

Seeing and Supporting Identity Development in Science Education

Heidi Carlone, The University of North Carolina at Greensboro, School of Education,

346 Curry Building, Greensboro, NC 27402, hbcarlone@uncg.edu

Melissa Cook, Jacqueline Wong, William A. Sandoval

University of California at Los Angeles, 2339 Moore Hall, Los Angeles, CA 90095

Email: cook.ucla@gmail.com, writejackie@gmail.com, sandoval@gseis.ucla.edu

Angela Calabrese Barton, Edna Tan, Michigan State University, 116E Erickson Hall, East Lansing, MI 48824

Email: acb@msu.edu, tane@msu.edu

Nancy Brickhouse, University of Delaware, School of Education, College of Human Services,

Education and Public Policy, University of Delaware, Newark, DE 19716, nbrick@udel.edu

Abstract: The primary objective of this session is to highlight ways in which identity can be construed and studied within science education, and to advance a discussion about how science education can embrace its civic responsibility toward students to help them appropriate science as a meaningful tool in their lives beyond school. The four papers reflect a range of perspectives on the construct of identity and approaches to its study and development. Each presentation will focus on the authors' conceptualization of identity and identity development and their approaches to characterizing expressions of identity or identity change through student talk and/or participation in particular contexts of science learning. Presenters will discuss their own goals for identity development within science education, and the implications from their work for approaches to supporting positive identity development through science learning.

Overview of the Session and Session Objectives

A recent trend in science education is the concern that students develop identities in relation to science. This focus on identity is especially directed to students who belong to groups who are historically under-represented in science: girls, ethnic minorities, and the poor (e.g., Calabrese Barton, 1998; Brown, Reveles, & Kelly, 2005; Carlone, 2004; Kozoll & Osborne, 2004). What it means to have a "science identity" can vary, of course, as individuals could potentially come to identify as scientists, or as consumers of science, or critics of science, and so on. Concurrent with this interest in identity construction, or development, as an outcome from "Science for All" reforms, an alternative to the traditional psychological construct of identity has emerged from new literacy studies (Gee, 2001), which view discourse as a medium for the development and expression of identity, and sociocultural theories of development more generally that view identity as one of the core outcomes of human development (Wenger, 1998). On this view, all learning entails a change in identity, as the meaning that individuals make of their place within the communities of practice in which they participate changes their view of themselves. This sociocultural view of identity also asserts that identities are socially constrained, in the sense that individuals cannot really assume identities that are not recognized within a community (e.g., poor urban students of color not being able to assume identities as good students).

Yet, in "opening up" the construct of identity to acknowledge and try to account for its social dimension, the sociocultural notion of identity raises several issues. A key change from the traditional psychological construct is that sociocultural views see identity as enacted through one's participation in activity and discourse, as opposed to a set of psychological beliefs that can be interrogated through surveys or interviews. For example, Carlone and Johnson (2007) recently argues that someone who has a science identity demonstrates competent performance in relevant scientific practices and deep and meaningful knowledge and understanding of science, and recognizes herself and gets recognized by others as a "science person". In other words, identity construction requires the participation of others. To be a particular kind of person (i.e., to enact a particular identity) requires that we talk, think, use tools, value, act, and interact in ways that render who we are and what we are doing recognizable to others (Gee, 2001). Thus, this stance on the role of identity in learning has implications for not only how we fashion learning but also how we seek to unpack the outcomes of learning methodologically.

Opening up the construct of identity also calls into question how issues of power and positioning frame opportunities and outcomes of learning as well. For example, Brickhouse and Potter (2001) show us how complex the relationship between identity and success in school and in peer groups can be for urban girls. Their work reveals that through the experiences of marginalization in the science classroom and even in peer groups, urban girls learn that membership in a school science community is often impossible or undesirable. Having a science or technology related identity does not mean that one will necessarily succeed in school, if that science related identity does not also reflect the values of school-mediated engagement or if students do not have access to the resources they need to do science well. However, successful participation in school science or technology,

despite a lack of resources in the home environment, can be better facilitated when students have a science related identity they can draw upon.

