Chapter 3
Identity-Based Research in Science Education

Yew-Jin Lee

Introduction

As one of the fastest growing areas in the social sciences, identity-based research has likewise begun to make its presence felt in science education. Because of its philosophical richness, the concept of identity, as well as closely related notions of subjectivity, self, and selfhood has generated a diverse and typically puzzling array of studies for the newcomer. Identity-based research is nonetheless exciting for it is associated with agent-centered development, a sense of belonging and affiliation, and engagement in learning, which are all right in the middle of what we hold dear in education. Identity is, as Anna Sfard and Anna Prusak (2005), p. 15) put it, the "perfect candidate for the role of 'the missing link' in the … complex dialectic between learning and its sociocultural context." This chapter does not seek closure but, instead, attempts to provide a rough guide of the terrain by examining some of the theoretical roots of identity and how it has energized science educators in recent years. Specifically, through the lens of identity, we better appreciate learning from a sociocultural perspective and the contingent processes of making different kinds of people and places.

An accessible vantage point for unraveling identity is to consider how it has been handled in psychology and sociology. Risking oversimplification, the former has generally emphasized internal or essentialist aspects of identity as characteristics of individuals, whereas the latter has understood it to be a collective property of people engaged in social interaction (Côté 2006). Based on these dichotomies, there emerge various epistemological and methodological conundrums, including to what extent identity is reflexively constituted by agents or their social groups and in what manner (e.g., biology, talk, rules, schema), whether the linguistic/postmodern turn holds any implications for determining identity (e.g., changeable, multiple, or indexical selves), and the salience of our

Y.-J. Lee (✉)
National Institute of Education, Singapore
e-mail: yewjin.lee@nie.edu.sg

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abstract theoretical models of identity vis-à-vis lived experience across time and space (Hammersley and Treseder 2007). Indeed, when temporality is factored in, it adds yet another layer of complexity as different aspects of identity formation seem to run at different speeds while other aspects remain invariant (Lemke 2000).

Some authors have understandably grown disdainful of identity-based research because of the sheer multiplicity of meanings and cognate terms, which allegedly has resulted in fuzzy thinking. The term "identity" is absent from the indices of the first *Handbook* in this series published over 10 years ago, as well as those by Sandra Abell and Norman Lederman (2007) and Dorothy Gabel (2004). Most educators, however, are comfortable with taking identity as being a subjective sense or definition of oneself, and the corresponding recognition of being a particular kind of person, an intersubjective component. Again, the degree to which one's identity changes with respect to the social situation and how much an individual is defined by the latter depends on one's starting assumptions about the mutual constitution of agency and structure.

Without trivializing these problems, it might be fruitful to heed Gilles Deleuze's adage and question about what identity can "do" rather than attempting to define what it "is." Besides proposing a popular composite model of identity that mixes four essentialist and nonessentialist dimensions, Gee (2000–2001) explains that using identity as an analytic lens can help shed light on critical issues of fairness and access in education. Scholars concerned with gender disparities and inequalities in science have thus not been slow to pick up on the theme of identity (Brotman and Moore 2008). Building upon James Gee's (2000–2001) fundamentally sociocultural model, anyone possessing a *science identity* would signal (1) competence, (2) performance, and (3) recognition (Carlone and Johnson 2007). Allied to this and a recurring motif in this chapter, it is evident that if teachers can support student science discourse (i.e., talk and behavior) use in classrooms, this assists in developing their *academic identities* in science and mastery of scientific literacy (Reveles and Brown 2008). This presupposes teachers identifying themselves as science teachers who are competent and like science in the first instance (Helms 1998; Luehmann 2007). Insofar as identity issues are implicated during personal meaning-making, success, and emotional energy in science learning (Olitsky 2007), having any identity that is valued or powerful in official school contexts is contingently shaped by other meta-factors such as race, class, and gender. Schools do provide a significant sense of place and resources for (science) identity development among students, although this transformation need not necessarily be affirming or positive over the short or long term. Other activities and locations are similarly pivotal sites for identity formation among youth, which science educators can co-opt for planning better learning experiences and engagement with science (Eisenhart and Edwards 2004; Rahm and Ash 2008).

