

## The Culture of Power and Science Education: Learning from Miguel

Angela Calabrese Barton,<sup>1</sup> Kimberley Yang<sup>2</sup>

<sup>1</sup>*The University of Texas at Austin, Austin, Texas*

<sup>2</sup>*Teachers College, Columbia University, New York, New York*

*Received 26 January 1999; accepted 28 April 2000*

**Abstract:** In this paper we begin a discussion around the need for science educators to understand the relationship between cultural and socioeconomic issues and the science education of inner-city students. We refer to the works of critical scholars in science, education, and sociology in order to help us deconstruct the relationship between sociopolitical agendas and the lack of opportunity in science education for students from lower socioeconomic inner-city enclaves. Through our ethnographic case study of a homeless family in a major metropolitan area in the Northeast, we frame our analysis through the pedagogical questions of representation of science through culture, socioeconomic status, and “culture capital.” We use this analysis to raise questions for further research on the significance of understanding, accessing, and critiquing the “culture of power” in science education. © 2000 John Wiley & Sons, Inc. *J Res Sci Teach* 37: 871–889, 2000

### Just One of Many

Miguel<sup>1</sup> is a young 26-year-old Puerto Rican father who lives with his girlfriend/wife of 10 years and two young children. He is not the stereotypical homeless person, yet his physical appearance and demeanor are characteristic of many other young men at the shelter where he lives. He dresses in the latest fashions, is well groomed, and wears a few strategically placed facial piercings in his lower lip. Miguel and his family moved to City-Side Shelter in a large metropolitan Hispanic enclave in New York City when his family could no longer afford housing. Miguel had been gainfully employed as an industrial painter for fire engine trucks for a year and a half, but his company downsized. Like many of the other young workers, Miguel was left unemployed. Although his wife worked as a beautician, the income was not sufficient to meet the financial demands of a family of four in the city.

Born and raised in this Northeastern city, Miguel was highly influenced by urban street culture. He described his high school career as a time when he received little adult attention or guidance—in or out of school. As a result, Miguel was never encouraged to pursue academics. He was never encouraged—or expected—to enroll in science courses. One of Miguel's few fond educational experiences occurred outside of school through his brief participation in the Boy Scouts of America. He described this short experience as having exposed him to the wonders of nature and science. Although through the Boy Scouts and other home activities he developed an enthusiasm for science and nature, this was neither acknowledged formally by his teachers nor cultivated in school.

During his junior year in high school, Miguel dropped out of school because he felt that school was a waste of time. After several years of self-labeled, meaningless jobs, he landed a position in a rural town in the Northeast as an industrial painter. Miguel described his experience in this rural area with excitement and exaggeration. For example, he reported his first encounter with a possum by declaring that he had found “rats on steroids.” He described his experience there as “living the American dream.” Without a high school education, he was able to earn a living that enabled him to rent a beautiful home and own a brand new car, a 1996 Chevrolet Cavalier. Many of his material dreams were coming to fruition. He acquired a menagerie of pets that included snakes, frogs, hamsters, and rabbits. In his spare time, he pursued this personal interest in science, and became, in his own words, a self-taught herpetologist. In fact, he even conducted business (both in this rural setting and in New York City) as a black market herpetologist. When he was laid off as an industrial painter, he enrolled in culinary school. However, the financial burden became too great and he no longer was able to maintain his lifestyle. He soon lost his home.

After his move to this homeless shelter, Miguel earned his Graduation Equivalency Diploma [GED] and worked as a day laborer. Miguel described the loss of his job as an industrial painter to the dropping out of culinary school to moving his family to this homeless shelter as a “downfall.” Furthermore, he attributed this downfall to a conflict between his own cultural upbringing and U.S. culture. For example, Miguel described urban Puerto Rican culture as not valuing the need to acculturate their members to the “American way of thinking and upward mobility.” When we asked him why he felt this way, he described how the ideals of education, saving money, and autonomy were never discussed in his home life or in his neighborhood. He also described differences between the culture in which he was raised and dominant U.S. culture as the reason why “his people have become permanent wards of the United States.” As Miguel stated, “Puerto Ricans are not respected in American culture, and in turn we [Puerto Ricans] make no effort to gain respect. We believe that the U.S. Government would take care of us, and they have, through welfare, public housing, and WIC. Our kids are never encouraged to participate in the educational process and that is why the majority of us are always going to be disadvantaged.” Thus, Miguel blamed Puerto Rican culture as well as the U.S. response to his culture for why U.S. Puerto Ricans have been blocked from the upwardly mobile career tracks.

Knowing these forces were playing out in Miguel's life, but also knowing that he expressed a passion for understanding the natural world, we asked Miguel why he never considered a career in science even though this path was discouraged by many adults in his life. His response speaks to the pervasiveness of the culture of power: “You never hear of people looking for scientists in the newspapers or ads. I mean, they are special or something. It is usually just one guy who invents or finds this stuff. I never thought that there were jobs for scientists. They are people that are geniuses and discovered somewhere, but not in the 'hood. . . Yeah, we sometimes pick on the one's that think they are better than us and want to get out of the 'hood.”

Miguel described his fatherly commitment and responsibility through this same lens of culture and achievement. He stated that his major goal as a father was to “rectify the past

through his children.” He and his wife, Marisol stated that they were raising their children to be Americans of Puerto Rican descent as opposed to being Puerto Ricans that live in one of the “hoods” in this city.

Miguel’s daughter attended the after-school science program that we offered at their shelter. Miguel often attended the program with his daughter. He engaged in all of the activities, often offering stories to the children and to us about science and his own experiences. For example, he would tell the other children stories about frogs, turtles, and snakes, and he also often offered us ideas for activities he felt would be interesting and worthwhile. He even offered to share his turtles with the youth in after-school science. Eventually Miguel and his daughter stopped attending after-school science (and all other shelter-based programs). Although Miguel felt the programs were important and useful, he believed that the other children at the shelter were a negative influence on his daughter. Not only did he want to protect his daughter from the harsh reality of homelessness by keeping her “away” from other homeless youth, he also did not want his daughter to take on the “attitudes” and “values” of those who lived there.

Through his “hard lessons” in life Miguel believed that culture played a role in who succeeds in the United States and who does not. Miguel believed that in order to be heard and accepted he had to embrace the “culture of power” and he had to teach his children to do the same.

\* \* \*

We begin this manuscript with a portrait of Miguel because it raises issues of culture, power, and education in U.S. society. Miguel’s story is one of missed opportunities. Indeed, Miguel’s central concern seems to be how he can give his children access to the benefits and opportunities afforded scientifically literate people in our society—benefits and opportunities to which Miguel himself does not have access. For us, this concern raises the question: How did the practice of schooling and school science (including the cultural values and experiences embedded within those practices) influence Miguel’s experiences and opportunities for success in and out of school? For example, Miguel described a culture of power which counseled him out of the academic track at school, yet he also described the value of the “culture of power” which he believed he needed to embrace in order to succeed. Similarly, although Miguel had been a proficient herpetologist since his days in the Boy Scouts, neither his parents nor his teachers drew on this strength and encouraged him to pursue science as a viable school activity or even career. To make sense of the question posed above we first examine the concept of the culture of power in education generally and in science education specifically from a critical theory perspective. We then apply this lens to our ethnographic case study of Miguel and four key sets of experiences in his life: studying/doing herpetology, dropping out of school and science, critiquing peer culture, and child rearing.

