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Science teacher identities in the making

Rory Glass[1]

Abstract
This commentary explores some of the salient aspects of Lucy Avraamidou's study, specifically those of identity and the origins of those characteristics. I begin by considering the literature on identity and highlight some theoretical considerations, with an understanding that identity is fluid and an aspect of oneself in the making. Of particular importance will be contrasting ideas about science identity and science-teacher identity. By considering these two concepts separately I will explore their similarities and differences to offer a fuller view of the core assumption within Avraamidou's study. I ask whether it is reasonable to consider "science identity" and "science teacher identity" simultaneously, given the context-dependent nature of each. Next, I will look at the information we are given about the subjects of Avraamidou's study and suggest the advantages of seeing them in a slightly different view. And finally, I consider the recommendations from her study and suggest some alternative perspectives that may serve researchers and teacher preparation programs equally well equally well.

Keywords Teacher identity · Science identity · Life history · Early career elementary teachers

Lucy Avraamidou's multiple case study on early career science teacher identities, "Stories we live, identities we build: How are elementary teachers' science identities shaped by their lived experiences?", provides an interesting perspective on the lives of four young female teachers. Avraamidou utilizes a teacher-identity framework which allows the researcher to offer a rich narrative and draw upon teachers' own recollections of important events from their lives. This narration brings with it context which allows the readers an opportunity to not only hear the comments but also to get a sense of why these events are important.

✉ Rory Glass
rglass@albany.edu

[1] Department of Educational Theory and Practice, State University of New York at Albany, 1400 Washington Avenue, Albany, NY 12222, USA

Avraamidou does an excellent job of isolating moments from her participants' lives, to tell the story of resilience and fortitude which was key to these young women finding careers in teaching; more specifically in teaching science.

This qualitative multiple case study takes a life-history approach while considering a "figured worlds" model of identity development. As such, the figured worlds provides multiple/different perspectives to be isolated and analyzed for significant contributions. The narrative provided by Avraamidou offers her opportunities to speak directly about these teachers across cases strengthening the arguments being forwarded by the researcher. The six figured worlds that became relevant to this study (childhood/family, school, out-of-school, university, professional experiences and science as a field of study) were also interesting, in that they spanned everything from early childhood science schooling to university level study, and from childhood experiences on a family farm to professional science careers. In this regard, the study provides a breadth of information not present in earlier studies; making a significant contribution to existing literature.

Identity as fluid and in-the-making

A great deal of the literature on teacher identity has concluded that "identity" is not stagnant; it is evolutionary (Beijaard, Meijer and Verloop 2004). As perhaps the strongest supporters of this point of view, Michael Connelly and D. Jean Clandinin (1989) concluded that identity is an embodiment of stories shaped by the past and present landscapes in which they are enacted. This is consistent with Kathy Carter and Walter Doyle's (1996) perspective that teacher's identity is necessarily linked to their life stories. Going even further, Anna Sfard and Anna Prusak (2005) state that identity is essentially the construction of stories. First, the stories one tells about oneself, then further influenced by the stories told about individuals by others.

Throughout these perspectives we see the connection between the assumed identity of the self and the stories, or accounts of one's past, that the self has experienced. As Judyth Sachs (2005) noted, teacher identity is not fixed; it is negotiated by making sense of past experiences. Identity is therefore a product of this sense making, and the meanings that can be ascribed to the self as a result. In their work on personal self and professional identity, Carol Rodgers and Kathleen Scott (2008) concluded that identity was shifting, unstable and multiple. This was one of four basic components identified in their research. The other three included its context-dependent nature, that it is formed within relationship and therefore involves emotions, and that it is constructed and reconstructed over time.

We can see evidence of the dynamic nature of identity among the participant stories provided by Avraamidou. Three of the four participants in her study recall moments when they began to dislike science; especially when the teachers (typically older men) made the subject less engaging. In each of these cases these young women were able to regain their enthusiasm for science through teachers who they found to be caring and engaging. Engagement took the form of active, inquiry-based teaching approaches and experimentation. Throughout these stories the fluidity of the participants identity in relation to science is evident. More importantly we can see how these identities are influenced by the

relationships and underlying emotions associated with their teachers. All of these elements support the findings of Rodgers and Scott, and point to the dynamic nature of identity.