Theoretical Frameworks in Identity Research

Because ontologies of difference are normative when thinking about science education in the twenty-first century, we ought to expect nothing less when undertaking identity-based research (Roth 2008). Compared to earlier times when identity-based research

in science education was closely aligned with investigating student motivation, learning, and achievement from more psychological perspectives (Roeser et al. 2006), the focus has gradually shifted toward adopting sociocultural modes of inquiry because of an increasing acceptance of interpretative paradigms. What perhaps unites sociocultural viewpoints that are myriad within themselves is the denial of "mind" as the pure cogito: ability is better considered as a skillful coordination of people and objects in specific social settings – "knowing" is a performance. Being knowledgeable (or not) is thus equivalent to assuming an identity that is recognized by other members of a community. A review of salient literature from the last decade has shown that the three theoretical frameworks below have been among the most favorably received among science educators.

Figured Worlds and Practice Theories

A remarkable piece of anthropological scholarship, *Identity and Agency in Cultural Worlds* by Dorothy Holland, William Lachicotte, Debra Skinner, and Carole Cain (1998), continues and will continue to exert a powerful influence on identity-based research in science education. The book, almost single-handedly, has developed a model of identity development – *identity-in-practice* – that accounts for both free will and structural constraints at the intersection of shifting social contexts and individual circumstances. Besides stressing how identities are situated achievements, it directs one's attention to how identity is also a verb, something that requires action/work from self and others. A lynchpin in this argument lies in what is called *figured worlds* – "*historical* subjectivities, consciousness and agency, persons (and collective agents) forming in practice" (Holland et al., pp. 41–42). As imagined or "as if" locales that have recognizable social architectures (e.g., teenage romances), figured worlds motivate people to action, existing in a dynamic interplay with identities and human agency. They are populated with their typical agents (e.g., the science geek), appropriate ways of behavior and attached values, which then become heuristics for developing into certain kinds of people. Figured worlds permit or at least inspire a modicum of agency and control in situations that at first sight deny all such privileges. One quickly acknowledges their utility for science educators as tools for redesigning culturally sensitive learning environments with which students desire connecting and that they deem to be integral for their lifeworlds (Kozoll and Osborne 2004). If figured worlds are a generative unit of analysis, how large or encompassing should they be? It would seem that a science classroom can be decomposed into smaller figured worlds, such as individual work, group activities, and whole-class instruction (Tan and Barton 2008). It is not denied that figured worlds seem to be a convenient metaphor or that they overlap with culture (Brickhouse et al. 2006) and communities of practice (Barton et al. 2008), although these questions await final answers. At present, figured worlds have been used extensively by (science) educators who embrace the critical tradition, especially those who work in urban areas (Urrieta 2007).

The social theorists to whom *Identity and Agency* frequently refers range from Pierre Bourdieu and Mikhail Bakhtin to Lev Vygotsky and, above all, George

Herbert Mead. The authors take a middle stance between what they call culturalist (i.e., more structural, anthropological) and social constructivist, for which identity is solely constituted in interaction, in the *positionings* (see Holland et al. 1998, pp. 271–272) involving power, privilege, and rank. Identity is thus viewed as multiple and fluid though not entirely free and unbounded. Identity change both occurs in and is a by-product of the dialectic of past histories (and material circumstances) and the present semiotic signs that people improvise or resist. Sometimes these temporal and contextual *spaces of authoring* are said to occur within a lifetime and might become the next generation's new habitus or cultural artifacts. At this point, identity-in-practice appears to overlap with *practice theories*, which likewise emphasize the dialectic of structure and agency – that tango of interpellation which supports social others/culture/institutions at the same time as its remakes and the parallel manufacture of subjectivities. One can certainly orient toward and pursue certain goals though the outcomes are never guaranteed (Levinson and Holland 1996). For instance, in the process of creating a culture of academic success in an urban Magnet school, both individuals and institutions changed, alienating some players though ultimately achieving a niche for success in science and mathematics (Buxton 2005). Likewise, teachers who are caught up in reform movements face complex positioning and shifting subjectivities as they attempt to fulfill their objectives (Enyedy et al. 2006). Metaphors used here to (partially) capture how the social and personal are integrated have included habitus, history-in-person (Holland and Lave 2001), and lamination (Holland and Leander 2004). Key issues that are now being addressed are whether there are focal or anchoring practices that spawn other practices and social rules, and a call for more fine-grained empirical analyses of the actual mechanisms of practices (Swidler 2001).

Discursive Stances

Language, as preeminent social practice, is inseparable from identity. We use talk to do things and bring all manner of objects, including ourselves and others, into being. At other times, it seems as though the reverse is equally true. Physical objects and phenomena, mental states and identities are spoken into existence by prevailing discourses, which underscores that facet of subjectivity in identity as one being fitted into a mold or social position (Bucholtz and Hall 2005). This dual role of language with respect to identity is what Gee (2005) refers to as the mutuality of "D" and "d" discourses, which finds no conflict with structure/agency frameworks. Defined by immense heterogeneity rather than commonality in theory and methods, identity-based research that relies on discursive stances draws upon a long, albeit kaleidoscopic, record of use in the social sciences.