### Understanding the Culture of Power

The “culture of power” represents a set of values, beliefs, ways of acting and being that for sociopolitical reasons, unfairly and unevenly elevate groups of people—mostly white, upper and middle class, male and heterosexual—to positions where they have more control over money, people, and societal values than their non-culture-of-power peers (Delpit, 1988). The separation of people through these arbitrary marker results in a tiered society where set rules and ideological standpoints result in barriers for those not part of the culture of power. These barriers are a product of human invention, yet because they are legitimized by a caste-oriented society are often accepted as normal.

The “culture of power” and its effects are part of nearly every institution in the United States, including the institution of schooling. Lisa Delpit (1988) describes the “culture of power” in schools as having five aspects: (1) Issues of power are enacted in classrooms, (2) There are codes or rules for participating in power; that is, there is a “culture of power,” (3) The rules of the culture of power are a reflection of the rules of the culture of those who have power, (4) For those who are not already a participant in the culture of power, being told explicitly the rules of that culture makes acquiring power easier, (5) Those with power are frequently least aware of—or least willing to acknowledge—its existence, and those with less power are often most aware of its existence. Delpit (1988) argues that without making the rules for the culture of power explicit, those who are not familiar with the culture of power will lack opportunities for upward mobility, be perceived as deficient, inferior, or disadvantaged, and be viewed as the cause of society’s problems.

The separation of those in the culture of power from those who are not runs deep. Even in the most progressive circles where those in the culture of power are “sensitive” to the needs of those outside the culture of power, those who do not possess the values, beliefs, and ways of acting of the culture of power have been labeled “disadvantaged” (Pianta & Walsh, 1996). The discourses of “disadvantaged” or “at-risk” in schooling and their effects on children cannot be overstated. This concept of “disadvantaged” or “at-risk” has been debated for over three decades and continues to shape the educational policy and practices of this country. The terms “disadvantaged” and “at-risk” have consistently referred to low-income, urban, ethnic minorities who, for a variety of structural and ideological reasons, have remained outside the culture of power (Pianta & Walsh, 1996).

The terms “disadvantaged” and “at-risk” have defined the scope and focus of educating those not in the culture of power in competing ways (Natriello, McDill, & Pallas, 1990). One perspective reflects the belief that being disadvantaged is the fault of the students, and results in their inability to function within the established frameworks of schooling and society (Hammack, 1987; Morrow, 1987; Pianta & Walsh, 1996). Supporters of this position believe that the children who do not succeed in schooling or society ought to be targeted for remedial and compensatory programs intended to “fix” children so that they might function effectively in society.

A potential problem with this argument is the assumption that understanding or conforming to the culture of power is enough to promote equality. For instance, part of the 1964 Civil Rights Act legislated that underprivileged ethnic minorities were to be given equal educational opportunities so that they would be able to “rise up” from poverty and become full participants in the culture of power. However, as research has shown, those remedial programs that do not value the cultural standpoints of participants have been unsuccessful in helping students achieve educational success (Heath & McLaughlin, 1993; Anyon, 1997; Knapp & Associates, 1997).

The second position rests on the belief that the educational problems of disadvantaged children lie in the institutions that serve children rather than in the children themselves (Luke & Gore, 1992). Supporters of this position argue that focusing attention on groups of students instead of on school practices misdirects attention away from the problems of the schools and the role they place in “disadvantaging” students (Natriello, McDill, & Pallas, 1990). The argument that social institutions play a role in disadvantaging students provides a lens for understanding how culture and power work together in schools to create a tiered society. Using the critical analytic frame of the “culture of power,” this description of disadvantaged or at-risk is important because it shows how the practices of schooling often promote an exclusionary culture. To be part of that culture, students must understand the norms and rules for participation in it. As a

result, students who are familiar with the culture of power fair better and are more often included in the school system (Delpit, 1988).

### Examining the “Culture of Power” in Science Education

Recent reform initiatives, *Science For All Americans* (AAAS, 1989) and *National Science Education Standards* (National Research Council, 1996), hold as central the egalitarian belief that all children can learn science regardless of age, sex, cultural, or ethnic background, disabilities, aspirations, or interest and motivation in science (NRC, 1996). Both documents discuss how science education ought to serve as a vehicle for maintaining a vital, just, and responsible society through fostering in children scientific understandings and habits of mind. The need for scientific literacy is also expressed in terms of world changes, in which it has become a necessity for all to be science literate, not just the privileged few (AAAS, 1989).

Until *Project 2061*, science education in the United States has had no major reform initiatives that encouraged inclusion of *all* students (DeBoer, 1991). For example, the last major reform period in science education prior to Project 2061 (the 1960s reform initiatives) focused only on the “best” students who, for the most part, were already part of the “culture of power” (DeBoer, 1991). They advocated the position that those who wanted or needed to learn science needed to “come to” science and learn science on scientists’ terms. In essence, the students were the ones in need of being fixed. Finally, these reforms firmly established the image of “who is entitled to study science” as one who is already a member of the culture power (Rosser, 1990).

Pushing toward the ideal of Science for All through more inclusive reform-based practices is essential. Historically, science classroom practices have changed little regardless of what curricular initiative gained popularity (DeBoer, 1991). Consequently, there is a long history of the culture of power dominating school science through such things as how, in schools, science gets defined, how science is taught and practiced, and how science is treated in relation to the rest of the world. For example, in schools, teachers often promote technical jargon over more colloquial language, even at the expense of understanding (Edwards & Mercer, 1987). They also often selectively emphasize, interpret, and reconstruct students’ comments making it appear as if there was only one right answer. Classroom activities, such as labs and projects, seldom reflect the “real work” of scientists (Eisenhart, Finkel, & Marion, 1996). For example, most adult scientists spend relatively little time copying facts and definitions out of books, yet that is the primary activity of students in many science classes (Anderson, 1991). Textbooks and other curricular materials often hide the people, tools, and social contexts involved in the construction of science. The result is often a fact-oriented science which appears decontextualized, objective, rational, and mechanistic (Brickhouse, 1994). Science labs and classrooms are typically structured hierarchically with the teacher and the text controlling what knowledge counts (Brickhouse, 1994). The image of the scientist most frequently projected in science curricula is that of the western self-assured, technologically powerful manipulator and controller (Hodson, 1993). It has even been shown that when children are asked to draw a scientist, the most common drawing is that of a white man wearing a lab coat and glasses.

