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## Whither Science Learning as Identity Transformation?: Theory into Practice

### A Vexation

In science education, psychological theories of learning have been prescribed to describe effective science teaching and powerful science learning. Specifically, the idea of “learning for conceptual change” has served as a guidepost for how we should go about teaching students science. Conceptual change models of learning served as a foundation for some specific, reform-based strategies. These strategies include: drawing out students’ prior knowledge, introducing discrepant events to challenge existing ideas, and facilitating reflection to consider the status of existing knowledge in light of competing ideas. We recognize that, even with effective use of such strategies, students still often walk away with inaccurate (or alternative) conceptions of science concepts.

Frankly, I am less concerned with the science content students know and more concerned about whether students see themselves as individuals who view science as one useful way to understand the world. This notion of learning has its roots in anthropology and promotes learning as a process of identity formation. In recent years, science education scholars have begun to challenge conceptual change models to stress learning as a process of identity transformation. This translates into a different view of learning, not something that happens between the ears, but is instead the process of being enculturated into the norms and discourse practices of science. In a nutshell, my vexation centers on the current lack of practical applications afforded by a “learning as identity formation” lens. This notion of learning as the process of identity formation has its roots in sociocultural perspectives, which imply the following theoretical principles (adapted from Forman, 2003):

- Learning science is a social and cultural process. It involves socializing students into the cultural norms and discourse practices of science. Therefore, evaluating learning requires, in part, a unit of analysis that is larger than the individual.
- Learning as enculturation requires sign mediation. It is accomplished via learner engagement with talk, tools, inscriptions, and texts. Therefore, evaluating learning depends on assessing communication—the normative ways of “talking science” and the ways students have access to, take up, and/or reject those norms.
- What is learned within science is a function of what we feel (or others feel) is important for us to learn. Learning engages personal values and emotions. Therefore, evaluating learning necessitates accounting for the affective and dispositional dimensions of learning.
- What is learned in science and how it is learned is linked to the kind of person the student is and wants to become. Thus, learning science becomes a process of forming an identity in relationship to science.
- To understand what and how something is learned, one must consider changes over time. Therefore, evaluating learning requires multiple assessments and ways to depict changes.

What makes this a potentially compelling way to think about science learning? The identity lens considers the whole learner in her/his cultural context(s); learning, in this sense, becomes more multi-faceted than constructing and/or creating robust understandings of key scientific concepts. The identity lens obliges us to ask questions about the people celebrated or marginalized by science and the ways students come to see science as a set of experiences, skills, and knowledge worth or unworthy of their engagement. In doing so, we need to pay attention to the cultural tools (i.e., the talk, the scientific practices, the physical scientific tools, the scientific texts) made available to students, the accessibility of these tools for a wide range of students, and the students’ views of the tools’ utility for making sense of problems that are important to them.

This view of learning speaks to me; it makes sense. It resonates with my own experiences of science learning and with my experiences facilitating science learning for elementary science methods students (many of whom expressly do not recognize themselves as having a science identity). Thus far, I think the “learning as identity formation” lens is a powerful *theoretical* tool; i.e., it holds robust explanatory power. But, as yet, it does not obviously hold much value as a *practical* tool for science teachers and science teacher educators. If a teacher

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understands learning as a process of identity formation, what will she do differently in her classroom to facilitate learning? How would this enactment compare to the classroom of someone who treats learning as a process of conceptual change? How would our science teacher education curricula look different if it were based on a theory of learning as identity transformation? Or *would* it look different?

### **A Venture**

I recently received a grant from the National Science Foundation to study the connections between pedagogy and science identity development. I am expected to identify specific teaching practices that are effective in facilitating students' science identities. In addition, I am expected to show evidence of my improved teaching practice and to create professional development materials for teachers and other teacher educators who seek to facilitate more robust learning communities.

The project has the following objectives:

1. ***Determine the normative scientific practices in exemplary science classrooms at 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grades.*** With this ethnographic study, I will identify the normative scientific practices (ways of investigating, communicating, and evaluating scientific knowledge) within classrooms taught by exemplary teachers. This ethnography will provide clues about the science identities promoted in science classrooms.
2. ***Chart students' science identity development during the year they experience "exemplary" science instruction and then, over time, as they participate in other science classes.*** Through longitudinal case studies, I will trace the science identity development of three cohorts of students through three years of science instruction. I am defining science identity along three dimensions: competence (knowledge & understanding of science; performance of relevant scientific practices), scientific dispositions, and recognition of self (and by others) as "science person".
3. ***Identify specific teaching practices, at different grade levels, that cultivate strong science identities for a broad range of students.*** I will extract data from Objectives #1 and #2 to identify successful teaching strategies used to create learning environments supportive of students' science identity development.
4. ***Develop teacher preparation and professional development materials designed to support teachers' efforts in creating learning environments and using teaching strategies that foster the development of students' science identities.*** I will use the study's findings to develop pedagogical cases and observation instruments to promote teachers' encouragement of science identities among their students.

It could be that I will have to wait until I obtain preliminary results for Objectives #1 and #2 before I even think about enacting Objectives #3 and #4. But, wouldn't it make sense to have an idea of the kind of information that would be helpful to teachers and teacher educators as I embark on the project?

In summary, I am seeking feedback from Crossroads participants upon the questions raised in my Vexation. I am also seeking guidance regarding the information that might be helpful to those responsible for teaching science, and future science teachers, from a "learning as identity transformation" lens.

Forman, E. A. (2003). A sociocultural approach to mathematics reform: Speaking, inscribing, and doing mathematics within communities of practice. In J. Kilpatrick, W. G. Martin & D. Schifter (Eds.), *A research companion to the principles and standards for school mathematics* (pp. 333-352). Reston, VA: National Council of Teachers of Mathematics.