

Science Education in Urban Settings: Seeking New Ways of Praxis through Critical Ethnography

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Abstract: The challenges faced in urban science education are deeply rooted in the ongoing struggle for racial, class and gender equity. Part of this struggle is tied to huge differences in class and involves making more equitable the distribution of resources. Another part of this struggle is tied to the rich diversity of children who attend urban schools and involves generating new ways of understanding, valuing, and genuinely incorporating into school-based practices the culture, language, beliefs, and experiences that these children bring to school. Thus, this article argues that to address these two challenges—and indeed to achieve a more just science education for all urban students—explicitly political research methodologies must be considered and incorporated into urban education. One potential route for this is critical ethnography, for this kind of methodology emerges collaboratively from the lives of the researcher and the researched and is centrally about praxis and a political commitment to the struggle for liberation and in defense of human rights. In making this argument, I have drawn from stories from my own research with homeless children. © 2001 John Wiley & Sons, Inc. *J Res Sci Teach* 38: 899–917, 2001

Ethnographic inquiry is most appropriate when it places events and people in the social, cultural, and political history and contexts in which they are constituted. It can never be innocent nor neutral, since it is embedded in a political and moral process—Murillo, 1999, p. 7.

Introduction

In this article I argue that the foundation for making sense of urban science education is a critical and political methodological framework. In other words, science education research, unless it emerges from praxis and is centrally about a political commitment to the struggle for liberation and in defense of human rights, will fall short of helping us to make sense of the goal

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of scientific literacy for all. To accomplish this task, I first share a story written by two homeless fourth-grade Mexican-American girls and me to make a case for why new research methodologies are urgently needed in urban science education. I follow this story with an overview of some of the most important issues in urban science education, including a demographic portrait of those involved in urban schooling and a description of the challenges raised by science education in urban settings. I then present critical ethnography as a methodological framework useful for engaging in research as praxis. Finally, using the girls' stories, I describe the implications that critical ethnography has for urban science education.

El Secreto de las Niñas

*Maria:*¹ My name is Maria, and I am 9 years old. I am in the fourth grade. I have lived with my family in Well Springs for 5 years. Before moving to Well Springs I lived in Mexico. Most of my family still lives in Mexico, but some of my family lives here in Well Springs with me. Right now my family lives in a homeless shelter. We have lived here for 1 year. We used to live in an apartment. I have lots of friends to play with here. I don't like living here when it gets dark outside. It is not safe. I also do not like it when boys think they are better than me, or when they think I cannot do all of the same things as them! I only like school sometimes. I like school when we get to party and say whatever we want. I also like school because I can see my friends. I do not like school when my teacher is mean to me, which is most of the time. I don't like science. I definitely hate art! My teacher always picks on me.

Claudia: My name is Claudia, and I am 8 years old. Maria is my best friend. I also go to school in Well Springs. My parents are from Mexico, but from a different part of Mexico than Maria's family. I live in the same shelter as Maria. Our families moved into the shelter at the same time. I used to live in an apartment in Well Springs before my family moved to the shelter. I really like spending time over at my friends' places. I don't like it when people fight, especially when people fight in my face! I also don't like it when boys try to show me up. I can run as fast as any of the boys! I also don't like going outside at night because it is not safe around here! I never like school. It's boring. It's boring because we have teachers and work, and we never play. I always have to be here or there, and I am always getting in trouble. It's not even my fault, and I get in trouble. If school did not have teachers, then it might be fun.

Angie: *You say that you do not like school because it is boring and that your teachers are mean. What about science? What do you do in school science? Do you enjoy it?*

Maria and Claudia: Okay. We want to tell about science in school. Actually, when Angie asked us to write a story with her, we did not want it to be about science in school. The truth is, we really do not like science. Our favorite subjects (if we had to pick) are math and reading. We are going to call our story "El Secreto de las Niñas" because the reason we do not like science is that we are not used to science! Sometimes when we complain about science in school, people think we don't like it because we are girls. That is not true. They tell us "we can be

anything we want to be!” We know that we are just as good as boys! We just don’t want to explain our reasons. It is our secret.

Angie: *Your secret is interesting, but what do you mean by not being “used” to something? Does it mean that your school teacher never teaches science, and so you were not used to having science? Does it mean that when your teacher did teach science, you were not used the topics she talked about, the words she used, or the way she taught it?*

Maria and Claudia: One time our teacher told us we were going to make a movie. We thought this would be cool because we love to watch movies! One of the first things we were going to do was make a shoe box camera. It would take real pictures. And we would be able to keep the camera and take whatever pictures we wanted! At the beginning we were really excited because neither of us ever owned a camera before. We remember only one time when we were able to use a camera, at Maria’s birthday party. The day before we were to start the camera project our teacher asked each student to bring in a shoe box. Well, where are we going to get empty shoe boxes? I told my teacher I didn’t have a shoe box. So then she said to the whole class, “If you don’t have a shoe box, you can ask your mother or an older brother or sister to take you to a shoe store and ask for a shoe box. They will give you one.” She said if we couldn’t get a shoe box, we could bring in 50 cents and buy one from her. She then told us we had to learn to be more responsible for our own education. Well, we are still like, Where will we get a shoe box? My mother can’t take me to the store! She doesn’t even have a car. And she can’t speak English that well. And she has to watch my baby brother. And then we are also like, Where will we get the 50 cents? So, the next day we went to school without our shoe boxes and without 50 cents.

At the beginning of the day the teacher collected the shoe boxes. A couple of other students in the class did not have shoe boxes or money either. Our teacher gave our class a lecture about being responsible. So, we told her in private right before recess that our mothers could not take us to the store and we did not have any money, and that is why we did not have a shoe box. She asked us why we didn’t tell her earlier. She told us we could help clean the erasers during recess to earn the shoe box and that it would be our secret. Well, we decided to go to recess because we were mad at her and we didn’t want to share a secret with her. When it came time for science, our teacher said nothing to us. She gave us a shoe box anyway so we could make our camera. But we were the last ones to get a shoe box. They were ugly. We did not want to make a camera anymore, and we just sat there and poked at our boxes. It’s like we said before: We never do science, and we hate it.