For example, the majority of the science images portrayed in media and popular culture reflect a white, male practice. It is rare that scientists in television and movies are ever portrayed by Hispanic or African American actors. Nor are the parts written with these ethnic minorities in mind. Even in classes where students are engaged in active scientific inquiry, there is often a push toward one right answer. Thus, the canon of science is seen as irrefutable and separate from the values and experiences of those who have generated it. Indeed, all of these practices lend themselves to promoting a singular vision of science. All of these practices promote scientific

concepts over scientific contexts—those stories which shape concepts and give them deeper, complicated, and connected meanings.

The kinds of school-based science practices have led to an overwhelming number of students believing that science is a body of knowledge which consists of events, facts, and theories existing “out there” (Cobern, 1996), that science is static rather than dynamic (Yager, 1990), that only the very brightest of people can do science (Lemke, 1990), that science does not connect with their personal lives (Brickhouse, 1994; Barton, 1998), and that once they fulfill their scholastic requirements, they will be “done” with science for the rest of their lives (Kahle & Meece, 1994). These kinds of views of science have contributed to low achievement levels in school science, low attitudes toward science and science careers, and low numbers of women and people of color entering the sciences as career choices in the United States (Kahle & Meece, 1994).

Returning to the notion of the culture of power, feminists and critical science educators argue that the kinds of traditional and positivist visions of science described above promote one cultural perspective at the expense of all others. Stanley and Brickhouse (1994) have argued that science curriculum should be, in part, about addressing such questions as “Whose knowledge are we teaching?” and “Whose knowledge is of most worth?” (p. 387). These questions fundamentally challenge the nature of science as reflected in the traditional science curriculum, because they imply that scientific inquiry is subject to the cultural contexts of those who perform it. To return to the example of the white male scientist drawn often by youth, this suggests an image of white-male superiority at the expense of other cultures (Sleeter, 1996). The “sterile” image of science does not encompass other cultures nor does it project friendly accessibility. These images of science as a Western entity are directly tied to the “culture of power.”

Feminist and critical science educators also argue that this singular vision of science is exclusive in how it defines science and in how it allows science to define the world. Harding (1998) argues that science is framed through subjective western boundaries around what constitutes the content, process, rules for participation, and discursive practices of science. Longino (1990) describes the complex interactions between value and knowledge through those values that determine acceptable scientific practices or methods, and those personal, social, and cultural values that involve the societal process in which science is done. Finally, Haraway (1989) argues that the knowing and the doing of science are historically, socially, and politically situated processes where the context of science shapes the purposes and goals of science.

Feminists and critical science educators believe it is important for all students to know and be able to do traditional science, since that is what schools and society measure. Yet, they also argue that it is not enough to teach students the practice of science—and the rules for participation in science—if those practices and rules do not connect to the students’ out-of-school lives (Rosser, 1990; Rosebery, Warren, & Conant, 1992; Ladson-Billings, 1994). Here, the dichotomy of “inside/outside” of school is very pertinent to the “culture of power” in science education. Students learn that boundaries exist which separate who is and who is not capable of science not only through textbook and class activities, but also through the kinds of out-of-the-classroom activities valued in school (Anyon, 1995; Sleeter, 1996).

In short, the culture of power is present in all domains of science and science education. This analysis suggests that if all students are to be allowed to become full members of the culture of power in science and science education—and to be allowed to help shape that culture—then we must seriously consider not only how we teach science, but also the science that we teach and its relationship to students.

### Case Study Approach

We utilized a case study approach in this paper for two main reasons. The first reason is that the use of case study allows us to provide the reader with an opportunity to “to experience vicariously unique situations and unique individuals within our own culture” (Donmoyer, 1990, p. 193). In other words, a major advantage to using case studies is that case studies can take the reader to places where most of us would not have the opportunity to go (Yin, 1984). Second, we believe that our case study also allows the reader to look at the world through our eyes and in the process to see things that they might otherwise might not have seen (Holland, Blair, & Sheldon, 1995). We believe this second point is crucial for two reasons. As co-authors we come to this research from two different perspectives: One of us is an ethnic minority, the daughter of immigrants, bi-lingual, and raised on the west coast in a family that during her lifetime moved from “poor immigrant status” to upper-middle class professional. The other of us is a white, middle-class woman raised on the east coast with experience as a homeless individual in the same metropolitan area as the family presented in this paper. We believe the similarities and difference we bring to doing case study research together as well as bring to our participants allows for multiple insights into our story. Furthermore, Donmoyer (1990) indicates that the value of case study allowing for the reader to “see through the researcher’s eyes” does not mean that the reader looks at the world through the researchers’ personal idiosyncratic perspective, but rather the intersubjectively shared theoretical perspectives and life experiences.

We believe it is important to raise one last issue regarding case study and that is the issue of generalizability. We have heard it argued in science education circles that single case studies are simply not enough information to provide the community with meaningful research findings. Yet, Becker (1990), Donmoyer (1990), and Eisner and Peshkin (1990) all remind us that the practice of education is inevitably focused upon individuals. Here, generalization emerges as “a form of personal knowledge often revealed in the narrative of the parable or story; we generalize each time we try to learn lessons from the past” (Eisner & Peshkin, 1990, p. 172). Donmoyer (1990) refers to this as naturalistic generalization (as opposed to formal generalization which is that used through statistically driven research).

This particular case study involving Miguel was part of a larger ethnographic study of homeless families and science education (Barton, 1998). For the case study presented in this paper, data generation included participant observation of Miguel along with his family in after-school science and at home and interviews with Miguel and his wife over the course of 9 months. Data were first open-coded in order to develop themes connecting the family’s life experiences with degrees of success in and connection to schooling and school science. They were then closed-coded within a set of pre-selected themes which include the parents’ views of self and science in connection with beliefs about the culture of schooling, street life, dangerous neighborhoods, shelter life, extended family child raising, and economic futures (Heath & McLaughlin, 1993). A cross-comparison of the coding schemes was performed using the concept–indicator model of grounded theory approach based on constant comparison of various data sources.

### Learning from Miguel’s Experiences

In the remainder of this paper, we use the theoretical position of the culture of power developed thus far in this paper to examine, in detail, the question raised at the beginning of the paper by Miguel’s story: How did the practice of schooling and school science (including the

cultural values and experiences embedded within those practices) influence Miguel's experiences and opportunities for success in and out of school? The opening vignette taken from our ethnographic research highlights four key experiences in which culture, power, school, and science played out in Miguel's life: studying/doing herpetology, dropping out of school and school science, critiquing peer culture, and child rearing. In what follows, we summarize Miguel's experiences in each of these areas. We then follow these summaries with a discussion of the ways in which these experiences in Miguel's life influenced his experiences and opportunities for success in school science.

