

Identity Development and STEM Learning Multiplex Monthly Theme Synthesis October 2020

Identity is a construct that has become increasingly important in research about STEM learning, and Identity Development and STEM Learning was the Theme of the Month for October 2020. This synthesis draws on the blog, the expert panel, the discussion after the panel, and the resources which our experts shared and posted on the site.

The theme was introduced through a blog by Dr. Carrie Tzou, Professor of Science Education and Director of the Goodlad Institute for Educational Renewal at the University of Washington Bothell. The expert panel for this theme was moderated by Dr. Sasha Palmquist, the Senior Manager of Community at CAISE. The panelists included Dr. Heidi Carlone, the Hooks Distinguished Professor of STEM Education at University of North Carolina Greensboro; Dr. Nichole Pinkard, Associate Professor in the School of Education and Social Policy at Northwestern University; and Dr. Zahra Hazari, Professor of Science Education in the Department of Teaching & Learning and the STEM Transformation Institute at Florida International University. (More [details about these experts](#) can be found with the [October Theme of the Month](#) on the Multiplex site.)

Dr. Tzou summarized some of the key connections between learning and identity, based on recent research. These include:

- Identity and motivation are deeply intertwined.
- Learner's expectations of how interesting an experience will be is shaped by aspects of identity and in turn contributes to STEM identity—creating a kind of positive feedback loop to encourage further activity and learning.
- Researchers study, document, and even measure identity in a variety of ways—through both quantitative and qualitative approaches.

As more and more attention has been paid to identity, its definition has eluded any one definitive formulation. In part, this results from the intuitive recognition that no one can be summed up as having a single identity — a science or math identity will live alongside a family identity, or an ethnic/racial identity, a regional identity, or religious, political, or ecological identities. As theorists such as the Pragmatist G.H. Mead realized, this multiplicity is to be expected if we recognize that identity or self image is not a static, unitary achievement, but rather is a performance or enactment, that is deeply social/interactive in nature, and functions to relate us to others in the many communities and contexts within which we live.

How does this relate to STEM learning? Because our identities are shaped in relationship, they represent our communities messages about ourselves, as much as our own self-definition. As panelist Dr. Carlone emphasized, identity cannot be seen as separate from cultural constructs and processes. Thus, an identity shapes our imagination and our agency. It provides default ideas about what we can or should do or be, what we should not or cannot do, and shapes how we should see ourselves in relation to (for example) the enterprise of science or math. Am I the sort of person who studies physics, or conducts biomedical research, or investigates questions in number theory? Do the traditions and wisdom of my community have any standing or value in relation to “official science”?

This cultural lens on identity enables us to examine our agency, our sense of possibilities, and our context, both in terms of resources for action and growth, and of boundaries/barriers or oppressive structures. This kind of critique then enables us to examine the assumptions underlying our identities, and in a sense renegotiate or re-author our identity (e.g. our STEM identity). We can come to see that my kind of person can indeed be an engineer, a biologist, a statistician.

Here is where STEM education (formal or informal) can play an important role — engaging the learner in ways that help them re-examine their identity, their agency, and their relationships to powerful enterprises like science or other STEM fields, where they might not have felt welcome or safe before. How can STEM educators (and practitioners) help people change the narrative embedded in their identities, to author themselves (in Dr. Carlone’s term) as participants in STEM learning and practice — and re-author the STEM enterprises of research and communication to embrace the values that diverse people and experiences represent?

Acknowledging the whole self. The panelists all pointed out that in creating these spaces, it was important to ensure that students’ “whole selves” be acknowledged. One of the important consequences of the research on identity is the recognition that one’s various identities are negotiated and functional in different social contexts, and together constitute a tapestry of personal meaning. They are nevertheless often in tension. An identity that is developed and enacted to facilitate participating in “mainstream science” may conflict with one’s identity as part of an indigenous culture, in terms of epistemology or in such matters as the relative valuation of cooperation vs. competition, or individual vs. collective agency. In one of the breakout discussions, several participants spoke about how they have negotiated conflict among their various identities — their religious vs. their scientific identities, for example. The need to reconcile or balance different identities arose as they became aware (often at an early age) of irreconcilable contradictions in the assumptions being made by each “figured world” (as Dorothy Holland labelled “frames of meaning in which interpretations of human actions are negotiated” in practice).