Whether talk is better regarded as a *resource* or carrier of knowledge and identity labels, as opposed to it being the *topic* of scrutiny itself, it is a useful analytic distinction. Researchers interested in knowing *what* was articulated and the meanings associated with these identity classifications would analyze narratives as a resource, as content to

be mined at various levels of organization, such as clusters of science sense-making by students in Bryan Brown (2006) or stories of kids negotiating discrimination, poverty, and science in Angela Calabrese Barton (2003). Those who make thematic discourse as a topic accordingly follow an opposite track by examining *how* people present themselves and make sense of each other and of the rhetorical devices that they (un)consciously use to accomplish these tasks (e.g., constructing expertise during science discussions in Alandeom Oliveira et al. (2007) or signaling science discourse identities in Brown et al. (2006). Thankfully there is no necessity for taking sides because each approach has been very productive. It ultimately depends on the preferences for top-down or bottom-up contextual influences. In the real world of research, there is often an amalgam of these stances mentioned above, such as when grounded theory is used in conjunction with established sociological themes to trace a science teacher candidate's identity changes (Rivera Maulucci 2008) or when elements of narrative theory and discursive psychology explain the life-history accounting of a scientist (Lee and Roth 2004). One fascinating study of nerd girls used communities of practice derived from practice theories and sociolinguistics to show how "nerdiness" was a contested domain and that this identity depended upon linguistic and social factors (Bucholtz 1999). Compared with the other two theoretical frameworks in this section, discursive stances (e.g., those using conversation analysis) enjoy the advantage of being the most empirically founded (i.e.. open to verification by readers as well as being potentially closer to participants' concerns).

Activity Theory

Cultural-historical activity theory, or activity theory, furnishes a substantial set of principles for analyzing social action in everyday life (Roth and Lee 2007). Subjects (those whose perspective are taken) are always understood as motivated toward some Object (that which is to be acted upon). When Objects are absent, there is no societally relevant activity or motive of which to speak. Identity, rather than being an innate property of individuals, is thus an outcome of dialectically engaging in practical activity (Roth 2007a), which has much affinity with practice as *the* unifying methodological element (Cole 1996) and, by extension, identity-in-practice (Wenger 1998). Further, identity development is above all purposeful, a meaningful life project – though not always in favorable settings – that simultaneously is determined by and contributes to social life. Even though leading educators have endorsed activity theory as a means of understanding learning holistically (Kelly 2008), it remains a recent and daunting framework of choice for identity-based researchers in science education. For instance, Wolff-Michael Roth et al. (2004) explained how identities changed as people crossed from one activity system to another, while Roth (2007b) argued that efforts to inculcate scientific literacy and identities without taking into account the emotional-volitional and ethico-moral aspects were doomed. Outside science education, Kevin Leander (2002) showed how classroom artifacts as significant mediators of action served to stabilize one girl's identity as

"ghetto." It is also surprising to note how welfare shelters could still afford positive sites for identity formation among homeless youth (Penuel and Davey 1999). Cognizant that some of these studies were performed in challenging urban environments, activity theory offers hope for the future. Being historically created institutions, these too are amendable to the transformative effects of human agency.

Identity-Based Studies in Science Education

In what follows, summaries of three recent identity-based studies give a sampling of the kinds of theories used to uncover identity and some substantive areas of concern among science educators.

Global Identities Among Immigrant Students

Katherine Bruna and Roberta Vann (2007) used critical discourse analysis and a "practice of science" (Barton 2003) perspective to ask how ready science teachers in the USA were to build spaces of hope for all learners. From their ethnographic results, they feared that educators were largely unprepared to draw on their students' funds of knowledge and were also restricted in granting students' control over their learning. Borderland identities in science were not celebrated (Brickhouse and Potter 2001). Seen through a critical episode – a classroom dissection of a fetal pig – this seemingly mundane science experiment took on greater significance as the students came from Mexican immigrant families in the town whose economic wealth depended on the alienating forms of labor supplied by these same meat-packing workers. As much as Linda (the science teacher in the study) showed genuine care, she could not escape positioning her English Language science students as future unskilled laborers for that was the socioeconomic structure (and identities) with which she was most familiar. The science lesson thus became metonymic of global capitalism and privilege, whose uneven effects were filtering down to classrooms and the kinds of people that the students were now, and could be later. In common with the increasingly loud calls for social justice, access, equity, and quality in science education, issues of identity formation among youth were central here and were used as weapons of critique, exposing the underbelly of educational systems (Brown 2004; Tobin et al. 2005).