The questions that frame this session emerge from opening up the construct of identity. They include: How do individuals develop identities with respect to “learning” science? How can identity development be measured and traced over time? Also, as identity change becomes an outcome of interest for science education, other questions arise. What does it mean to have a “science identity”? What kinds of identity would we like students to develop – should everyone develop an identity as a scientist? Why or why not? How do we support identity development in science classrooms, however we define them? Finally, from an equity standpoint, how do we help students in retaining identities that is desirable to them in their home communities while supporting them in crossing the boundaries of race, class and gender, in order to get access to a science culture that too often resides only in more privileged communities?

The presentations in this session attempt to answer these questions related to seeing identity and supporting identity development in science classrooms. Yet while each paper draws upon rich data sources in order to bring to light critical issues and findings with respect to identity and science learning, each paper also brings into focus critical conceptual and methodological issues that shape identity-based research in learning. The presenters bring a range of perspectives on the construct of identity and approaches to its study and development. Each presentation will focus on the authors' conceptualization of identity and identity development and their approaches to characterizing expressions of identity or identity change through student talk and/or participation in particular contexts of science learning. Presenters will discuss their own goals for identity development within science education, and the implications from their work for approaches to supporting positive identity development through science learning.

Session Structure

The primary objective of this session is to highlight ways in which identity can be construed and studied within science education, and to advance a discussion about how science education can embrace its civic responsibility toward students to help them appropriate science as a meaningful tool in their lives beyond school. Opening remarks from the session chair will be kept to a minimum, less than five minutes. Each of the 4 presenters will have approximately 15 minutes to make their remarks, in the same order as the paper descriptions provided below. As is evident by the paper descriptions, there is a coherent story line regarding identity research and learning to emerge from paper set and its particular organization. The first paper, while grounded in a multiyear national study, focuses more intently on specific conceptual and methodological concerns related to identity research. By leading with this paper we hope to set out particular parameters in terms of the issues and challenges of research on identity and learning. Papers 2 and 3 examine specific identity related questions within the context of science learning environments and use their findings to sharpen the focus on conceptual and methodological identity research dilemmas. Finally paper 4 crystallizes particular methodological concerns related to identity research evident in each of the previous three papers. Presenters will streamline the presentation of their individual studies in order to focus on critical conceptual and methodological issues in conducting research on identity and science learning and its implications for *what* we can learn about identity and for science learning. The discussant will have 10 minutes to speak to the key themes that cut across the papers and to raise questions for discussion. Audience question and answer with the presenters and discussant will occupy the final 20 minutes of the session.

Session Presentations

Page length descriptions of the five papers included in this symposium are provided below.

Paper 1: Science learning as identity-transformation: Attending to theoretical and methodological challenges

I present three inter-related challenges to studying science learning as identity-transformation: (1) the definitional problem; (2) the situated vs. enduring identity problem; and (3) the structure vs. agency problem. These challenges demand ongoing attention in my own work and, more importantly, I see them as persistent challenges for sociocultural research as a field. Using examples from my current work studying connections between science pedagogy and 9-10 year-olds' science identity development (NSF, REC #0546078), I propose ways to address these challenges.

The definitional problem

Operationalizing “science identity” is an obvious challenge because it is not reducible to a set of core defining characteristics. The model of science identity I developed with a colleague (Carlone & Johnson, 2007) provides a way to recognize multiple dimensions (competence, performance, recognition of self/by others) of “being a science person” in local science learning contexts. The model was based on a 6-year longitudinal study of the ways successful women of color in science persisted in undergraduate science majors and science-related

careers. In creating this grounded model, we documented the importance of “recognition by meaningful others” in these women’s ongoing science identity development. Further, the model was flexible enough to account for *multiple* science identity trajectories. The shortcoming of this work, however, was our inattention to the “performance” dimension of science identity. Because our study drew on interview data only, we had little evidence of their performances of science selves (the ways they took up, resisted, and/or transformed normative uses of physical tools, representational technologies, and talk) and the ways, in moment-to-moment interactions, those performances were recognized (or not) as legitimate.