Angie: *Claudia and Maria, I have one more question for you: Is it really that you do not like science, or is it that your teacher is just not a very good teacher?*

Maria and Claudia: We really do hate science! It’s boring. All we do is read. Learn about plants and spaceships. It’s boring and stupid. We like doing projects but not the cameras. Our boxes were ugly, and all our teacher wanted us to do was to make it just like she said. I [Claudia] just didn’t want to do it anymore. I [Maria] didn’t want the ugly box she gave me, but I really wanted a camera! She yelled at me for poking holes in my box, and I was trying to think of what I could use instead of that box, like a bag or something. I had to poke holes through the box. It was a

little kid's shoe box, and I didn't want those pictures on my camera. My teacher kept telling me no because she said I had to make it like her or it wouldn't work. Our teacher does not really care about us, and science is boring.

This article opens with a story written by Maria and Claudia,² two girls I got to know well because they lived in a long-term homeless shelter (referred to here as Hope Shelter) where I, along with graduate students from my university, taught after-school science and conducted ethnographic research around urban poverty and science education. Hope Shelter is in Well Springs, a southwestern urban center known for its recent economic boom and population expansion. Its population now ranks it as one of the 20 largest cities in the United States. This population explosion has had a devastating impact on the working poor in Well Springs. The housing and rental markets are so saturated that affordable housing is nonexistent. More than 10,000 school-aged children (K–12³) are homeless in Well Springs over the course of a year, and a significant percentage of these children are from working families who simply cannot afford the rising cost of living.

Claudia and Maria were involved in the after-school teaching and research program during the 1999–2000 school year. These two girls were bright and energetic and had lived in Wells Springs for 4 and 5 years, respectively. They were fluent in English and Spanish, easily moving back and forth between the languages as situations dictated. In fact, I observed both girls missing school to translate for their mothers.

Claudia and Maria were mentally and physically strong girls. I observed many boys at the shelter try to pick on them by calling them names or pulling their clothes; however, both girls fought back. I even observed Claudia pick physical fights with the boys to prove her status and strength. She was small physically, but she also appeared strong, quick, and aggressive. I also witnessed many other girls at the shelter look up to Claudia for these qualities. However, Claudia also seemed somewhat alienated from the cliques of the more “feminine” girls. While Claudia used her physical strength, Maria, on the other hand, appeared to me to use her quick wits. During the time I got to know her, her defense had been to use language to get back at the boys. I had observed Maria challenging boys, in both Spanish and English, when they said or did “mean and nasty” things toward her. Although Maria seemed to be less aggressive physically than Claudia, she certainly stood her ground.

During the time I got to know Claudia and Maria, they were both conscientious about completing homework. Maria, in particular, received tremendous amounts of drill-and-skill homework. Even when other children were building kites or playing tag, these two girls frequently resisted the temptation to participate in these games so they could complete at least part of their assigned homework. They described their desire to succeed in school; however, they also spoke passionately about how much they were bored by school. As Claudia stated: “I don't like science. It is boring. All we do is read.” In fact, both girls admitted that they did not talk very much in school and did not raise their hands in class because they wanted their teacher to know they were bored.

The girls shared with me other stories of their experiences in school and home. They told me about how they got picked on by other children because of their clothes or how they felt as though they got called out of class to meet with special counselors more than did the other children. They also told me they actually liked to go to school despite all these negative experiences because they could at least be with their friends (they are not allowed to have friends visit the shelter).

Claudia's and Maria's stories challenge the commonly perceived ways in which race, class, gender, language, culture, and power shape the learning and doing of science. On the one hand, the girls like doing projects and initially were excited to make a shoe box camera. They expressed confidence in their abilities as girls and believed they were smart and could do many things. On the other hand, they did not like science, found their teachers mean and their school boring. It seems to me that fundamental to the girls' story is a yearning for a more just world. What would it mean for us, as science educators, to embrace "building a more just world" as one of our key goals in science education? How might we in science education (teachers, researchers, curriculum writers, and policy makers) gain access to and use experiences of girls such as these to build science education programs that are empowering, inclusive, and transformative for youth like Claudia and Maria? These questions are crucial. After all, Maria and Claudia are bright, inquisitive girls who have been linguistically and culturally silenced in science class yet have managed to find ways to actively resist that silence.

Urban Science Education

Urban Centers in the United States and the Challenges They Raise

The U.S. Census (2000) estimates that urban areas hold about 75% of the U.S. population, while central cities, the largest actual incorporated city in a designated urban area, make up about 29% of the U.S. population. There are several key factors that characterize urban centers. First, urban centers are home to large numbers of ethnic minorities. The minority population of New York City (the largest city in the United States) is 57%, Houston (the third-largest city) is 60%, and Detroit (10th-largest city) is 79% (U.S. Census Bureau, 1998). Second, urban centers are home to immigrant families. Nearly 1 in 10 residents of the United States is foreign born, with the majority of foreign-born residents living in urban centers in California, New York, Florida, and Texas (Lollock, 2001). Indeed, 38%, 59%, and 28% of the total populations in Los Angeles, Miami and New York City, respectively, consist of foreign-born residents. Third, poverty is a key urban issue. The poverty rate in the United States exceeds those of all Western industrialized countries except Australia (Smeeding & Rainwater, 1995). Twenty-one percent of all urban children in the United States live in poverty, and 50% hover near the federal poverty line at some time in their lives.⁴ In fact, children make up 39% of the urban poor, although they are only 26% of the total population, and 40% of urban students attend high-poverty schools (U.S. Department of Education, 1996). Fourth, poverty disproportionately affects urban minorities. Although White children comprise the majority of the poor in absolute numbers, children from Hispanic and African American families are overrepresented⁵ in poverty statistics (U.S. Census Bureau, 1998). The poverty rate in 1998 was 8% for Whites, 25% for Hispanics, and 26% for African Americans (U.S. Census Bureau, 1998). Further, chronic poverty for urban African American children is evident at both the family *and* neighborhood level.

