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Science identity in science education: Possibilities and complexities

A Success

For decades, psychological perspectives dominated science education research. Though fruitful, they formed an incomplete picture of the science learner. For example, science education research often disregarded students' raced, sexed, and classed history and prior affective and bodily experiences in and out of school as shapers of students' science interest, achievement, and learning. Recent work in science education has begun to acknowledge the ways these histories, bodily experiences, and contexts shape students' orientations toward the subject matter. At the same time, we have also recognized that these things do not determine students' science interest and learning; students actively take up and reject scientific practices. In other words, recent work in science education has begun to acknowledge students' agency in the science learning process. Science educators are beginning to pay attention to structure and agency in the consideration of students' interest, achievement, and learning. I see this as a success because we now have a more robust understanding of the multi-dimensional aspects of science learning.

Seeing the science learner in these new ways should force us to ask new questions about effectiveness of innovations in science education. Historically, we have evaluated "effectiveness" based on cognitive and skill-based outcomes. So, for example, the primary justification for inquiry-based instruction is that it better promotes students' knowledge and understanding of scientific ideas and abilities to understand and conduct scientific inquiry. But, does it promote students who want to understand the world scientifically once they step outside of the science class? Students who increasingly recognize themselves as science people as they gain greater access to scientific practices?

These questions concern the kinds of science people science education produces—they relate to students' science identities. Since 1998, 31 articles addressing "identity" have appeared in two of science education's top journals (*Journal of Research in Science Teaching* and *Science Education*); roughly half of these (15) have been published in the past two years. I see the identity studies work as a budding success because it has the potential to push our definitions of "effective" science education.

There are three main arguments for emphasizing identity in science education research. First, there is a *quest for a more equitable science education*. Traditional school science's narrowly defined tasks emphasizing science as a finished body of knowledge promote narrow science identities unappealing to a broad range of students (Barton, 1998; Gilbert & Yerrick, 2001). Scholars interested in understanding girls' and women's participation in science pay close attention to the kinds of people we ask students to become as they participate in science and the ways they embrace and/or resist promoted science identities (Brickhouse & Potter, 2001; Carlone, 2003, 2004; Eisenhart & Finkel, 1998; Hughes, 2001).

Second, a focus on identity opens up a *new way of viewing teaching and the learning environment*. The "identity" lens allows us to ask questions about the kinds of people celebrated and marginalized by science and the ways students come to see science as a set of experiences, skills, and knowledge worthy or unworthy of their engagement (Cobb, 2004). Boaler's work evidences the promise of examining teaching/subject matter identity connections (2002; Boaler & Greeno, 2000). She found that students in reform-based classrooms used math flexibly, empowering them as "doers" of mathematics. Students in traditional classrooms rejected math because its practices clashed with their aspiring identities.

A third, related argument involves *new ways of viewing the process of learning*—as socialization of students into the norms and discourse practices of science (Brown, 2004; Kelly, 2004; Varelas, House, & Wenzel, 2005; Warren, Rosebery, & Conant, 1994). If we view classrooms as communities of practice (Lave & Wenger, 1991) into which students must be enculturated, we must understand how students affiliate with or become alienated from these communities.

The work cited above has transformed our notions of what it means to "learn" science. But, I argue that we need a more concrete definition of "science identity" to increase the concept's practical value. This brings me to my vexation.

My Vexation

I have spent the last few years toiling over a workable model of "science identity." My interest in this concept came about as I taught elementary science methods students, many of whom claimed that they were not "science people" upon entering my class. I wondered, "What does it mean to be a *science person*, anyway?" And then, "How can I foster students' science identities in my classes? How can they foster *their* students' science identities?" And finally, "How will I know this 'science identity' when I see it?" These questions continue to vex me and motivate my work. I am excited about the prospect of sharing my current thinking about these issues using my most recent model of "science identity" as a starting point for discussion. I turn to a discussion of my model.

Someone with a science identity demonstrates competence in and successful (recognized) performance of relevant scientific practices. Further, she/he demonstrates deep and meaningful knowledge and understanding of science, a motivation to understand the world scientifically, and recognizes her/himself and gets recognized by others as a "science person." The three relevant dimensions of science identity are: *competence*, *performance*, and *recognition* (Figure 1), rooted in Gee's theory of identity (1999, 2000-2001). He defines identity as "the 'kind of person' one is seeking to be and enact in the here and now" (1999, p. 13). But, one cannot claim an identity all by oneself—being "somebody" requires the participation of others (Gee, 1999). To be a particular kind of person (to enact a particular identity) requires that we talk, think, use tools, and interact in ways that render who we are and what we are doing recognizable to others. We cannot pull off a particular identity unless we make visible to (perform for) others our competence in relevant social practices, and, in response, others have to recognize our performance as relevant.

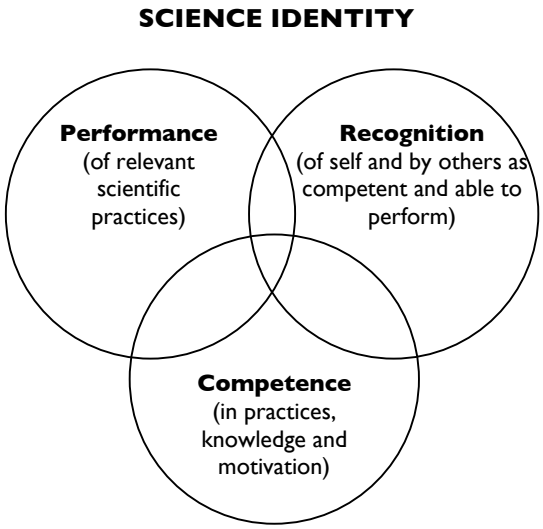

Figure 1. Dimensions of science identity, based on Gee's (1999, 2000-2001 theory of identity

The very thing that excites me about this model is what also vexes me. The model's multi-dimensional nature creates methodological complexities. How does one go about collecting data about each dimension? What kinds of analysis procedures might work well? How does one characterize a science learner's science identity if "identity" is not a fixed characteristic? Creating a complete picture of a student's science identity, using this model, requires that the researcher understand ethnography (to get at local definitions of science and scientist), case study (to follow students' science identity development in different contexts; identity is not a fixed characteristic), longitudinal design (to understand how or if students' science identity development changes over time), and discourse analysis (to understand better the "performance" and "recognition" categories of the model). The researcher will also need to create strong instrumentation to measure students' conceptual understanding of the subject matter and motivation to participate in science (i.e., to get at the "competence" dimension). Creating this new, holistic picture of the science learner is incredibly complex. Is it too much to ask of one researcher?