Positional Identity and Science Teacher Professional Development

Positional identity or positionality (Holland et al. 1998) is the sense of one's relative place in the world shot through with power, privilege, access, and constraints that have historically stemmed from various social markers such as race,

gender, ethnicity, age, and economic status. While it is acknowledged that these cultural worlds influence how a person views the world and is defined by others, we do not fully comprehend how they shape teachers in terms of their everyday classroom decision-making, their sense-making of life experiences, and their professional learning and career goals, which is the subject of a study by Felicia Moore (2008). Drawing on a sample of three African-American secondary science teachers in a rural district, Moore (2008, p. 685) examined how positional identity could open our minds to understand "teachers on a personal level, their classroom practices on a practical level, and their professional development on a professional level." Aligned with critical feminist thought, there was no single positionality expressed by these teachers, even though they came from rather similar social backgrounds and ethnicity. Cultural-historical worlds collide, overlap, and intercept in diverse, random ways. In terms of teacher professional development implications, accounting for positional identity, with its focus on sense-making across one's past experiences, nurtures sensitive and personal ways of teaching and relating to students, especially those who are marginalized (Proweller and Mitchener 2004).

Differential Identities from a Common Curriculum

Researching the experienced curriculum involves asking what it is like to learn in *this* environment and it foregrounds the feelings of teachers and students in their learning journey. With regard to gender differences in science learning (Brickhouse et al. 2000), these questions of meaning have been examined using concepts from cultural anthropology by Heidi Carlone (2004). Part of an ethnographic study of a reform-based physics curriculum, the author takes pains to show that just as some embraced the new pedagogies, some female students contested the associated science identities that it promoted. Replacing the identity of "listener, memorizer, and recipient of knowledge" (p. 404) with that of problem-solver, hard-worker, and generator of knowledge was simply too great a loss of identity (c.f. Black honors students acting White in Andrew Gilbert and Randy Yerrick (2001)). This resistance is unusual as the students were largely White, upper-middle-class teenagers whom we would expect to subscribe to student-centered teaching. But we are told that there was a culture of achievement in their community that narrowly defined success in terms of academic performance. This ideology, of course, conflicted with the inquiry goals of the physics curriculum, which eschewed didactic teaching and instead encouraged open-ended experiments by student groups. In the end, the report card for this curriculum here was mixed: some girls did not contest the circulating cultural myths in which science was seen as difficult or that scientists were superintelligent males. Yet, other girls responded to the new ways of learning and crafted new science identities for themselves. The power of this micro–macro approach in practice theory is that it offers reasons for the differential choosing or refutation of identities and learning trajectories by agents. For the science educator, it demonstrates

how both reform and implementation processes are fraught with unintended responses, which truly "complicates our quest for gender-fair science" (Carlone 2004, p. 392).

Conclusions

For decision-makers in education, identity-based research of the kind articulated here presents frustratingly little in terms of "hard data" from longitudinal or large-scale studies to guide change. The uncertainties surrounding the theories of identity are legion and present further obstacles for policy and concrete translation into curriculum or programs (Brotman and Moore 2008). We are still unsure if it is necessary to change identities in order to learn science, the affordances that science practices allow for person-making, and the real, material consequences of identity as a construct (see Moje et al. 2007). So what does the crystal ball augur for identity-based research in science education? A decade ago, Barton sensitized educators to the situated nature of *all* pedagogy, how it was located within historical and sociopolitical currents that made "representation in science (what science is made to be) and identity in science (who we think we must be to engage in that science)…central" (Barton 1998, p. 380). This observation is still pertinent and it is clear that identity-based research is suited for interrogating these problems for it refuses to dichotomize the making of people from their learning and milieu. The concept of identity places tremendous power in the hands of science educators for it encapsulates within itself literally life-changing educational means and ends. Identity as being inveighs against deficit philosophies of learning that devalue differences, whereas identity as becoming invigorates our struggle for a better world that is not unattainable. Starting from our current troubled (and troubling) spaces called classrooms, where we literally coerce youth to occupy, identity-based research can help us to transform them into places that youth want to inhabit for the long term and in which they invest their talents in science.

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