside and takes up a supporting yet deeply situated position, students' lived experiences and understandings of their figured worlds can become fore-grounded and valued as legitimate discourse in the science classroom. Thus hybridization between school science and students' lived experiences of their figured worlds can proceed.

We noted two aspects in which the shift in the position of science could lead to meaningful science learning. First, from an entry point (to science learning) perspective, the shift can encourage multiple entry points and furthermore foster deep engagement in science learning as we saw from the healthy snack story. Second, from an outcome/learning perspective, the shift can nurture connected science learning opportunities i.e., deeply situated and "real" understanding of the role of science in their communities. As we saw in many examples such as healthy snack story, anti-smoking skit story, and farming debate, students encounter real world situations and problems in which they are encouraged to try to make sense of and try to make the best use out of science or scientific information that they have.

When science is framed as a context, science is no longer the goal of the learning attempt. Science is no longer wrapped in its own separated disciplinary world. Science is opened up and positioned within the complicated interconnected figured worlds of students. In real world situations, science is no longer the sole factor in making decisions. When students try to buy snacks, they not only have to consider what is a scientifically sound decision, but also what could count their empty stomach or taste buds with given limited budget and/or given "poor" cafeteria food. When students try to keep away from smoking, they have to utilize scientific understanding of the harmful effect of smoking but also deal with the peer pressure coming from the youth community surrounding them. When students try to make sense of and critique the dominance of industrial farming while the scientific benefits of organic farming is so evident, they have to consider multiple sectors and players involved in the food industry. Science learning becomes more complicated yet "real" and thus connected and meaningful for students when they can see science "in action" in their everyday lives.

Repositioning of science as a tool

Lastly, when science is framed as a context and hybrid spaces are created, students can see and understand how science is connected to their figured worlds therefore, it is more likely to become visible or evident how science can be used as a tool for their meaningful participation. When science is a tool it highlights the relationship between object and subject. When science is both a tool and a context it allows participants to become more agentic because they are highlighting the relationship between object, subject, rules, roles and community.

The youth in our study often told us how they want to use science as a tool to participate in their communities. We often get amazed and surprised by the students' stories, especially by how "agentic" they are and the possibilities they see in bringing science out of the classroom into their lives, whether or not such possibilities were taken up by the teacher. As we saw in the story of the anti-smoking poster, science was framed as a context and a tool and learning experiences were designed to foster students' deep understanding, connection and participation in their community. What we also found from their stories is that how often their desires and agency gets truncated in school science. In the Jameer's story about pigeon study that we introduced at the beginning of this paper, we were amazed by Jameer's strong desire to use science as a tool to deeply and critically explore and understand her community and we shared her disappointment by the lost opportunity. After the unit on nutrition, the youth expressed their concern over their school cafeteria lunch. However their concerns and desire for change were stopped there. One of the reasons why science as a tool is often truncated in school science is that "place" or "community" is stripped away from the subject object relationship in science class. In other words, students' relationship with their place or community is often times undervalued in school science.

Conclusions

Valuing place is antithetical to the homogenizing culture of classrooms where individuality is not highly regarded. School place is all that matters. In the healthy snack example, place mattered in so far as it allowed the class to reconstruct how they thought about and applied the food guidelines. However, Mr. M., for example, did not recognize the students' desire to reshape their participation in the classroom or their community through place. The value placed on sense of place was cursory in the sense that the teacher acknowledged the students' point of views in so far as "side conversations" were pursued but the school task was not reconfigured to fully include the students' discourse grounded in their sense of place- their experiences in this neighborhood grocery store. In other words, the kinds of ties the students had with their place were not drawn out or made to matter in how the students moved forward with rethinking the food guidelines. Mr. M. returned to the standard guidelines and the students were not challenged to think through how their experiences and criticisms of the guidelines might really matter in how they approached healthy eating in their school or neighborhood.

Through this study we witnessed that_students are more agentic when science is a context and when science is used as a tool (in addition to science as a goal). They have more reasons, more impetus to participate in science because more than just the world of school science is at stake. What is at stake is their place which is not merely condensed into a physical environment but rather, it includes their figured worlds including who they are and who they can and will become. Students exhibit more agency when they can inhabit more than the world of school science in the classroom, because when more roles and perspectives are valued, more kinds of knowledge are valued. Students therefore have more opportunities to act when they feel empowered as experts to act in pursuit of a particular outcome, be it voicing an opinion or applying scientific knowledge in an outside setting such as their out of school communities.

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