### *Studying/Doing Herpetology and Doing Science Outside of School*

As the opening vignette points out, Miguel has a passion for the natural world around him. Miguel often talked about observing nature (mainly in the country but also in the city), and studying the different animals and reptiles to which he had access. Miguel spoke highly of his brief Boy Scouts experience in elementary school which formally introduced him to studying nature. As Miguel described, the Boy Scouts taught him how to question the world around him. They also taught him the skills and knowledge he needed to answer those questions. He was also grateful for the times he could spend away from the city environment—both as a Boy Scout and later as an adult moving out of New York City, because these times gave him more freedom and opportunity to experience the natural world. As Miguel stated, he would “never [have] had a chance to experience nature” and his love of nature if he had “never left the city environment.”

Indeed, Miguel followed this passion for the natural world and in particular for amphibians and reptiles so earnestly that he even became a successful self-taught herpetologist. He even operated a small, black-market herpetology business out of his homes both in New York City and later in his more rural northeast community. He was supplied reptiles and amphibians by people in the business that he knew. He handled mainly snakes and turtles, some rare and exotic. He located them, cared for them, taught others how to care for them, and sold them for profit. He prided himself on the fact that he had a “zoo” at his house. Although he managed a small scale business, he was devastated when he had to dismantle it when he and his family lost their home. Even when his family moved into the shelter he kept two small red-foot tortoises in his unit until the administration found out and took them away.

Despite Miguel's love for and expertise in the natural sciences, and in particular with reptiles and amphibians, Miguel expressed concern that neither his middle school nor high school valued the experiences which he found meaningful in his own life even when those experiences carried academic overtones. For example, during an interview Miguel described enthusiastic feelings toward science, which he described as “studying and understanding the world.” Speaking with enthusiasm, he said that he enjoyed science because “science tells you the truth.” He was drawn to a way of explaining the world around him that went beyond books. The world—the turtles, rats, snakes, and other creatures he studied—was real life. However, the science to which Miguel referred was always outside of school, always a part of his own research into the world around him. In fact, in all of our conversations with Miguel, he never once mentioned a positive experience of doing science in school, largely because, as he described, he never did science in school. What is most interesting about this last point is that Miguel expressed anger and regret that these kinds of non-school science experiences such as his involvement with the Boy Scouts of America were never formally acknowledged *in school* as science learning. In fact, Miguel emphasized his enthusiasm for biology *as being outside of school*.

### *Dropping out of School and Science*

Miguel dropped out of school when he was a junior, and when in his words, he had “done all of the time [he] could handle.” He expressed frustration with how schools treated youth like himself who were deemed not academically oriented. Miguel presented vivid descriptions of not being respected or challenged in school. He described how he received little attention or guidance in school, and when he did receive guidance, he described that guidance as not worthwhile.

One major example Miguel provided regarding how he received little helpful guidance was his story about being actively counseled out of school science. As Miguel described, when he met with his counselor at the beginning of his freshman year to discuss his high school curriculum, his counselor steered him toward the vocational track. In fact, according to Miguel, his counselor never even described other potential curricular options. Similarly, Miguel recalled how his classroom teachers throughout junior and senior high school constantly reminded him and his classmates how they must prepare for the job force (rather than college) after they graduate from high school. He said that “none of my teachers ever suggested college, let least careers in the sciences to me or any of my classmates.” Furthermore, according to Miguel, his counselors completely neglected to suggest science—even basic science—as a possible course in which he might enroll.

In retrospect, Miguel believed these actions on the part of his teachers and his counselors only reinforced his belief that school science and scientific careers were not realistic options for youth “from the ’hood.” As the opening vignette illustrated, scientists, in Miguel’s mind and in Miguel’s experience, were “special” people who were “discovered” and selected by the scientific community to join their ranks. It was not something that one could select for one self. And, it was something that someone from the ’hood rarely ever was selected to do. Miguel stated how he had never heard about people looking for science jobs in the newspapers or want ads and therefore scientists must just somehow be selected. This seems to us an accurate reflection of his school experiences!

Miguel’s wife, Marisol, also dropped out of high school, and also described having received little guidance and encouragement from those in teaching and administration positions in the high school. As she stated, she experienced “a lack of belief and motivation” on the part of her teachers. Like Miguel she attended school in a predominately ethnic minority, lower socioeconomic section of the same Northeastern city. Marisol said her teachers had “very low expectations of the students” and never encouraged her to “seriously pursue her academics.” Marisol had even stated that her own teachers “merely did their time and never thought much of [her] peer group’s academic abilities.” In fact, her teachers often referred to her high school as the school for “Training Animals for Tomorrow.” Marisol never enrolled in any science courses nor was it ever suggested to her. She never enrolled in any science courses because she was not encouraged to by her teachers. In this way, teachers being part of the “culture of power” add further legitimacy to the students’ belief that they are not capable of certain kinds of learning such as science.

### *Critiquing Peer Culture*

Our opening vignette also described how Miguel viewed the conflict between the goals of his home culture and the goals of U.S. schooling. Miguel believed that his own cultural upbringing, which he described as being that of urban U.S. Puerto Rican street culture, emphasized qualities of schooling different from those valued in school. In his words, he felt that

he was influenced by “the streets” rather than by “school” to value the “social aspects of schooling.” In fact, he described having learned as a child that “school was merely used as a social meeting place for [him] and many of [his] peers.” In describing his own background, he said that his family was “not able to give [him] guidance in school because of the differences between what his family valued and school valued.” For example, at one point Miguel stated passionately:

Our parents are the bastards of the 1960s. We are a genocidal group. These PR thugs fight over the littlest things. School is used as a social thing. Yeah, every once in awhile we get someone that becomes a doctor or something, but they stay away from all this shit that the rest do. We were constantly reminded about getting a job, you know reality stuff. We’ve been kept in our place because of what we don’t do. PRs have been the spoiled babies of the United States government. They [the U.S.] gave us enough but not a lot. And we do not take charge of the educational opportunities like the Asians and Blacks. Even the Blacks know how to use the schools. PRs just hang out.

As we believe this quote suggests, Miguel appears conflicted over his perception of the U.S. Puerto Rican practice of valuing the social aspect of schooling, and the failure of the schools or his family to teach him to use schools for other purposes such as academic and career development.

In addition, Miguel described how his familial and community influences helped him to develop an “image of toughness,” a “lack of motivation and delinquent behaviors, such as stealing and public nuisances,” all of which, he believed helped him on the street but hurt him in school. According to Miguel, he felt that when he walked down the street, he was automatically “pegged as a PR [Puerto Rican] from the hood.” Thus, as these quotes suggest, Miguel valued the social connections that school afforded him, but he also believed that they, along with other things he learned on the street, hurt his own academic success and achievement.

These clashes in experiences and expectation led to a complex belief system on Miguel’s part. At times in our conversations with Miguel he expressed anger toward “the system” for making him feel “dysfunctional” in school because of his family and community and the kinds of experiences they valued. He appeared to be angry at the ways in which schooling denied him valuable opportunities. For example, Miguel described PR youth as “never encouraged to participate in the educational process and that is why the majority of us are always going to be disadvantaged.” Yet Miguel also appeared to be angry with his own culture for not understanding and challenging these oppressive practices. He appeared to be angry with his own community for not teaching him what he needed to know to succeed in the system. Miguel described his family as being “like many of the other families he knew” because its influences were “from the streets” rather than “school.” As the quote earlier illustrated, he even went so far as to refer to this vicious cycle as cultural genocide.