The situational vs. enduring identity problem; The definitional problem, continued

A central argument in my work is that science education’s measure of “effective” pedagogy is too narrowly construed. Instead of measuring pedagogical effectiveness by what students know and can do in the short term, a focus on learning as identity transformation forces attention to whether and how students see science, *in the long term*, as a useful way to understand the world and view themselves as learners and doers of science. While I recognize that identities get formed in practice, I also acknowledge that, over time, people’s performance, participation patterns, and expectations become patterned and habitual (Elmesky & Seiler, 2007; Roth, 2006).

Currently, my research team and I study 4th-grade students’ science identity development in four standards-based science classrooms. We apply multiple units of analysis to understand students’ science identity in practice and over time. First, we use ethnographic methods to identify the taken-for-granted scientific practices and social norms that come to define what counts as a legitimate science person in the setting. This analysis loosely based on work by Cobb, Gresalfi, & Hodge (in press), yields information about promoted science identities.

Next, we turn the analytic lens on individuals, examining the ways they perform their science selves (the ways they take up, resist, and/or transform normative scientific practices and identities). Here, the main dimensions of analysis are uses of physical tools, representational technologies, and talk, as each of these represent important disciplinary and identity resources. We are developing a mapping technique based loosely on Gresalfi’s (under review) study of students’ trajectories of participation in mathematics classrooms. This allows us to track individual students’ performances in these dimensions, over space and time, and in comparison with the normative scientific practices, so that we can characterize their identities in practice and over time.

We also consider students’ perceptions of themselves as learners and doers of science. A critical aspect of science identity is not only *performance of self* that is *recognizable to meaningful others*, but also a *recognition of self* as science person. A survey and interviews enable us to evaluate students’ scientific dispositions (Cobb, et al., in press; Cobb, Hodge, Visnovska, & Zhao, 2004), perceptions of possible selves in science (Holland, et al., 1998), feelings of belonging in school science, outside-of-school science-related activities (diSessa, 2001) and understandings and valuations of their class’s normative scientific practices (Cobb, et al., in press).

The Structure/Agency Problem

Those who attend to social and cultural processes of learning face the ongoing tension of competing foci of structure and agency. Recent critiques of sociocultural theory have focused on the lack of attention to macro-level (institutional, political, economic) contexts that shape learning and identities (Lewis & Moje, 2004; Nasir & Hand, 2006). And, while the construct of identity has been touted as a way to attend to both the individual and her/his social context (Wenger, 1998), much of the sociocultural literature tends to focus on how individuals shape and get shaped by the relatively local social contexts (O’Connor, 2001). On the other hand, straying too far towards the macro-level treats individuals as if they are simply passive recipients of oppressive structures. Brandt & Clinton (2002) put the dilemma thus: “[W]e are stuck either working at the interactive level where people seem to be calling their own shots or else gesturing to hegemonic forces... that impose themselves in some undefined way on human actors” (p. 346).

Lewis & Moje (2004), in their call for sociocultural theories to take up more critical perspectives, mention cultural studies, poststructural theory, and discourse analysis as potentially robust theoretical orientations to account for systems of power that shape and are shaped by participants in local contexts. Nasir & Hand (2006) argue a similar point, calling for sociocultural theorists to more carefully consider multiple levels of culture, power, and social structure. Interestingly, neither piece of work mentions practice theory as a way to attend to tensions between the micro- and macro-level contexts. My study of students’ identities is undergirded by practice theory, which recognizes implicit, taken-for-granted practices at the micro level shape and are shaped by more macro contexts of science and schooling (Carlone, 2004, Eisenhart & Finkel, 1998). In the paper, I present the ways practice theory helps me characterize the mutuality of micro-/macro-contexts that is under-examined in many existing sociocultural studies of identity.

Paper 2: “We’re going to be doing actual science”: Teachers’ and students’ positioning moves in inquiry-oriented science classrooms

One of the motivations for current inquiry-oriented reforms is that engaging in scientific tasks has the potential to change students' ideas about science and how it is done, and thus to provide opportunities for students to develop identities as scientists. However, these opportunities are not automatically available anytime a teacher uses inquiry-oriented reforms. In order to develop science-related identities, students must recognize the tasks in which they are engaged as legitimately scientific and they need the opportunity to inhabit the scientific roles and norms associated with those tasks. The appropriation of these roles and norms enables identity change to happen (Gee, 2001). The extent to which inquiry activities actually provide these opportunities for science identity development is mediated by the classroom discourse surrounding inquiry curricula. Within this discourse, key social positioning moves may make the difference between activities being seen as scientific or not by students.