In recognizing and negotiating the tensions between identities, we can also see how the cultural boundaries created make it hard to create a safe, healthy, and welcoming space for learners. The demand by a dominant culture (of science, of education, etc.) which exerts what Dr. Hazari called a “reductive” force, preventing the whole person from being present, also reduces the kinds of STEM that can be practiced — maintaining hegemonic disciplinary boundaries, but impoverishing the disciplines by excluding questions, approaches, and cross-boundary collaborations that could enrich the inquiry by welcoming broader participation. This welcome brings with it new challenges, as diverse values may conflict and need translation (never easy) or other kinds of adjustments. As an example, participants noted the long-standing conflict between evolutionary biology and some other traditional world-views. Such tensions are often not easy to negotiate.

Designing healthy spaces. Nevertheless, the central focus of this Theme is identity in STEM learning, and given the inequitable, exclusionary impacts of schooling on learners of many kinds, a central challenge is to so design our learning spaces and our pedagogy that every child can feel safe and welcome to participate in STEM. In brief, this means that students must see something of their identities reflected in the STEM they encounter, and they need also to know that they are seen, whole, in the learning environment.

As Dr. Pinkard put it, a child can’t develop an interest until they’re in a space that’s situationally engaging, and unthreatening and indeed welcoming. This starts with such very basic and important things as seeing others like ourselves in that space. Dr. Pinkard said, for

example, that she had never seen herself represented in the STEM space, “so I never knew who I ought to be.” She cautioned, though, that we should be clear about our goal: Is it to create more examples of ourselves, or to address barriers, including barriers in the infrastructures of education and the disciplines, creating “opportunity spaces”: “If these barriers were removed, learning could be a lifestyle.”

Dr. Carlone asked in the same vein, “How compelling, imaginable and achievable are the meanings of “science person” for different youth in a given setting?” She suggested that one element of STEM identity work involves explicitly addressing people’s understanding of key cultural constructs such as who is smart, who is competent, how do people ask and answer questions, what is the relation of individual to collective responsibility or agency? Addressing such constructs will help learners and teachers re-author these constructs, especially as they apply to themselves.

Another strategy is to change the STEM that the learner experiences. For example, as Dr. Hazari pointed out, the STEM disciplines can be seen as power structures that dictate who can participate, what good practice looks like, and what the core questions of the discipline can be. These structures in some cases have a history that reaches back to the time of the Greeks. But most problems that we seek to solve, or research questions that probe into such problems, are to some degree interdisciplinary, or multidisciplinary; school science should reflect that reality. Moreover, despite the long-established privileging of “pure research” over “applied research,” the problems and puzzles of real people in the real world are a key source of new knowledge.

STEM teachers and others can learn to understand and discuss the power structures, the constraints, the boundaries — the goal, she argued, is to identify experiences, approaches, and activities, that might happen in formal and informal learning spaces that can disrupt structures of power, to allow new ways to be or act. In this way, they can create what Dr. Pinkard called “healthy, safe spaces” welcoming youth — especially youth from historically excluded groups — into STEM environments. For evidence of impact, consequently, we can start by noting whether we see expansion of formerly excluded people’s participation in STEM. This means also recognizing the importance of narrative as a way to learn, and also as a way to understand the learning trajectories, and the formation and negotiation of identities within the STEM space.

This requires from teachers and others an explicit discussion of bias and hegemony -- both as it relates to their practice, and also as a matter to address with their students. As Hazari said, “We can’t skirt the idea with students, pretending that there aren’t invisible structures that are making choices for them. We have to make the marginalizing and hegemonic structures visible, we have to have discussions about what constitutes knowledge, who decided, what the boundaries of a discipline are, and how the discipline functions.”

But how do you facilitate the conversations? How does one negotiate identities across the spaces inhabited by the students and the teacher? How do we learn to acknowledge (see, name, work with) implicit biases?

Narratives are an important tool to get at these complex and subtle identity processes. For example, in an interview with CAISE researchers, Dan Kahan of Yale University talked about how he and his colleagues have come to understand public reactions to climate science.

“A perfectly plausible hypothesis would be that the reason we have disputes and confusion and conflicts about risks like climate change is that people don’t know a lot of science, and we don’t think the way that scientists do... You might think that people [who are good at careful, “slow” reasoning] understand the evidence better and can reason about it. They’re going to basically go with the evidence, whereas the people who don’t understand how to think that way are likely to rely on heuristics like “What do my friends think?” and become polarized.