The particular ways in which urban settings bring people, nature, and technologies together give urban centers their unique character. Many of the youth with whom I work described the population density in urban life as leading to "no privacy" and "everybody know[ing] what is going on with everyone else." Many of the youth also described the ways in which different kinds of buildings, subways, bridges, tunnels, and other structures marked and separated different parts of cities, and they had critical remarks about what these demarcations meant for the kinds of spaces they were allowed to claim for themselves. They spoke about highways and train tracks separating their part of the city from more affluent parts. They used the perceived

financial well-being of neighborhood inhabitants and the style, quality, and conditions of the buildings, cars, sidewalks, streets, parks, and sidewalk vegetation to demarcate rich from poor areas. Although a visit to a city park, zoo, or cultural center may only be a bus ride away, the barriers are great. For example, several upper elementary youth with whom I had worked had lived only eight blocks from New York City's Central Park, yet they had never visited the park with their friends, school, or family.

Science Education in Poor Urban Settings: Trends and Challenges

Despite such high levels of urban poverty in the United States, we have barely begun to understand the science education experiences of poor urban children like Maria and Claudia. Even though we have experienced nearly 40 years of school reform since the civil rights movement, stark inequalities in the science education of poor urban children persist. These inequalities can be seen in four areas: academic achievement, resources, schooling practices, and the culture of schooling.

Academic Achievement. Poor urban children score disproportionately lower on standardized tests across all academic subjects and on school grades (Anyon, 1997). Nowhere is this more telling than in Berliner's analysis of disaggregated TIMSS data (Berliner, 2000). He shows how the United States, which in a cross-country analysis comes across as mediocre, is by no means mediocre. It is a country of both super and dismal achievement. Once scores are disaggregated by race, and each grouping scored as an individual country, stark differences emerged in the outcomes of White versus Black and Hispanic students. As Berliner states: "In science, for the items common to both the TIMSS and the TIMSS-R, the scores of White students in the United States were exceeded by only three other nations. But black American school children were beaten by every single nation, and Hispanic kids were beaten by all but two nations. A similar pattern was true of mathematics scores" (p. B3).

Claudia's and Maria's school lives reflect this disproportion. Even though both girls struck me as bright, inquisitive, and diligent, both girls' report cards during the time of this study portrayed them as below-average students in most subject areas. Other research has shown that less than half of urban students are above national achievement norms (Counsel of the Great City Schools, 1994). Poor urban children drop out of school at rates significantly higher than more affluent children, with poor and urban Black (17%) and Hispanic (23%) children having the highest dropout rates in the United States (Fine, 1991). Furthermore, less than half of the ninth graders in central city schools complete high school in 4 years (Education Trust, 1996).

Resources. As the girls' story about the shoe box suggests, access to resources is another key issue. Resources can be thought about in four ways: school-based materials, home- and community-based materials, teachers and other human resources at home and school, and school-based and extramural programs. Children attending poor urban schools typically have access only to outdated textbooks, limited scientific equipment, and few science-related extracurricular activities (Oakes, 1990). They also have limited access to certified math and science teachers or to administrators that support high-quality science teaching (Ingersoll, 1999). In impoverished urban districts, such as some districts in New York City and Los Angeles, the percentage of uncertified and unqualified science teachers outweighs the percentage of certified and qualified teachers (Darling Hammond, 1999). In addition, students in poor schools or schools with a high minority enrollment enjoy only limited access to high-level math and science courses (Oakes, 2000).

Schooling Practices. Poor students are disproportionately tracked into low-level classes (Oakes, Gamoran, & Page, 1992). The lives of Maria and Claudia fit this norm: As fourth graders they were already tracked into low reading groups and targeted for language and literacy remedial pullout programs. Furthermore, poor urban schools typically offer low-track courses but few high-ability courses (Oakes, 2000). Oakes et al. also showed that in low-track classes educational achievement typically focuses on behavior skills and static conceptions of knowledge with classes that are teacher-centered. Further, students spend more time reading from textbooks and completing worksheets and are expected to be passive learners rather than active users and producers of disciplinary knowledge. Similar studies have shown a complete absence of science in low-track classes (Page, 1989, 1990).

Culture of Schooling. Finally, there is the issue of how the school culture may conflict with students' home cultures. Cultural differences are particularly salient when the culture of schooling is accepted as "better than" the culture of home because of concerns like poverty, language differences, and ethnic identity (Lee & Fradd, 1998; Barton & Yang, 2000). Indeed, many teachers consider low-income families to be deficient despite their general intentions to be helpful (Davies, 1988). This deficiency model has dominated much of the research and schooling practices for poor children who are also racial or ethnic minorities, and has been shown to be a major contributor to poor student performance and school drop out (Valencia, 1991). In many cases this deficit model relationship between teachers and parents plays out through a cycle of blame: On the one hand, when faced with rebellious students, teachers may blame parents for failing to teach students proper behavior and respect (Cullingford, 1996). On the other hand, many inner-city parents are frustrated by the decay in society and in schools and blame the schools and teachers for their children's poor academic performance. Children like Claudia and Maria are caught in the middle of this cycle, hoping to do well in school but fragmented by the competing cultures of home and school.

The inequalities in these four areas reduce poor urban children's opportunities to develop scientific literacies in school and to develop an awareness of and achievement at a high level in science and related careers. This point is especially significant because children make up nearly half the poorest segment of the U.S. population, and the majority of poor children live in urban centers.