Social positioning takes place through discourse when someone is offered or afforded a particular sort of subject position, such as “at-risk student” or “scientist” which they are called upon to occupy and which they may either accept or attempt to modify or resist (Holland & Leander, 2004). Positioning moves in classroom lessons have significant learning consequences not only because of how they affect the moment-to-moment participation of students and teachers, but because positioning can have a cumulative effect on students' identities if many instances of being positioned in a certain way build upon one another and are accepted to some degree by students. (Wortham, 2004; Holland et al., 1998). Repeated opportunities to accept the position of “scientist” in classroom discourse may be a prerequisite for the kind of learning and motivational benefits many researchers believe will accrue to students if they develop positive identities within science.

This study examined differences in how teachers positioned students during inquiry science activities and in how students accepted and resisted those positions. Our focus was on whether classroom talk positioned students as “doing school” or as “doing science.” We used videotaped lessons from two classrooms in different schools with different teachers who were both using the same three-week inquiry unit in which students worked with data from a network of sensors in a local mountain range to construct arguments about how plants adapt to different microclimates. We developed a coding scheme to identify when and how teachers positioned students in relation to school roles, norms, or tasks, or in relation to science norms, roles, and tasks. We then examined how students accepted or resisted these offered positions. Drawing both on fine-grained analysis of science role positioning statements and overall differences in the frequency and timing of positioning moves across lessons, we developed a picture of the nature of positioning in each classroom: one teacher operated around the idea of students “pretending” to be scientists, while another tried to organize students for “doing actual science.” Students in both classrooms accepted and resisted these positions in interesting ways. We discuss the discursive patterns of each classroom in terms of the differences between each setting, including the teachers, students, and the communities the schools are in. From these analyses, we draw implications for the design of instruction that can support discursive environments that give students the opportunity to take the position of scientists, setting the stage for exploring new science-related identities.

Paper 3: “We be burnin’!” Student science identity development through digital counter-story telling

This paper reports on the counter narratives that middle school youth construct about their role and identities in science through the use of digital “counter-storytelling” (Delgado, 1995). We use the context of an intensive field-based summer program that focused on “green energy” issues for youth, ages 11-13, in a mid-sized Midwest city. Our research questions include: What salient identities do students draw upon in producing a series of science documentaries? How do these identities influence and shape the production of student documentaries including: (a) the documentary content-story line, and (b) the production, meaning, and role of science? How are students' identity development with science transformed through digital counter-storytelling?

Science education researchers (e.g. Brickhouse, Lowery & Schultz, 2000; Kozoll & Osborne, 2004) have begun to highlight the importance of identity formation in relation to how students engage in science. Some argue that identity formation is especially pertinent for minority students and girls who regularly participate in “cultural border crossing” in order to gain access to and succeed in school science (e.g. Aikenhead, 1996). Costa (1995) has categorized a range of student types, from “Potential scientists” who make easy transitions given the congruence of their life-worlds and science, to “Outsiders” for whom science and indigenous life-worlds are mutually exclusive. Students with varying degrees of success are labeled as “Other Smart Kids,” “I Don’t Know” students, and “Inside-Outsiders”. Not surprising, the majority of the students identified as “Potential Scientists” are white, male students.

Yet, identity is not as static or self-imposed a construct as Costa’s work might imply. Identities are constructed socially within communities of practice. As Lave and Wenger propose, upon entering a community-of-practice such as the science classroom, students develop identities through engaging with the practices and

tasks of the science class. Learning science becomes “a process of coming to be, of forging identities in activity” (Lave & Wenger, 1991, p. 3). These identities are fluid and dependent on environmental factors inherent to that community-of-practice.