Miguel felt that this difference between his home experiences and his school experience led to his failure in school, and that ultimately it was his community’s fault for not making him aware of how these experiences were situated within a cultural hierarchy. This is a tough stance taken by Miguel, because it implies that his family and community completely understood the oppressive nature of schooling for those youth from the hood. Yet, Miguel repeatedly stated that it was not the “dominant, American culture” that was to blame for his lack of success in academics, but his own culture which was too much “at odds with American success.” In some ways we see Miguel forced into this hierarchical dichotomy of his culture or U.S. culture. After

all, to Miguel, it was not so much that his culture was “wrong” but rather that they neglected their responsibility for helping him to understand the difference and the power embedded in knowing that difference. Miguel’s critique embraces this understanding he feels is so essential because, as we described in the opening vignette, Miguel described the need to acculturate his culture’s members to the “American way of thinking” if they desired upward economic mobility. For example, the ideals of education, saving money, and autonomy were never discussed in his home life or in his neighborhood and the lack of conversation around these issues led “his people [to] become permanent wards of the United States.” As Miguel stated, “Puerto Ricans are not respected in American culture, and in turn we [Puerto Ricans] make no effort to gain respect. We believe that the U.S. Government would take care of us, and they have, through welfare, public housing, and WIC.” Miguel reinforced his belief that cultural differences were the reason behind his lack of success in school by stating that he believed it was *necessary* to learn from the dominant culture in order to succeed both in school and in science. In fact, at one point in one particular interview, Miguel felt so strongly about this that he said his “lack of success in school had nothing to do with the school system. . . that the lack of value towards education from [his] cultural background was [his] biggest downfall.”

### *Child Rearing*

Miguel is father to two young children, one of whom was school-aged at the time we conducted this case study. As we described in the opening vignette, Miguel believed strongly in a good education for his school-aged daughter, and as such was highly involved in her own educational pursuits. He attended after-school science with her, met with her teachers in school on a regular basis, and encouraged her to succeed academically.

Miguel said that his daughter attended a public elementary school in the same neighborhood as the shelter where he currently lived. He wanted his daughter to use schooling as a tool to gain access to the culture of power. He wanted his daughter to know how to succeed in school. He also wanted her to value what educational success meant in the larger society. He wanted her to be influenced by those who held power within the cultural hierarchies within the US; not by those who did not. He stated the principal was Puerto Rican and seemed to know what she was doing all of the time. Although he appreciated the close tabs the school principal seemed to keep on his daughter, he also stated that he “preferred to send [his] children to a school populated predominately by whites and run by whites.” In his opinion, “they [Puerto Ricans] can learn from others because they are succeeding and we [Puerto Ricans] are not.” In short, Miguel did not want his daughter to re-live his own experiences with schooling.

This position certainly played out in many of the parenting actions we observed Miguel initiate. For example, Miguel removed his daughter from participation in all shelter-based after-school programs including the after-school science program we conducted, because he did not want her to associate with her peers at the shelter. In his words, he wanted to protect her from the “negative” interactions she might have with those youth influenced by the street. He also asked for our advice, as people from the university, on what his daughter should know and where he might find the kinds of resources she might need to learn it. Finally, he actively prevented her from developing friends at the shelter. In addition to removing his daughter from the after-school shelter-based programs, he also placed strict restrictions on whom she could play with from the shelter. Miguel realized he might be going overboard, he was adamant that his daughter would have opportunities to succeed.

*Making Sense of Miguel and Success in Science and the Culture of Power*

We have asked the question: How did the practice of schooling and school science (including the cultural values and experiences embedded within those practices) influence Miguel's experiences and opportunities for success in and out of school? The four key experiences just described (out-of-school science experiences, dropping out of school and science, peer culture, and child rearing) provide insight into this question about schooling, experience, and opportunity in the inner city because they point toward the powerful ways in which culture, power, and opportunity intersect in Miguel's story of missed opportunities.

Miguel's experiences of missed opportunities make us wonder if his lack of formal success in science can be traced to his own, his school teachers' and counselors', and even his family's belief that there is no place for him or other youth from the 'hood in the formal science culture even if he acquired the skills to compete in that arena (Harding, 1998). For example, Miguel and his peer group viewed themselves as different from those in power, especially those in schools and those in science. As a youth, Miguel and his peer group did not rally around the ideal of academic achievement or success. This is not true of all non-dominant cultural groups. Tobin and McRobbie (1996) illustrate how Chinese-Australian students, although cultural, political, and linguistic minorities in Australia possessed a sophisticated understanding of the culture of power. In response to the culture of power, the Chinese-Australian students created a support network among themselves so that they might attain the same science academic achievement as their culturally and politically dominant peers. Miguel's group, on the other hand, discouraged the notion of "becoming" like the dominant culture.

We also believe that Miguel was discouraged by the sociocultural practices of *formal* science and science education. Miguel's experiences are particularly poignant reminders of how the formal science and science education communities have been organized around cultural norms and expectations. Children begin to develop understandings of the nature and practice of science long before high school, the point at which Miguel dropped out of science. A common image of a scientist among school children in the U.S. is a white male with glasses (Hodson, 1993). This image continues to be re-inforced in the media and in science textbooks. That there existed a difference for Miguel between Puerto Ricans of the 'hood and scientists came out in many of his statements. Miguel consistently reminded us that only "other people" went into science: "It's the other people that go into those things [like science]." This argument is supported and complicated by the fact that, although the counselors in Miguel's life were themselves gatekeepers, in some ways their advice could be read as good advice if the only science courses offered are low track "warehouse" courses and high track courses designed for middle class European American students.

Finally, we believe that definitions of valued knowledge are also significant in Miguel's life. Not only was achievement in formal science not valued by Miguel and his neighborhood community as described earlier, but also Miguel's own self-taught understandings of and experiences with the natural world were not valued by his teachers or school counselors. Miguel was deeply passionate about studying and understanding the world around him. He described a love for animals and reptiles, for the process of figuring out how things worked, and for exploration and the out-of-doors. He was proud of his black-market herpetology business and the kinds of things he knew to help make him a success in that world. Although short-lived, he was also proud of his experiences in the Boy Scouts.

One might expect that Miguel's love for understanding the world around him would have been the kind of enthusiasm that would have been noticed, then fostered by a teacher, mentor, or parent, and that Miguel would have been encouraged to pursue the sciences as a career or at least

a viable subject of study in high school. After all, interest in, devotion to, and experience with science is often described as the first step, indeed the most potent barrier to be overcome, in helping more girls and minority youth become successful in school science (Kahle & Meece, 1994). Yet, this was not the case with Miguel. In fact, Miguel never even enrolled in science in high school.