Why Critical Ethnography Is Necessary in Urban Science Education

Critical ethnography is a *methodology* for conducting research focused on participatory critique, transformation, empowerment, and social justice (Pizarro, 1998). Harding (1986) distinguished between three elements in the research process: methods, methodology, and epistemology. Methods are tools for gathering data (i.e., interviews, participant observations, etc.); methodology is the research paradigm used to organize the research tools, that is, the set of principles detailing how to conduct research and apply theory (i.e., narrative inquiry, ethnography); and epistemology is a theory of knowledge that supports the methodology by providing a philosophical basis for deciding what kinds of knowledge are possible and for ensuring that the knowledge is adequate and legitimate (i.e., positivism, constructivism, etc.). The distinction between methods, methodology, and epistemology is important when fleshing out the terrain of critical ethnography because one's views of knowledge generation is connected to one's understanding of the research process. It is important therefore to recognize that critical ethnography is grounded in a social-constructivist epistemological framework in which knowledge generation within research is understood as an active, context-based process influen-

ced by the values, histories, and practices of the researcher and of the community in which the research is done (Atwater, 1996).

Critical ethnography emerged in the education research literature in the 1980s as a merger between critical theory and ethnography in response to conducting empirical research in an unjust world (Nobilt, 1999). This merger was timely and important. Ethnography was being challenged theoretically as overly functional, too apolitical, and riddled with hegemonic practices and methods (Anderson, 1989; Lather, 1991). Critical theory, on the other hand, was labeled as overly idealistic and lacking an empirical method (Anderson, 1989; Nobilt, 1999). Merging these theories allowed critical theory to develop an empirical basis and allowed ethnography to move into the political realm. In essence, critical ethnography emerged as openly ideological research (Giarelli, 1992).

“Politicizing” ethnography is a defining characteristic of critical ethnography because it is rooted in the belief that exposing, critiquing, and transforming inequalities associated with social structures and labeling devices (i.e., gender, race, and class) are consequential and fundamental dimensions of research and analysis. Given that urban education is marked by layers of inequalities, from how schools are staffed and funded to the kinds of courses and resources available to students, making the analysis and transformation of inequalities is of particular importance for urban science education research. Critical ethnography also calls for searching out and using tools that enable the examination and transformation of inequalities from multiple perspectives, in particular from the “perspective of the oppressed” (Trueba, 1999, p. 593). This perspective is equally consequential in urban science education: The majority of youth in urban schools live in poverty at some point in their childhood, and more than half belong to an ethnic minority group. Moving toward more equitable and socially just science education research and practices demands we pay attention to the role and importance of perspective.

Since critical ethnography was introduced to the educational research community nearly 20 years ago, it has been critiqued and refined by various critical traditions, including the feminist, critical race theory, and postcritical perspectives, in order to build a more empowering and transformative research methodology (Giarelli, 1992; Holland, Blair, & Sheldon, 1995; Lather, 1991; Pizarro, 1998; Trueba, 1999; Villenas, 1996). Critical ethnography has been challenged by these perspectives as being too focused on production and reproduction theories; being too ahistorical; not being focused enough on analyzing broad shifts in social institutions; not considering adequately empowering research methods such as oral histories, informant narratives, and collaborative research; and emphasizing too strongly macroanalysis (Anderson, 1989). As a result, critical ethnography has broadened, drawing its strength not only from its openly ideological agenda but also from its embrace of human agency, which it locates within the shifting, contextual, and multilayered terrain of power and oppression. Thus, critical ethnography is useful in “facilitat[ing] the examination of culturally hegemonic practices”; documenting the “cultural conflict . . . taking place in the classroom” through the lenses of gender, class, ethnicity, and race; examining “the reproduction of social order”; and valuing “the right to voice in one’s own language and through one’s own experiences” (Trueba, 1999, p. 594).

This critical and political framework for research is defined through four major principles. First, critical ethnography is situated within the belief that all education and research is intrinsically political and steeped in cultural beliefs and values. Embedded in this political view of education and research is a renewed understanding of culture as “a complex circuit of production that includes a myriad of dialectically reinitiating and mutually informing sets of activities . . . both discursive and material” (Trueba & McLaren, 2000, p. 42). Second, critical ethnography is based on a vision of praxis centrally about a “political commitment to struggle

for liberation and in defense of human rights” (Trueba, 1999, p. 593). Doing research as praxis involves a dialectical theory- and practice-building process in which practice and research shape each other in an endless cycle. Third, research is framed through the agency and the corresponding responsibilities of the researcher and the researched. All research participants can, and must, act for themselves and others. This principle of agency draws strength from catalytic validity (in which the actions of the researcher “must be premised upon the development of research approaches which both empower the researched and contribute to the generation of change enhancing social theory”) and critical reflexivity (with all research participants “becom[e] increasingly critically conscious of their situations in the world and the impact this has on relationships and knowledge construction” [Lather, 1991, p. 295]). Fourth, critical ethnography is research that is an advocate for the oppressed in ways that genuinely embrace the histories, cultures, and epistemologies of the oppressed. At its core critical ethnography must be about documenting the nature of oppression and the process of empowerment, “accelerating the conscientization of the oppressed and the oppressors” and “sensitizing the research community to the implications of research for quality of life” (Trueba, 1999, p. 593).

These principles for research draw attention to the most urgent issues in urban science education raised both by the literature and by Claudia and Maria. Schools, like all social and cultural institutions, are not neutral environments. Teachers, students, administrators, researchers, and policy makers generate and reproduce differentiated education experiences for children. Sometimes differentiated experiences can be sound, as when educators respond thoughtfully and productively to the individual needs of children. However, sometimes such differentiation can be oppressive. After all, disproportionate numbers of minority children continue to be targeted for special-education programs, thereby equating racial and ethnic differences with low intellectual abilities. Poor children continue to be disproportionately placed in low-track classes, equating access to resources with ability. Science education in high-poverty urban schools continues to reflect a follow-the-text mentality that emphasizes low-level skills, confounding scientific literacy with compliance and memorization. These practices must be uncovered, critically analyzed, and transformed into more equitable and socially just schooling experiences.