The science learning community, as a community-of-practice, offers many different spaces, or figured worlds, where students can author identities. These spaces include whole class settings, small group work, and individual locations, among others. Drawing from Bakhtin, Vygotsky and Bourdieu, Holland and her colleagues (1998) posit a framework for the development of an identity-in-practice carved out in figured worlds. Figured worlds are socially situated, and are “peopled by the figures, characters, and types who carry out its tasks and who also have styles of interacting within, distinguishable perspectives on, and orientations towards it” (p.51). Individuals have the proclivity to be drawn into certain figured worlds to shape and be shaped by them in authoring an identity. The act of authoring an identity is necessitated via a constant state of dialogism where “sentient beings exist in a state of being ‘addressed’ and in the process of ‘answering’” (p. 169).

We want to highlight that integral to science learning are the discourses that youth draw upon in their everyday and academic lives. Discourses, in addition to talking, are ways of knowing, doing, interacting, valuing, thinking, believing, reading, writing and representing oneself that are social, produced and reproduced in social and cultural practices and interactions (Gee, 2001). Drawing on the interconnectedness of youths’ cultures and the discourses they draw upon to make sense of their worlds, discourses can also be understood as reflections of youths’ identities (Gee, 1999). If the discourses that youth, or in our case girls, draw upon in their lives can be understood as reflections of their identities, then their knowledges, behaviors, conventions, activities and beliefs are constantly shaping how and why science is done. A focus on youths’ identities, particularly on how and why they draw on particular discourses when interacting with science, is essential to understanding how youth engage in science because it allows for important connections to be made between the contexts of their lives and how and why they do science. Youths’ identities may change depending on the context within which they are doing science, depending on who they are with, where they are, and what is motivating them to engage in a certain practice at a particular moment.

Finally we call attention to how students are positioned in the learning classroom affects the process of identity development. Students are not only positioned as novices, they are also positioned as the “loud and dramatic girl”, the “field-trip girl” or the “generous girl” based on their identities in other worlds that are brought to bear in science class. These positions imbue students with relative power and status in the science classroom. Official student positioning by the science teacher assigning group roles such as “group leader” or “reporter” also accords students power which can transform learning experiences and affect identity formation in science class.

We bring this framework for identity and learning to bear on making sense of youth learning in an intensive, five-week summer program called Get City (Green Energy Technology City) conducted at a local community club that serves low-income minority children. Drawing upon ethnographic case study, data generation techniques included: daily participant observation and fieldnotes, videotaping of several lessons, individual and group interviews with a subset of ten youth, and artifact collection. We used constant comparative analysis (Glasser & Strauss, 1967; Strauss, 1987; Strauss & Corbin, 1990) in the tradition of grounded theory for data analysis, guided by our research questions.

The GET City program served 20 youth during the summer, all of whom were either African American or Latino. Technology was a focal point in this program where students use laptops extensively for gathering and analyzing data and communicating results to others. Lessons were adapted to promote and capitalize on student interest and funds of knowledge. The urban heat island phenomenon was explored during the five week unit, which culminated in a set of student directed mini science documentaries, each of which was intended to answer the question, Is [your city] an urban heat island? These mini documentaries featured the students investigating the urban heat island phenomenon in the downtown area of their city with temperature sensors, laser tape measuring devices, observations, and interviews they conducted with members of the community. The documentaries also incorporated other data generated during the five week unit (i.e., images, figures, and graphs produced from experiments conducted) as well as youth culture (i.e., music selections, discourse, etc.). The videos were subsequently previewed at the local state university and also used as part of a presentation in the community club’s efforts to successfully solicit funds from a local organization.

In their videos, the youth frame the heat island issue on their own terms, seek out and interview various community members and recruit nontraditional funds of knowledge linked to their identities in other figured worlds, such as hip hop music and dramatization infused with youth genre to produce an educational video on a somber scientific topic. By carefully analyzing *what* they say with respect to urban heat islands and *how* they say it (i.e., how they represent their ideas through talk, music, imagery, and storyline), their videos tacitly call into question such issues as to who can do science, what science looks like, and who are the authorities in science in their community as well as the nature of epistemic authority. Each one of these points is taken up in detail and discussed drawing upon analysis of the video production as well as supporting interview and observational notes. By viewing their video production on heat islands as a counter-story, we examine the intersections of

place and identity with what it means to be knowledgeable citizens on energy-related issues. We discuss implications that digital counter stories have for how we frame the relationship between socioscientific issues and scientifically literate citizens in urban communities.