Science identity

The notion of "science identity" is framed by the idea that it is a representation of how one perceives themselves and their relationship to science. Further as Heidi Carlone and Angela Johnson (2007) note, it includes both the sense of self and recognition by others. In this context, "others" included teachers, family, friends, and society at large. This self-perception has been used a lens for examining ethnic, social and gender disparities within science fields, and to consider the influence of these on career choice. Of particular importance to Carlone and Johnson was recognition by others, and they noted that women in their study found recognition particularly problematic. In essence, the composition of science at large, mostly white and male, complicated their attempts to be recognized as a member of the science community. For the women of color studied, having had positive science experiences, family support and teacher encouragement were among the important factors that aided in the development of strong science identities. All of the participants in Avraamidou's study, from Maria's experiences on a family farm to Lisa's methods instructor, were offered support in forming positive science identities.

Similar to other areas of identity development, there is an association between creating our identity and having one created for us. In terms of developing a science identity, it can be seen through success in science (school/academic), encouragement by others (family/teachers), and identifying ourselves, or attributes of ourselves, with respected and influential role models from our experiences. These are all addressed by Avraamidou's figured worlds perspective. Among Avraamidou's participants, the importance of role models and experience is evident. We see this most clearly in Jennifer's recollection of visiting her aunt who was a scientist and closely observing the butterflies she was working with. Avraamidou notes that gender was not explicitly referenced but that there was some evidence.

Increased engagement in a field increases the likelihood that we will see ourselves, or future selves, among those we encounter. Still, enduring and negotiating recognition within the science field is challenging. As Angela Calabrese Barton (1998) noted, the idea of "science for all" as promoted by reform efforts of the 1990's has proven extremely difficult to actualize because concepts of self and science are influenced by complex power relationships rooted in the science and educational communities as well as those of society. As discussed above, science identities are heavily dependent upon the recognition of others. These important others represent either the school or science community, and in situations where one is an outsider (socially, culturally, racially or even from the perspective of gender) this recognition may come from family. Important here is that science identity can be facilitated in isolation and recognition may come in the form of a single teacher or scientist.

Science teacher identity

In her review of the current literature, Avraamidou points to the idea that identity is an important aspect that reaches beyond isolated cognitive enterprises such as knowledge and skills. It allows for inclusion of the myriad affective elements of teaching which may be

even more significant for making connections to students. James Gee (2001) suggested that professional identity included four dimensions; affinity for the tasks of the profession, roles assumed as part of the institution one is associated with, discourses shared with others within the profession and natural elements including personality. When considering the formation of teacher identity, Catherine Beauchamps and Lynn Thomas (2009) noted it is the early years of practice where the effects of contexts are strongly felt. Important elements for them included the nature of the educational institutions, teacher colleagues, school administrators, students and the wider school community.

Embedded within these views is the acknowledgement that the identity of teachers is importantly dependent upon the communities within which those identities are formed and enacted. What Rodgers and Scott (2008) considered the social, cultural, political, and historical forces at play in professional identity formation. This short review points strongly to the influence of the contextual forces at play in science teacher identity formation. It includes the influence of the school in which the identities are formed and the communities they serve. Unlike science identity above, professional identity, here that of science teacher, is more concerned with communities of practice and one's role within those communities; be they at the level of the school or the broader community (society).

Science identity versus science teacher identity

I offer here a slightly different perspective for Avraamidou to consider regarding the formation of "science" and "science teacher" identities. From the brief review above, it is clear that science teacher identity is more a community identity (relationship to the profession) and science identity a more personal one (affinity towards science enterprises). As Gee (2001) noted, identity suggests a type of person in a particular context, and though one may have a core identity that operates across contexts, it exists in multiple forms; or, has multiple manifestations which are context dependent. Each context is likely to have its own identity; that of science teacher, that of scientist and that of science enthusiast. The complexity of identity in various contexts, even within a single domain, and the fact that each context constitutes its own community of practice (Lave and Wenger 1991) makes seeing strong connections between these two very difficult.