But we have done lots of studies that show that the people who are the most polarized are also the most cognitively proficient...you have to reevaluate what you thought was going on when people were forming these identity-expressive or identity-protective kinds of risk perceptions. They're not making a mistake. The problem isn't that they're irrational, the problem is that they're too rational. They're engaging this information in a way that's most relevant to their lives, and nobody, no individual member of the public, can do anything about climate change. But if they make a mistake in their own community, given that climate change has now become a symbol of group loyalty, they could be in a lot of trouble."

If you recognize the socially embedded nature of identity as a situated practice, and also that everyone (students and teachers, too) lives in multiple, compelling figured worlds, then you need to develop strategies to support students in doing their identity work. Dr. Carlone notes that in this work, we have to remember that the students' (and teachers') disciplinary identity is only one among many. STEM learning and identity formation (in performing STEM practice) doesn't happen separate from other social identities important to youth, including such relational roles that a student might be developing such as "defender of the under dog," "helper," and so on). And identities are not just what you carry around in your head: each of these social identities can get construed by others, both in their understanding of you, and of themselves. Dr. Pickard has found in her work that it's important for students to develop their "posses," their peer group, so as to develop and grow with a feeling of safety, with their whole selves present and active. To this end, teachers and others need to collaborate with partners to ensure the learning ecosystem is hospitable — maintaining authentic connection with the worlds (and identities) outside the classroom environment. The classroom is filled with other worlds from beyond the walls, and if our STEM environment and teaching are designed with this recognition, these many worlds represent both rich challenges and rich resources for authentic education.

Recommendations for Teacher Leaders

The experience of the panelists and many participants is that it is hard to discuss issues of identity and the inhibitory effects of traditional structures in STEM disciplines and education. Teacher leaders can help facilitate the conversation among their colleagues by doing some identity work themselves, and by examining who is not at the table, that is, what students, what community elements, what mentors are missing from, or missing out on, the STEM learning in their school.

A pedagogical doorway to this examination can be found in considering the disciplinary structures that may present barriers to some learners. The move towards project- or problem-based learning situated in the students' communities and their needs and hopes can serve as an enactment of a different approach more welcoming of the different funds of knowledge represented in the students' lives, and help make room for students' whole selves. The [Resources](#) for this Theme are particularly rich in theoretical and in practical ideas from which to build.

Recommendations for researchers

Although identity is an active area of inquiry right now, the field is not over-crowded, and there is much more to be understood about how identity formation and identity negotiation relate to STEM learners' motivation, engagement, and success. The idea that identity is "authored in practice" as developed by Mead, Engström, Holland, and others continues to suggest possible research on learning and identity in activity, and its implications for STEM learning and identity.

The panelists suggested also that more needs to be learned about the design and implementation of safe, welcoming spaces for students of color, and for others excluded from the

development of a positive “STEM identity” (or, perhaps, the inclusion of STEM participation in some form as a contributory part one’s self-image). What are (to use Dr. Carlone’s terms) important and effective design principles for “spaces where kids can show up feeling that they are already equipped to belong and be a valued contributor to the community?”

The webinar pointed out that teachers and other educators are often hesitant to have this conversation with their classes. Further research on teachers’ STEM identity, and factors and practices that can facilitate their seeing and including students’ “whole selves” in the design of curriculum, could provide the basis for valuable professional development. Collaboration, in the style of research/practice partnerships could engage teacher leaders in the research. Nicole Pinkard spoke of her efforts to develop “proof of concept” experiments, leading to broadly useful innovations in teaching and learning design, suggests the possibility of design-based research exploring different aspects of identity as an active process in STEM learning and teaching.

Recommendations for administrators and policy-makers

This synthesis, and the webinar and resources on which it draws, portray a fruitful area of active inquiry, with direct implications for STEM learning in both formal and informal settings. The field to date is already showing that to incorporate the promising insights about identity and learning will require conscious changes in curriculum, in teaching, and in the relation of school to community. Administrators and policy-makers should become familiar with some of the resources provided for this Theme, which provide a good introduction to the key ideas and insights from identity research and design. As with many other innovations in STEM learning, the key resources to mobilize are *sustained attention* (Who will shepherd the conversations within the institution? Who will help gather resources and mentorship needed to learn about and experiment with identity work in learning and design?) and *time for teacher learning*. Identity work, like identity itself, is not a goal to achieve once and for all: it is a continuing construction.



Written by:
Brian Drayton,
Co-Director for the Center
for School Reform at
TERC.



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