Critical Ethnography and Building on *El Secreto de las Niñas*

What does or should critical ethnography look like with children? How should I have responded to Claudia and Maria after the story-writing process in order to embrace a critical ethnographic perspective? In what follows, I present two stories from my interactions with Claudia and Maria (following *El Secreto de las Niñas*) to raise questions and ideas about how we might move forward with critical ethnography in urban science education settings. The first story is about how drawing from critical ethnography helped me (as the researcher) learn to use difference to challenge the process of research, including how methodological decisions get made, how outcomes of research are constructed, and how researcher/researched identities get crafted. The second case is about how my own attempts to enact critical ethnography allowed the children to problematize, how the boundaries of praxis get defined, and what that means for the kind of science they used and produced in the after-school science program.

Transforming the Research Process

Writing a story with Claudia and Maria allowed the girls and me to get to know each other better in new and different contexts. Although our story is short, it resulted from many hours of

taped conversation that ranged from discussing experiences in science to what it is like to be female. The girls also learned about me, as our conversations were a two-way dialogue rather than a directed interview. (In retrospect, it is interesting to note that the final story reflected only a small portion of our conversations and didn't include much of the dialogue from my end.) The girls' learning about me or my learning about the girls is not all that different from other approaches to research. However, *what* we actually learned about each other and *how* that influenced our future relationships with each other is what is important and what allowed us to question and then change the research process (methodology and outcomes) and our roles and identities in that process. What I describe below is how drawing from a critical ethnographic framework allowed us to use the story writing incident to begin to learn how to shift our relationships and thus the research process with each other (with varying degrees of success).

After working on the story, Claudia and Maria became much more vocal in their participation in the research and teaching aspects of the program. They began to come up to me during after-school science to tell me about what happened at school, to point out when they did or did not like something, and to note things about other children and their own relationship with them. For example, one afternoon Claudia pulled me aside and shared a story with me about what had happened in school that day. Her teacher had made her feel embarrassed because she commented on how Claudia did not pay attention, played with her hair, and never participated in class. Claudia told me it bothered her most when the teachers acted like they knew her when they really didn't.

This shift in our relationship felt important. From an epistemological standpoint, the girls' initiative to define what I needed to know helped me to keep problematic how I understood either the girls or their peers. This shift felt important from a methodological standpoint as well. Prior to working on the story neither girl had revealed her feelings or experiences so explicitly, and now both were making clear to me what data they felt was important for me to collect. In their assertiveness the girls also directly countered my own data collection decisions with ideas of their own: As an academic researcher, my desire was to follow up the story with a series of conversations to better understand the ideas raised by the girls; however, Claudia and Maria did not want to do any more of this kind of research! In all honesty, they even expressed concern that their stories would not influence teachers. They also wanted more fun and more accessible ways of sharing some of their ideas than writing or even talking for long periods of time about the "same" things. In particular, the girls wanted to be movie stars. They felt that making a movie with the video camera I lugged to the shelter each week would be more fun to do and more fun for teachers to watch. They thought the teachers should see how the girls really knew how to do science and what fun science looked like. As a result, we spent the next month making a movie with the girls and their friends about "how to make school fun," for which the scenes, stories, and costumes were decided on by the girls.

With the girls more vocal, I began to recognize an even stronger need to better understand how my own power and privilege framed my understanding and relationship with the girls. As I already noted, my relationship with the girls had begun to shift, but I also began to wonder how much our relationship really could shift given the constraints of our positions within society and the project. How could we actually change the power dynamics in our relationship given that these power dynamics were supported by larger social and cultural practices? For the girls (and me) to claim different kinds of research spaces we (or at least I) had to make problematic my power position in this research setting. Before I could even do that, I also had to understand the expansiveness of my power position. I had to be more open to the contradictions set up between the girls' lives and my own beliefs, and I had to use those contradictions to challenge what I thought I knew. As Villenas (1996) has argued, we have to embrace contradictions to hegemonic

norms as opportunities for understanding and acting out more empowering expressions of research.

For example, I had not understood the girls' decision to never raise their hands in school as intentional acts of resistance. I thought perhaps they were bullied into their silence by boys' desires to take up class space (Sadker & Sadker, 1994) or the teacher's desire to dominate classroom talk in English (Lee & Fradd, 1998). I even thought their "otherization" as homeless immigrant children might have made them want to further hide themselves in class (Quint, 1994). I had not considered that the girls consciously and politically were trying to teach their teacher that they were bored. Even if these other factors may have influenced the girls' decision, it was clear their intent was very different than what I had realized. In fact, had someone told me that a homeless fourth grader had planned and persisted in such a yearlong protest, I might not have believed it!

What is important from a critical ethnographic standpoint is not so much that I checked and changed my analysis to more closely match that of the girls (although this is important as many who study qualitative research point out). What is key here is how the presentation of such a conflict be used to challenge assumptions and the underlying supporting ideologies that make those assumptions valid—assumptions that I made about Claudia and Maria based on my own experiences teaching and my own knowledge of the education literature. In particular, I had to use this conflict as a call to rethink my own assumptions about power and identity and how power relations get enacted in fourth-grade classroom settings. Further, I had to see Claudia's and Maria's sophisticated analyses of their own situations and their responses to that situation in my own interactions with the girls. What were the many ways in which they "did not raise their hands to show me they were bored" in both the research process and in the teaching process in the after-school program? To think that their abilities to critique and respond were limited to their classroom and their classroom teacher would mean I missed an opportunity to be challenged myself.

Yet even when I presented these contradictions between what I perceived was going on and what they actually told me and even when I attempted to make problematic the power relations enacted between us by rewriting my analysis at their suggestion or scrapping my plan to conduct interviews for their movie making, the girls would look at each other, exchanges glances, and laugh. I took their laughter as a call to be more critically reflexive myself, wondering about what it was I said, how it was I said or understood it, or what set of understandings they shared that I just could not quite yet see. I began to think about their laughter as signaling our cross over into the taboo subject of the critique of the power structures that frame relationships within schooling and research (which is a taboo conversation for homeless immigrant children to have with an adult White teacher). They both expressed their belief in the importance of education for getting ahead in school and that I was the White lady from the university who physically signified the power hierarchy and White culture that dominated their negative schooling experiences in the United States.