Brickhouse (1994) has argued that narrowly defined “scientific ways of knowing” such as “rational thinking which has been separated from feeling and emotion”, “ideas separated from context and personal experience” are particularly problematic for female and minority students who do not see their own worldviews reflected in school science. Although we do not have evidence of what Miguel might have learned in school science since he was actively counseled out of school science, it is clear that his teachers and counselors did not view his interest in the out-of-doors, nature, or how things worked as important enough for him to enroll in school science. Thus it seems to us that many factors, including schooling practices, home culture and school culture, and definitions of valued knowledge, played a role in why Miguel’s love of understanding the natural world was never bridged to success in school science.

Thus, Miguel was discouraged from participating in school science from all sides. His school counselor actively counseled him out of science and into vocational education. His family did not actively encourage him to enroll in science or even to succeed in school. Miguel was also discouraged from participating in school science because of cultural norms and expectations. Miguel described how becoming part of school science also meant leaving, to some degree, his home culture: “Yeah, we sometimes pick on the one’s that think they are better than us and want to get out of the ’hood.” Entering science formally (i.e., through formal schooling), for Miguel, meant walking away from the ’hood. For Miguel, it did not seem possible to do both.

This last point is significant not because Miguel could not see connections between his home culture and science because we believe he, in fact, did. Rather we believe this last point is significant because Miguel perceived a great disconnection between his home culture and *school* science. In fact, his knowledge in the domain of out-of-school science was valued by his culture as was evidenced by his successful black-market business in herpetology. He described to us how he had to know quite a bit about reptiles in order to survive in that business and his peer culture supported that knowledge both personally and financially. What was not valued was knowledge in or experience with school science. So just as his teachers did not value his home-based knowledge of the world around him including his detailed knowledge of reptiles and amphibians, neither did his home culture value the ways in which such success might bridge his home knowledge with academic success.

## Discussion

We believe that the case of Miguel is a compelling case for why an understanding of the culture of power and its implications for how science gets defined and enacted in schools, for who has (easy) access to school science, and for how students are encouraged to succeed is critical within the science education community.

Miguel and Marisol’s school experience is common for many ethnic minority students in the United States (Fine, 1991). One way to look at this situation is through Ogbu’s ideas of involuntary minorities. European ethnic groups, as well as some Asian and Latino groups, for the most part, voluntarily immigrated to the U.S. in search of better opportunities, expecting to endure some hardships and discrimination initially (Sleeter, 1996). Indigenous Native Americans, as well as many African Americans, Puerto Ricans, and Mexican Americans, on the other hand, are “involuntary minorities” because they were brought into their present society

through slavery, conquest, or colonization (Ogbu, 1991). Their “involuntary” status automatically segregates, because this status carries with it the suggestion of substandard cultural influences and identities. Many children from involuntary minority groups grow up with messages of inadequacy and a separation from cultural dominance. Thus, children of “involuntary minorities” like Miguel often feel that they have no vested interest in becoming part of the “culture of power.” Their feeling of exclusion is only reinforced by their own peer group’s lack of acceptance of the “culture of power.” This cycle creates a self-imposed segregation that permeates into almost every facet of their lives.

Another way to look at Miguel’s situation is through production theories (Willis, 1977; Giroux, 1985; Connel, Ashenden, Kessler, & Dowsett, 1988; Weiler, 1988). Kathleen Weiler (1988) summarizes production as how individuals or collectives, and in particular oppressed individuals and collectives, through asserting their own experiences and resisting the ideological and material forces imposed upon them, created their own meaning and culture in both individual and collective ways. Productive theories were developed in response to reproductive theories which advocated that oppressed individuals were passive, and were always acted upon by those in power. Like the lads in Willis’ groundbreaking ethnography (1977), it seems, that Miguel resisted American education for a fundamental reason: Schools represented a particular way of knowing and being that was not reflected in his home life. This is an important point. Opportunities for experiences are often determined by societal standards and expectations of certain groups of people who most often represent the dominant groups in society (Anyon, 1995; Delpit, 1988). Schools in the United States and abroad serve specific segments of the population, and they operate to reproduce status quo values and expectations (Aronowitz & Giroux, 1994). As a result of this practice of reproduction in schools, non-white middle class experiences are marginalized in schools (Weiler, 1988). This is most significant with historically underprivileged ethnic minorities, such as Puerto Ricans. As exemplified in the case of Miguel and Marisol, they understand the lack of respect and appreciation of their cultural background by the dominant culture. Their awareness that their culture is not conducive to the “dominant” culture’s values and views on education makes it imperative to make our educational system more inclusive of all cultures. As Patthey-Chavez (1993) states,

school achievement is shaped by the parallel worlds constructed by students and teachers in school settings, and both groups draw on larger socioeconomic repertoires to manage the experience. The nexus of relationships to be found between school setting, the reproduction of knowledge, and novice enculturation in a multicultural setting remains an important domain for investigation.

Using this framework for cultural production and culture of power, Miguel’s peer culture and the culture of school science are both restrictive, demanding conformity to a narrow set of norms and expectations that failed to connect his interests and talents to the wide range of possibilities offered by our society and economy. Miguel is actively seeking a way to help his children escape the restrictiveness of both cultures. He has taken responsibility for making his children aware of ways in which they may be oppressed by the very structures such as schooling intended to offer opportunities, but that their own home-based cultural experiences may lead them to resist opportunities as well. He is looking for a kind of middle ground; a science education that is based on caring about children and their interests and talents as well as giving them access to the power of Western science.

The case of Miguel suggests that the culture of power—in both schooling and in science—plays a large role in who formally succeeds in American culture and who stays in the margins.

We live in an interesting society. The United States prides itself on its democratic and egalitarian principles. However, Miguel's story suggests that the reality for many Americans is different. Many ethnic minorities are actively pushed to the fringes by those in power through unwritten and unspoken rules for success and inclusion. In many ways, success is defined through how close one can come to emulating the established dominant culture. We believe that the case of Miguel and his science education sadly makes this point. He knew and loved science, yet his expressions of that knowledge and love did not match that of the dominant culture. Of course this is complicated by the fact that he was also counseled out of science because of his counselors' perception of an overriding need to get him into vocation education, and we believe that this only supports our point. Not only could (and can) students from his former high school take science in the vocational track and pursue vocational careers as laboratory technicians, but also the very act of pinpointing Miguel for vocation education meant that there was little hope placed in him for academic success beyond high school. After all, the argument for financial concerns falls short when one considers the financial trajectory of a scientist versus a day laborer.