In their study looking specifically at the co-construction of science identity and science teacher identity, Maria Varelas, Roger House and Stacy Wenzel (2005) found their subjects expressed a great amount of concern regarding the messiness of real-world science, it's uncertainty and whether or not it could have a place in their science teaching. There were concerns among their participants that exploring the work of scientists too closely did a disservice to the content and their students. As Varelas and her colleagues (2005) reported of their subjects:

> As teachers of science, the fellows recognized the messiness, complexity, and uncertainty of science-in-the-making, but hesitated, debated, wondered, and worried about the extent to which they could and should be enacting them in their classrooms. They differentiated the practice of science teaching from the practice of science referring to teacher's ethical and moral obligation to students, student prior knowledge and understandings, time constraints, need for closure, and student interest. (p. 503)

In this account we can see the tension between the practice of scientist, school science and science teaching. As is often the case, most important among these teachers' considerations

were that of time and leading students to the "correct" answer; the ones which would be needed for tests. In discussing the findings from their research, Varelas, House and Wenzel concluded that the mechanisms of developing science and science teaching identities did share some elements (mentoring, questioning, collaboration, critiquing and relating), but that there were also discrete elements which did not allow them to fully embrace their science identities while assuming the role of a science teacher. Most notable among these were the amount of time available to explore, the need for order and control in classroom science, the classroom emphasis on knowing, and the moral responsibilities teacher assume for the preparation of their students to be successful in school science. This tension between science as a field of practice and science as a school subject was repeatedly emphasized by the participants in Avraamidou's study. All of her participants discussed moments when they enjoyed the enactment of science; observing butterflies (Jennifer), participation in collecting data on rainfall at an environmental center (Maria), experimenting with real materials (Emily) and using a planetarium's telescope and computer applications with a virtual sky (Lisa). Each of these positive experiences were counteracted at some point by lectures, book work, worksheets, and demonstrations at a distance; the more typical working of "school science" from these accounts.

This leads us to a cautionary position. Though we can certainly see how the shaping of identity in both the science classroom (as a teacher) and the real-world are related we can not assume that these are happening together. The discrete nature of each community and the practices associated with them are too diverse. As we consider the role of context, we must assume that these two communities vary enough that the shifts in identity seen in one area may apply only tangentially in other, or, not at all.

A view of the participants from this study

As we consider the teachers' reported experiences from Avraamidou's study, there are a few elements which seemed to be particularly salient. First, as Avraamidou noted, these young teachers were exceptions to the norm. There were both explicit elements and tacit elements which the figured world perspective was able to tease out of the artifacts collected for this study. Among the most explicit were the importance of supportive family. Half of the subjects from this study (Maria and Lisa) had parents who were teachers. For these participants, out-of-school science had played a role in their development of positive relationships with science and enhanced their science identities. Jennifer, a third subject, also had a family member, in her case an aunt, who served as a role model for her to develop a more positive relationship with real-world science; as demonstrated by the time she spent with her aunt at her work—which she described as fascinating.

Glen Aikenhead's (2001) work on border crossings may be a valuable addition to the commentary provided by Avraamidou regarding these teachers' perspective on their identity. I would suggest that for these teachers their crossings were aided by emotional or affective supports derived from their earlier experiences. We see these supports coming from teachers with whom they established positive relationships and family members who demonstrated an affinity towards the subject area of science; the breaking of gender stereotypes may also be significant among these participants. Though it is hard to say the degree to which these influenced their career choices, it is certainly reasonable to assume that these experiences allowed them to perceive science as a positive and available activity for them as young females. I suggest that these teachers, who would otherwise find themselves in Aikenhead's category of "Other

Smart Kids", were able to develop self-image and lifestyle understandings that resonated with the field of science; allowing them to enter categories of either "Potential Scientists" or "I Want to Know" students. These relationships, or more accurately the individuals associated with them, became for the participants in Avraamidou's study role models with whom they identified and could see as possessing elements of themselves.