Thus, the girls' story writing began a spiraling process that influenced the research questions driving the project, the data generation strategies (the ideas in the movie, etc.), and the end products of research (the movie itself, asking me to use my own position within the education community to get teachers to actually watch their video, etc.). Yet I am still left with many questions. How can I engage in such a participatory form of research with young children without overwhelming or exploiting them—that is, turning over research responsibilities to the children without critically examining what they get out of it—or without making inadequate assumptions about what the children wanted or needed? It seemed to me that I needed to think about the outcomes of research in broader and more creative terms. I needed to listen more

closely to what the girls said or did in science as well as to their ideas about the research process. But I had to do so in ways that were authentic to their lives. I had to do so in ways that challenged my assumptions of what knowledge or action was important for the girls at that moment in their lives. I take up this issue next.

Transforming Boundaries of Praxis Through Redefining Science and Redefining Teaching

Responding to Claudia's and Maria's newly expressed assertiveness in voicing their ideas and concerns led to unanticipated changes in the direction of not only the research process but also the after-school science program. As I describe below, by challenging the purposes and products of research and her role as a legitimate participant, Claudia almost single-handedly redirected the after-school science program from focusing on the study of butterflies and butterfly gardens to architectural engineering and the building of a picnic table.

The children in the after-school program were involved in caring for caterpillars. This project came about because many of the children in the after-school program shared a desire for "pets" to take care of, even though pets were not allowed at the shelter. Caterpillars filled this niche and were "acceptable" as pets under the guise of scientific investigation. We could teach about migration, habitat, and local Texas ecosystems while at the same time allowing the children to explore what it meant to care for pets. The children decided to design and build a butterfly garden before their caterpillars metamorphosed into butterflies so that they could continue to keep their pets (and because as teachers we insisted they could not keep their butterflies in captivity). Because the shelter administration was opposed to a permanent butterfly garden (because of ongoing construction), we decided to build above-ground planters so that the gardens could be moved as necessary. An added benefit would be the ability of the children to individually own their own gardens.

On the day we brought in wood and other supplies as specified by the children's designs to build the planters for the garden, Claudia asked if she could use some of the wood to build a desk. She did not have her own private space to do homework and felt that a desk would solve this problem. Of course, this was not part of the after-school science plans. In fact, it would make after-school science more difficult because not only would she need some of the wood intended to go toward the planters, but other children would witness her actions and potentially want to build their own structures. So saying "yes" to Claudia was dangerous because it meant that the planters might not be built (even though the children designed them, and the garden was meant to meet the several needs they had articulated). What if everyone wanted to build a desk? Would we have enough wood? Would the children be willing to put the same amount of time and effort into the design of a desk? Would the garden ever be completed?

However, saying "yes" to Claudia seemed important for several reasons. First, Claudia recently had become much more vocal in expressing her views on science education. There was the potential that Claudia's lead might provide direction and substance to the question of how needs and knowledge construction intersect in the doing of science. Second, although following Claudia's lead could hamper the group's progress toward the goal of building butterfly gardens, it might also give rise to an exploration with the children about what it means for a science community when new needs emerge unexpectedly. Third, Claudia had been critical of her own experiences in school science. Although she expressed an interest in describing to teachers how to make science fun, Claudia had few specific ideas on how to do this other than "to do projects" and "play more." Indeed, this was one of the challenges we faced in the moviemaking project. Building the desk was an opportunity to work with Claudia to make sense of how science emerged from her interests and scientific abilities. Furthermore, the day Claudia decided she

wanted to build a desk, she did so on her own. Science did not have to be only reading or following a teacher's directions. After all, from a teaching standpoint she would get the same content (measurement and design) out of that activity and perhaps in more sophisticated ways as her design was more complex.

Another interesting aspect of this story is it occurred on one of the few days Claudia and Maria did not work together on their project. Maria, like the other children, spent the afternoon working on her planter. Instead of building a planter with Claudia (as she originally planned), she built one on her own, later labeling it with her name and her brother's name, claiming the planter for her family. Over the next week Maria colorfully decorated her planter, drawing pictures of flowers and butterflies on the sides.

An interesting final note to this story is that when Claudia's family moved out of the shelter, she took her desk with her. However, Maria did not take her planter with her when she moved out about a month after Claudia. So it seems that even though both the desk and the planter belonged to the children in a formal sense, the ways in which the process unraveled pointed toward the desk belonging to Claudia in ways that the planter never belonged to Maria. Indeed, Maria's decision to leave the planter (while I may never know the story behind its being left behind) may have signaled how she felt the planter belonged to the shelter or at least didn't warrant enough significance within the family to have to move it with the family.

On the one hand, it seems like this building activity led both girls to build meaningful projects and to engage in the practice (and content) of science in authentic ways. Both final products—Claudia's desk and Maria's planter—suggests that the girls successfully gleaned something about scale, measurement, spatial relations, and design. Claudia's desk may even suggest she practiced her skills in problem solving. On the other hand, the reality that Claudia's family took the desk and Maria's family left the planter suggests that Claudia used science to profoundly alter her environment and enact power over her situation. As Mukerji (1994) explains:

Science is certainly important as a system for experimentation in the world, but its power does not just reside in the experimental exercise of engineer control. It also lies in the physically generative power of science and technology to alter the environment in which human groups act, adding to and redesigning the vast and elaborated system of material culture in which contemporary social life takes place. Where the material culture of the scientific laboratory moves beyond the buildings that house labs and enters into the material culture of the larger society, it engages with systems of power. (p. 155)

Again, I am left with many questions. Praxis implies theory into action, but what kinds of actions are adequate, responsive, or necessary within this political framework? Freire (1971) has argued that through praxis the most important outcome of research should be the conscientization of the both researcher and participants. But who defines when one has reached conscientization and conscientization of what issues? Pizarro (1998) and Delgado-Gaiton and Trueba (1991) in different ways and in different contexts argue that conscientization is not just a mindset or a way of understanding. It also involves how that understanding influences what we do and why we do it. Indeed, they each argue that research as praxis must be concerned with breaking down the long held separation between research and the struggle for social change and that, according to Pizarro, justice must be viewed as "a more essential measure of the strength of research than its objectivity" (p. 63).