In listening to Miguel's life story both in and out of science and schooling, we are reminded of a common theme that seems to prevail with ethnic minorities and people in the lower- and underclass in science education. His ethnic background served as a liability for his chance to obtain a strong education in science (Lee & Fradd, 1998). This is not due to the inferiority of his heritage, but the positioning of his ethnic enclave's within U.S. society, both in terms of how his ethnic group is viewed by those in power positions (i.e., in need of vocational education) and in terms of his own group's response (i.e., we do not belong in science). We are also reminded of the fact that each person is born into a social and cultural setting—family, community, social class, and language—these all have an impact on how a child will develop social connections which inevitably result in the kinds of educational and social opportunities they may or may not receive. Both the informal and formal interactions of peer groups and school will guide a student's outlook and shape how he or she places themselves in this schema. In turn, how they reflect their feelings of school and themselves will affect how the institute of school will serve them. There is the belief by scholars that those American minority groups that do not assimilate will inevitably create numerous sociocultural problems for themselves (Menchaca, 1989). This lack of assimilation can result in a lack of opportunities, as Miguel has pointed out in his own life experiences.

In returning to science education, these points about culture, expectations, and outlook raise a larger question: How might Miguel's story and our understanding of the culture of power inform efforts to promote equitable science education reforms?

We believe that part of the answer to this question lies in moving beyond the rhetoric of "science for all" to critically understanding how culture and power influence what creating an inclusive science community might mean. One way to ameliorate this situation is to examine what has been traditionally considered school science versus non-school science. The silencing of scientific knowledge that does not fall in the realm of recognized school science has resulted in exclusion of certain populations toward the formal learning of science (Eisenhart, Finkel, & Marion, 1996). From this perspective we can draw on Miguel's science experience and see that learning had occurred away from the classroom. His knowledge of science was acquired and then measured in nontraditional ways. For example, Miguel's personal experiences with natural phenomena and his explanations of them would not be generally accepted as academically correct (i.e., Wow! Rats on steroids!). However, Miguel's comment reflects his own attempt to make connections between his urban experience and his observations. Miguel stated that school restricted his ability to understand things—to make the kinds of connections between his life in urban poverty and valued school knowledge. In fact, Miguel stated, "I just didn't get all that

science stuff in school. And the tests only made school worse.” Miguel believed there was little value in his life for the kind of learning that he was subjected to in school. Accepting Miguel’s experiences as important in formal ways is imperative in order to include populations that have been silenced by established standards (Roth & McGinn, 1998).

The other issue raised by the case of Miguel is examining who we have silenced and why. In this case, the silenced individual is someone of Puerto Rican descent and from lower socioeconomic status. Yet in his recollection of his own childhood experience, he displayed obvious enthusiasm for science. One would think that this enthusiasm could—and should—have been cultivated. However, the issue of inclusiveness in this subject area is still in debate. Should science education have provided him with an avenue for fostering *his* scientific curiosities? Was he denied a science education because of his ethnic background? his socioeconomic status? his cultural values and expectations? By definition, the deprived underclass consists of those members of the society who cannot assert themselves effectively (Ginzburg & Solow, 1974). If this is the reasoning for why many students from underprivileged backgrounds cannot break into the world of scientific endeavor, then as a democratic society programs to provide opportunities and empowerment into these fields—that are transformative to both the individual and the field—should be implemented at full force. In schools, science is projected as an objective messenger of our natural phenomena. Yet, in practice the canon of Western science has specific and culturally constructed boundaries. Those in power set the discursive norms and values, leaving those belonging to other cultural perspectives to be perceived as different and deficient (Harding, 1998). As Miguel pointed out, science is something in which only “smart” people partake. Science knowledge has been framed in a manner that has created a “stage” for “actors” to read a prescribed “script” (Roth & McGinn, 1998). This whole scenario has created a bias toward which population can obtain a science education. Whether inadvertent or deliberate it has created this inequality and skewed vision of whose science we are teaching. In assessing the stage, actors, and script, many agree that they can all be changed and re-written to include those previously excluded (Atwater, 1996; Barton & Osborne, 1998; Rodriguez, 1998). We can re-frame our point of reference of science in order to make it more inclusive. The “actors” do not have to fit the image of what has previously been prescribed, hence, a student from the ‘hood can easily fit the image of science as well as a suburban student. Our “script” can be re-written to include non-formal science and acknowledge other forms of knowing and learning of science.

### Conclusions

Our case study of Miguel leaves us with unanswered questions. Although we believe that the case study approach is important, we also believe that a wide-scale yet richly descriptive picture of the beliefs and experiences of people in situations like Miguel is critical. Why is it that large numbers of people from the inner city are consistently denied admission into the culture of power in school or science? We know that such populations have been shown to have low self-esteem in school science and negative views toward science (Atwater, Wiggins, & Gardner, 1995). This is important. But, as our case study indicates, we need to continue to develop rich portraits of a variety of experiences from the lives of inner-city children and parents if we are to genuinely construct science for all. Furthermore, what might a science class look like if we were to take into account our understandings about the culture of power? How might change the actors, the script, and the stage in science teaching and learning settings?

Current reforms in science education emphasize science for all. The curriculum and instructional practices developed for this endeavor seem to forget that not all children are provided with equal educational opportunities (Barton, 1998). The notion that one culture is

better than the rest suggests to students that only those who are part of or acculturated in to the superior culture can achieve in the sciences. This is what Miguel learned to believe despite his success, informally, with science.

Asking youth, like Miguel, to abandon their cultures or to deem non-dominant cultures as inferior is unfair and, indeed, oppressive. Yet, acknowledging the ways in which schools and home cultures may differ may provide a space for critically understanding both worlds in the hopes that we might find more equitable ways to balance the need to introduce the culture of power to students in explicit ways while acknowledging and valuing their home experiences. Miguel's argument is powerful because he helps us see the benefits and the limitations present in both worlds. Miguel realistically assesses the consequences of his own behavior while also critiquing those in power and provides insights into how science educators and inner-city youth might meet half way. Thus, Miguel's story seems to be arguing for starting points toward science literacy grounded in the interests and cultures of all children while also recognizing the need for mutual accommodation between science education and children and youth from the inner city.

Support for this research was provided by the National Academy of Education, Spencer Foundation Postdoctoral Fellowship Program, and is acknowledged with gratitude. The opinions expressed in this paper are those of the author and not those of the Spencer Foundation.

We would like to thank two anonymous reviewers as well as the editors of *JRST* for the insights which helped us to develop this paper.

#### Note

<sup>1</sup>All names (persons and places) used in this paper are pseudonyms used to protect participant identity.