Paper 4: Identities that Matter

In the situated cognition literature, learning is described as a process of coming to be a particular kind of person (Lave, 1988). Your affiliations with other communities happen as you develop ways of acting, talking, believing, valuing that make you a part of that community (Gee, 1999). I have found this to be a particularly powerful way of understanding learning perhaps in part because of my interest in understanding girls' relationships with scientific communities (Brickhouse, Lowery & Schultz, 2000; Brickhouse & Potter, 2001). Learning, in this articulation of it, is something quite significant in the life of a person. Learning changes who you are.

Moje (in Moje, Tucker-Raymond, Varelas & Pappas, in press) reports her observation that identity has become a ubiquitous construct in education research. Some researchers refer to changes in identity as taking place when students in classrooms learn practices that move them closer to authentic scientific practices. But is the acquisition of the practices of scientists the only way to take on a scientific identity? And how do we know that these changes effected in classrooms are changes in identities that matter? Perhaps these changes are just a "blip" in the life of a child and of no real consequence in the long run (see Lee, Brown, Brickhouse, Lottero-Perdue, Tobin & Roth, in press). Is it really possible to study identity in classrooms? After all, most of what happens in science classrooms is so scripted that the extent to which students adopt particular practices may be more a measure of compliance to school than of developing a relationship with scientific communities.

In this paper, I will argue that to make a claim that classroom instruction has made a significant impact on the identity of a child, our data collection and analyses must be multi-contextual and /or longitudinal. Identities that matter travel across time and space – and we should work toward making our research capable of capturing this. For girls, in particular, we should examine not only school settings where many are highly successful in appropriating school-based practices, but also in contexts where there is greater freedom of choice. These contexts of choice may be far more telling about identity than the heavily prescribed work that takes place in school. Furthermore, in freer choice environments, girls can perform identities that are often unavailable at school. On the other hand, some may also feel more pressure to conform to gender stereotypes when acting without a script. We need to know more about girls who choose to do science when it is not required and the ways in which our interventions in classrooms might influence the choices girls make.

Secondly, I will argue that there should be multiple ways of enacting scientific identities – but not so many that the construct of scientific identity loses meaning. Four types of scientific identities that can be discerned from the literature include:

- Student/scientist identity. This type of scientific identity can be detected by examining how closely students acquire the skills that we associate with scientific practice. This is perhaps the most commonly researched type of scientific identity, although it is not commonly found in practice. While this form of scientific identity is not the same as that of a conventionally good student, there is likely to be considerable overlap since much of what the student is doing is that which is deemed desirable by the teacher/curriculum developer.
- Community-based scientist/activist. This type of scientific identity is oriented toward the use of science to solve local problems. In many cases these are environmental problems. But the main characteristic of this identity is its orientation toward acquiring useful knowledge and taking action.
- Personal decision-maker. Like the community-based activist, this scientific identity is also oriented toward the uses of science. The difference is that rather than focusing on communal matters of significance, these individuals are more focused on personal decision making that influence themselves and close friends/family.
- Teacher/communicator. This type of scientific identity is focused on developing the competence to teach science to others.

These types will be discussed in conceptual and methodological terms. What does one look for in order to study them? What enduring patterns of participation might be important to document and analyze?

References

- Aikenhead, G. S. (1996). Science education: Border crossing into the subculture of science. *Studies in Science Education*, 27, 1-52.
- Brandt, D., & Clinton, K. (2002). Limits of the local: Expanding perspectives on literacy as a social practice. *Journal of Literacy Research*, 34, 337-356.
- Brickhouse, N. W., & Potter, J. T. (2001). Young women's scientific identity formation in an urban context. *Journal of Research in Science Teaching*, 38, 965-980.

- Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of a Girl Does Science? The Construction of School Science Identities. *Journal of Research in Science Teaching*, 37(5), 441-458.
- Brown, B. A., Reveles, J. M., & Kelly, G. J. (2005). Scientific literacy and discursive identity: A theoretical framework for understanding science learning. *Science Education*, 89, 779-802.
- Calabrese Barton, A. (1998). Teaching science with homeless children: pedagogy, representation, and identity. *Journal of Research in Science Teaching*, 35(4), 379-394.
- Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392-414.
- Carlone, H.B. & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, 44(8), 1187-1218.
- Cobb, P., Gresalfi, M., & Hodge, L.L. (in press). An interpretive scheme for analyzing the identities that students develop in mathematics classrooms. *Journal of Research in Mathematics Education*.
- Cobb, P., Hodge, L.L., Visnovska, J., & Zhao, Q. (April, 2004). *An initial contribution to the development of a design theory of mathematical interests: The case of statistical data analysis*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.
- Costa, V. (1995). When Science is 'another world': Relationship between worlds of Family, Friends, School and Science. *Science Education*, 79(3), 313-333.
- Delgado, R. (1995). *Critical race theory: The cutting edge*. Philadelphia, PA: Temple University Press.
- diSessa, A. (2001). *Changing minds: Computers, learning, and literacy*. Cambridge, MA: MIT Press.
- Eisenhart, M., & Finkel, E. (1998). *Women's science: Learning and succeeding from the margins*. Chicago, IL: University of Chicago Press.
- Elmesky, R., & Selier, G. (2007). Movement expressiveness, solidarity and the (re)shaping of African American students' scientific identities. *Cultural Studies of Science Education*, 2(1), 73-103.
- Gee, J. (1999). *An introduction to discourse analysis*. New York: Routledge.
- Gee, J. P. (2001). Identity as an analytic lens for research in education. *Review of Research in Education*, 25, 99-125.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory*. Chicago: Aldine Publishing Company.
- Gresalfi, M.S. (under review). [title blinded to protect anonymity of her work for this audience].
- Holland, D., & Leander, K. M. (2004). Ethnographic studies of positioning and subjectivity: An introduction. *Ethos*, 32, 127-139.
- Holland, D., Lachiotte, W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Cambridge, MA: Harvard University Press.
- Kozoll, R. H., & Osborne, M. D. (2004). Finding meaning in science: lifeworld, identity, and self. *Science Education*, 88, 157-181.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Lee, Yew-Jon, Brown, B., Brickhouse, N., Lottero-Perdue, P., Tobin, K. & Roth, W-M (in press). Metalogue on the discursive construction of identity. *Cultural Studies in Science Education*.
- Lewis, C., & Moje, E. B. (2004). Sociocultural perspectives meets critical theory: Producing knowledge through multiple frameworks. *The International Journal of Learning*, 10.
- Moje, E. B., Tucker-Raymond, E., Varelas, M. & Pappas, C. (in press). Forum: Giving oneself over to science: exploring the roles of subjectivities and identities in learning science. *Cultural Studies in Science Education*.
- Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (Spring 1992). Funds of Knowledge for Teaching: Using a Qualitative Approach to Connect Homes and Classrooms. *Theory Into Practice*, XXXI(2), 132-141.
- Nasir, N.S., & Hand, V.M. (2006). Exploring sociocultural perspectives on race, culture, and learning. *Review of Educational Research*, 76(4), 449-475.
- O'Connor, K. (2001). Contextualization and the negotiation of social identities in a geographically distributed situated learning project. *Linguistics and education*, 12, 285-308.
- Roth, W.-M. (2006). Making and remaking of self in urban schooling: Identity as dialectic. In J. L. Kinceloe & K. Hayes & K. Rose & P. M. Anderson (Eds.), *The Praeger handbook of urban education* (pp. 143-153). Westport, CT: Greenwood.
- Strauss, A. (1987). *Qualitative analysis for social scientists*. Cambridge, England: Cambridge University Press.
- Strauss, A., & Corbin, J. (1990). *Basis of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.
- Wortham, S. (2004). From Good Student to Outcast: The Emergence of a Classroom Identity. *Ethos*, 32(2), 164-187.