Returning to the desk-building story, it seems to me that Claudia's assertiveness grew out of not only our changing research/teaching relationship but also out of the redefined boundaries of

praxis in our project. It was the youths' conversation about whether Claudia had the authority to build a desk instead of a planter that was most powerful among the youth, for it changed how science was defined, produced, and used in their lives. After these conversations Ruben, a 12-year-old Mexican American boy, led a crusade for the next big project to be "building a clubhouse" (see Burkett, 2000). Citing Claudia's desk, he lobbied the other youth to think about the benefits of designing and building a youth clubhouse on the shelter property. Ruben's lobbying led the youth to design and build a picnic table and benches for their own use as outdoor furniture and for use in a possible future clubhouse. Thus, Claudia's decision to build a desk transformed what the others thought constituted science and radically affected the next two months of after-school science, during which they made conceptual pictures, blueprints, small models, and then finally a full-scale picnic table.⁶

Claudia's desk also persuaded me to think harder about such questions as: How is it that Claudia created spaces for her own needs and her cultural identities alongside an identity of being a successful scientist? In other words, how did Claudia create a coherent sense of self in science when social norms and expectations promote a more fragmented picture? What happens when children like Claudia and Maria begin to see their ideas and their needs as valuable and worthy of space in science? What happens when we, as science educators, let go of science and our own culturally ascribed understandings of successful scientists and students enough to see the girls' ideas and needs turned into reciprocally educative encounters? For Claudia, Maria, and the other research participants, Claudia's actions presented new ways of thinking about where, how, and when science gets done and the kinds of meaning such science has for individual children.

Research as Participatory Pedagogy for Transformative Action

Both these stories show the importance as well as the dilemmas inherent in using critical ethnography to move from research *on* or even research *for* to research *as* participatory pedagogy, that is, research *with*. Torres (1992) used the phrase *participatory pedagogy* because he believes research must be a fully reflexive process that intends to instruct the researcher/researched in an ongoing fashion about how oppression frames the social construction of knowledge and the nature of experience. This type of research requires the researcher and the research take on new roles: if it has not already occurred, the researcher must experience life in the researched communities to expose his or her own assumptions; whereas the researched ought to be afforded authentic opportunities to craft the nature, focus, and purpose of the research questions and methodological design. In other words, the outcomes of critical ethnography must be viewed through intentions, methods, and products that seek greater social justice so as to uncover racist, classist, or sexist norms in research and to keep the understanding of culture problematic or open to challenge.

As Figure 1 summarizes, attempting to heed the call of critical ethnography challenged me to move from sharing the data generation and reporting strategies with the research participants to finding more authentic ways to coconstruct more fully the research process with Claudia, Maria, and the other participants. This coconstruction included codesigning the research questions, data generation, data presentation, and products of research. In our case this process meant more than including the girls' ideas about "methods" into the research design. It meant recrafting the research design to also reflect new ideas about what constituted science and our identities in the process. Thus, critical ethnography is a critical and political methodology that helps to uncover and make problematic assumptions about what ought to constitute science, self, and research.

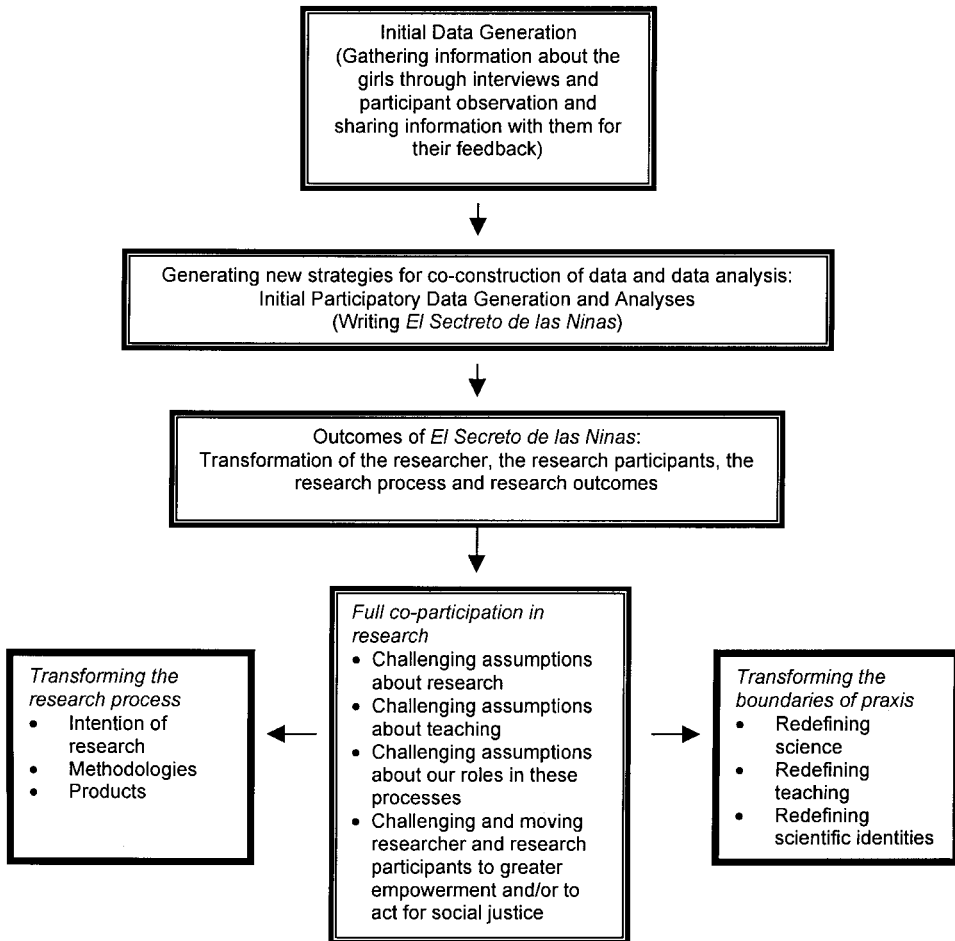


Figure 1. Research as participatory pedagogy.