#### References

- American Association for the Advancement of Science. (1989). *Science for all Americans*. Washington, DC: AAAS.
- Anderson, C. (1991). Policy implications of research on science teaching and teachers' knowledge. In M. Kennedy, (Ed.), *Teaching academic subjects to diverse learners* (pp. 5–30). New York: Teachers College Press.
- Anyon, J. (1995). Inner-city school reform: Towards useful theory. *Urban Education*, 30(4):56–70.
- Anyon, J. (1997). *Ghetto schooling*. New York: Teachers College Press.
- Aronowitz S., & Giroux, H. (1994). *Education still under siege*. Westport, CT: Bergin & Garvey.
- Atwater, M. (1996). Social constructivism: Infusion into the multicultural science education research agenda. *Journal of Research in Science Teaching*, 33, 821–838.
- Atwater, M., Wiggins, J., & Gardner, C. (1995). A study of urban middle school students with high and low attitudes toward science. *Journal of Research in Science Teaching*, 32 (6), 665–675.
- Barton, A.C. (1998). Science education and the politics of poverty. *Educational Policy* 12(5), 525–541.
- Barton, A.C., & Osborne, M.D. (1998). Marginalized discourses and science education. *Journal of Research in Science Teaching*, 34, 339–340.

Becker, H. (1990). Generalizing from case studies. In E. Eisner & A. Peshkin (Eds.), *Qualitative inquiry in education: The continuing debate* (pp. 233–242). New York: Teachers College Press.

Brickhouse, N. (1994). Bringing in the outsiders: Reshaping the sciences of the future. *Curriculum Studies*, 26(4), 401–416.

Coburn, W. (1996). Worldview theory and conceptual change in science education. *Science Education*, 80(5), 579–610.

Connel, R., Ashenden R.J., Kessler S., & Dowsett, G. (1988). *Making the difference: Schools, families and social division*. Sydney, Australia: George Allen and Unwin.

DeBoer, G. (1991). *A history of ideas in science education: Implications for practice*. New York: Teachers College Press.

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

Donmoyer, R. (1990). Generalizability and the single-case study. In E. Eisner & A. Peshkin (Eds.), *Qualitative inquiry in education: The continuing debate* (pp. 175–200). New York: Teachers College Press.

Edwards, D., & Mercer. (1987). *Common knowledge: The development of understanding in the classroom*. London: Methuen.

Eisenhart, M., Finkel, E., & Marion, S. (1996). Creating the conditions for scientific literacy: A re-examination. *American Education Research Journal* 33(2), 261–295.

Eisner, E. & Peshkin, A. (1990). Generalizability. In E. Eisner & A. Peshkin (Eds.), *Qualitative inquiry in education: The continuing debate* (pp. 171–174). New York: Teachers College Press.

Fine, M. (1991). *Framing dropouts: Notes on the politics of an urban high school*. New York: State University of New York Press.

Ginzburg, E., & Solow, R. (1974). *The great society: Lessons for the future*. New York: Basic Books, Inc.

Giroux, H. (1985). Marxism and schooling: The limits of radical educational discourse. *Education Theory*, 34 (2), 113–135.

Hammack, F.M. (1987). Large school systems' dropout reports: An analysis of definition, procedures, and findings. In G. Natriello (Ed.), *School dropouts: Patterns and Policies*. New York: Teachers College Press.

Haraway, D. (1989). *Primate visions: Gender, race and nature in the world of modern science*. New York: Routledge.

Harding, S. (1998). *Is science multicultural?: Postcolonialisms, feminisms, and epistemologies*. Bloomington, IN: Indiana University Press.

Heath, S.B., & McLaughlin, M.W. (1993). *Identity and inner-city youth: Beyond ethnicity and gender*. New York: Teachers College Press.

Hodson, D. (1993). In search of a rationale for multicultural science education. *Science Education*, 77, 685–711.

Holland, J. Blair, M., & Sheldon, S. (1995). *Debates and issues in feminist research and pedagogy*. Clevedon, UK: Open University Press.

Kahle, J., & Meece, J. (1994). Research on girls in science lessons and applications. In D. Gabel (Ed.), *Handbook of Research in Science Teaching and Learning*. Washington, DC: National Science Teachers Association.

Knapp & Associates. (1997). *Teaching challenge in high-poverty classrooms. Teaching for meaning in high poverty classrooms*. New York: Teachers College Press.

- Ladson-Billings, G. (1994). *Dream keepers: Successful teachers of African-American children*. San Francisco, CA: Jossey-Bass.
- Lee, O., & Fradd, S. (1998). Science for all, including students from non-English language backgrounds. *Educational Researcher*, 27(4), 12–21.
- Lemke, J. (1990). *Talking science: Language, learning, and values*. Norwood, NJ: Ablex.
- Longino, H. (1990). *Science as social knowledge: Values and objectivity in scientific inquiry*. Princeton: Princeton University Press.
- Luke, C., & Gore, J. (1992). *Feminisms and critical pedagogy*. New York: Routledge.
- Menchaca, M. (1989). Chicano-Mexican cultural assimilation and Anglo-Saxon cultural dominance. *Hispanic Journal of Behavioral Sciences*, 11(3), 203–231.
- Morrow, G. (1987). Standardizing practice in the analysis of school dropouts. In G. Natriello (Ed.), *School dropouts: Patterns and policy*. New York: Teachers College Press.
- National Research Council (1996) *National Science Education Standards*. Washington, DC: National Academy Press.
- Natriello, G., McDill, E., & Pallas, A. (1990). *Schooling disadvantaged children*. New York: Teachers College Press.
- Ogbu, J.U. (1991). Immigrant and involuntary minorities in comparative perspective. In M.A. Gibson & J.U. Ogbu (Eds.), *Minority status and schooling*. New York: Garland.
- Patthey-Chavez, G.G. (1993). High school as an arena for cultural conflict and acculturation for Latino Angelinos. *Anthropology and Education Quarterly*, 24(1), 33–60.
- Pianta, R., & Walsh, D. (1996). *High-risk children in schools: Constructing sustaining relationships*. New York: Routledge.
- Rodriguez, A.J. (1998). Strategies for counterresistance: Toward sociotransformative constructivism and learning to teach science for diversity and for understanding. *Journal of Research in Science Teaching*, 35(6), 589–622.
- Rosebery, A., Warren, B., & Conant, F. (1992). Appropriating scientific discourse. *Journal of Learning Sciences*, 2, 61–94.
- Rosser, S. (1990). *Female friendly science*. New York: Teachers College Press.
- Roth, W., & McGinn, M. (1998). Knowing, researching, and reporting science education: Lessons from science and technology studies. *Journal of Research in Science Teaching*, 35(2): 213–235.
- Sleeter, C. (1996). *Multicultural education as social activism*. Albany, NY: State University of New York Press.
- Stanley, W., & Brickhouse, N. (1994). Multiculturalism, universalism and science education. *Science Education*, 78(4), 387–398.
- Tobin, K., & McRobbie, C. (1996). Cultural myths as constraints to the enacted science curriculum. *Science Education*, 80(2), 223–241.
- Weiler, K. (1988). *Women teaching for change: Gender, class, and power*. South Hadley, MA: Bergen and Garvey Publishers.
- Willis, P. (1977). *Learning to labor: How working class kids get working class jobs*. New York: Columbia University Press.
- Yager, Robert. 1990. *Science, technology, society*. New York: State University of New York Press.
- Yin, R.K. (1984). *Case study research: Design and methods*. Beverly Hills, CA: Sage.