Regarding their identities as teachers of science, it appears that positive school experiences inspired these participants to persevere through less positive ones. Collectively, the subjects in this study regularly referred to pedagogical dimensions of instruction, specifically notions of it being teacher-centered, lacking adequate discussion time and a lack of hands-on opportunities when describing their negative science experiences. This does cause me, to wonder the extent to which the course influenced these responses rather than representing how they truly felt about the experiences. In the same way that only one subject reported gender explicitly as a feature of their experiences (Emily), yet it emerged as something consistently reported from more tacitly held conceptions, these science teacher considerations may be guided by a tacit conception of what they considered to be good teaching—immediately inferring negative teaching attributes with teachers who they did not like. Despite that potential bias, it is important to note the temperament associated with these experiences. Those perceived as negative being marked as; strict, requiring too much writing and memorization, and having a physical distance from their students (behind a counter, at the front of the class, etc.). In many of these cases both age and gender became aspects which were explicitly considered important enough to report—older man, looking like a mad scientist (or Einstein).

When sharing more positive experiences, the descriptors used were contrary to those mentioned above; young, energetic, friendly, caring, fun and possessing a sense of humor were a among them. Linking this reporting to the influence of the course the subjects were enrolled in, we see similar indications of possible influence. Subjects reported these positive experiences as including lots of experiments instead of demonstrations (hands-on), lots of real-world discussions, and active learning. The latter of these was stated both explicitly (actively engaged through experimentation and group discussion) and implicitly (going to the planetarium).

Among the most important features of these subjects' positive experiences was the emotional connections evident in Avraamidou's reporting. Positive activities brought with them; joy, excitement, fascination and fun. This was evident in both the in-school and out-of-school experiences of these subjects. The strong relationship noted in the literature between identity and emotion may also be significant to note at this point.

This account points to what I see as the most important part of Avraamidou's study, namely the importance of tacit dimensions of experience in perception and the significant contribution of emotion in regard to identity. The tacit element was important to Avraamidou's analysis in that she was able to make more tacit elements (such as gender) explicit though her analysis of her subjects' stories. It has been noted by other researchers that tacit elements often emerge during recollection of events where they are merely a byproduct of something else; in this case the story. Regarding emotions, the reporting in Avraamidou's study really points towards the emotional connection being critical to these young teachers' perseverance and maintenance of positive identity components across domains; that of science and science teacher.

Conclusions and implications of the study

When bringing her paper to a close, Avraamidou acknowledges the multidimensional and context dependent nature of teacher identity formation and the challenges faced by teacher education programs when they are attempting to reform those identities. We must consider

that by the time these young teachers enter a preparation program it may already be too late. In Leigh Smith's (2005) study she concluded that rich out-of-school experiences influenced the teachers in her studies ability to adopt a more progressive, reform-oriented, curriculum. In essence, early life out-of-school science experiences had already shaped her participants' ability to embrace less traditional models of instruction. This could suggest that despite science teacher identity being fluid, it may already be framed by previous experiences in ways that limit the breadth of future change. This would indicate the importance of ensuring that all students have opportunities to explore meaningful science experiences in less-formal contexts; museums, camps, aquariums and so forth.

Finally, Lucy Avraamidou's study adds to our understanding of how teacher education programs must engage teacher candidates in reflective practice to make them aware of the myriad ways their experiences have shaped their identities. Prompting teachers towards developing a clearer view of their own formation of identity may allow them to identify significant moments from their past that they can recreate, or reinvent, to promote their students' engagement with and love of science.

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Rory Glass is an instructor of science methods and general educational studies at the University at Albany (New York). His research focuses on tacit dimensions of knowledge and learning, and the use of language by teachers and students in the science classroom.