Implications for Science Education Research

In the end, critical ethnographers must continue to ask themselves what their praxis is all about, what their genuine contribution is to the intellectual growth of children—Trueba, 1999, p. 611.

In science education we are currently involved in generating a kind of science education that values both excellence and equity. We have charged ourselves with the task of actively pursuing curricular and pedagogical strategies that remove the barriers of exclusion so that all children, and indeed all people, may be scientifically literate for community and individual reasons.

The issues surrounding science education in urban settings are urgent and varied. Poverty levels are high, especially at the neighborhood level and among ethnic minorities. Urban schools that serve poor populations are understaffed, have few certified math and science teachers, and

offer few math and science resources. Urban students take longer to graduate, generally score lower on high stakes exams, and drop out of schools at high rates.

Indeed, Claudia and Maria resisted the portrait that popular politics has painted of poor immigrant girls even when their resistance forced contradictions in their lives. Claudia and Maria are confident in their abilities as girls, yet they were picked on by boys and told they could be as good as the boys if they would try (implying they are not yet as good). They are fluent in Spanish and English, switching back and forth as situations dictate, and both girls expressed interest in learning about the world around them. Maria even talked about possibly wanting to be a science teacher in the future. Yet both girls were pulled out of science and other classes for remedial language work, both outwardly accepted their poor grades in school assignments and report cards with comments like “It doesn’t matter” and “I don’t care,” and resisted participation in classroom activities because they wanted their teacher to know they were bored. They live in a homeless shelter with few material resources, yet they were made to feel delinquent for not bringing shoe boxes to school. These girls are not passive receivers of stereotypes, yet they often ran up against walls in helping others to understand just that. It seems that the more they “acted out of the box,” the more their actions got rescripted in accepted hegemonic terms. Their silent resistance (not raising their hands) was read as passivity and a lack of intelligence, and their desire to talk in Spanish in front of the teacher was read as a lack of facility with the English language.

The solutions to the challenges presented to us by Claudia and Maria or any poor urban youths with whom we work are not to implement even more high-stakes exams and hold students accountable for the failings of society, as many cities and states have attempted to do. Rather the solutions reside in documenting, critically analyzing, and acting on—indeed, changing—the discriminatory practices supported by urban schooling and society. Critical ethnography is a methodological framework useful for engaging in just this kind of work.

In short, critical ethnography requires a threefold commitment of urban science education researchers. First, research questions around science for all, like the ones posed at the beginning of this article, must be studied in depth and over time. The science education community has been working hard to explore questions of science for all. This work needs to continue, and it must struggle to uncover those practices and beliefs that support exclusion and cultural hierarchies and that make the cultural appear natural. Thus, critical ethnography pushes us to expose the consequences of a political system in which we all inevitably participate.

Second, appropriate strategies for research must be developed and enacted. Appropriate strategies are research tools that are sensitive to the cultural contexts of the participants, involve full participation of research participants and help them to feel competent, and are supported by research participants’ families and communities. They must allow for a multiplicity of identities to be valued. For example, enacting youth-centered research methods should enable youths’ ideas and expressions to be better heard by the research community so that our own understandings and beliefs will continue to be problematized. This also means that explicit conversations with “the researched” about what the best methods are for their experiences to be heard and recognized must be made part of research methods. We, as researchers, cannot make these methods decisions alone.

Third, critical ethnography is linked to action deeply connected to the concerns and realities of the research participants (Pizarro, 1998; Trueba, 1999). After all, all the writing on oppression, marginalization, or even on empowerment cannot substitute for real-world actions. Although linking research with action has been critiqued for being more about activism than about scholarship, we must find ways to better understand the ways in which worlds already are

so intertwined with one another so that research in the field is helpful in actually transforming the field.

Claudia and Maria remind us that science and science education research ought to be responsive to their lives. They want to believe in themselves, and they want others to believe in them, too. They do not want to be bored by school, and they do not want those in school to marginalize them. Critical ethnography is one way to work with youth like Claudia and Maria to understand and transform all aspects of schooling for all urban youth. It can help us understand in more deep and socially just ways what science education is and ought to be about. An embrace of critical ethnography as a viable methodology in the science education community may help to generate the kinds of positive, sustained science education practices in urban settings that youth like Claudia and Maria deserve.

Notes

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¹All names of people and places used in this article are pseudonyms to protect the identity of the research participants. In addition, some minor changes have been made to biographical information at the request of one of the girls and her mother.

²Writing *El Secreto de las Niñas* involved a lengthy process. To write the story, Claudia, Maria, and I met several evenings at Hope Shelter over pizza. We began by talking about their experiences. We taped these conversations, listened to them, and decided what parts to include in the story. This was important as the girls' story telling was much more detailed and complex in its oral form. Over about 8 hr of conversation, the story took several turns and iterations. The girls pushed me to consider different ways of writing the story—they wanted more to talk than to write, and they wanted to talk about why they didn't like their teacher rather than about what they wanted to happen in science class. They also wanted me to edit their story. They told me that they wanted their stories to sound "grown up" and "official." I also pushed them to more carefully describe why they said and wrote what they did.

³This figure only includes K–12 (approximately ages 5–18). It does *not* include pre-K or preschool.

⁴It should be noted that none of these poverty statistics include families living in homeless shelters because, according to the Census Bureau, it is too difficult for census workers to keep track of transient families. This is significant given that on any given night more than 700,000 people are homeless and up to 2 million people experience homelessness during a year (National Law Center on Homelessness and Poverty, 1999).

⁵The statistics are that 46% of African American children and 40% of Hispanic children live below the poverty line, as compared to 16% of White children.

⁶Almost a year later the picnic table remains central to the youth's after-school lives. It is the only piece of outdoor furniture in the fenced-off area by the children's portable. They use it as an activities table, a place to eat, a platform for peering over the fence that marks the shelter boundary, and as home base in outdoor games.

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