What is STEM Identity? An Interview with Heidi Carlone

On November 28, 2017, Jamie Bell, Project Director and Principal Investigator of the Center for Advancement of Informal Science Education (CAISE), interviewed Heidi Carlone to understand her thinking and work on the topic of STEM identity. Dr. Carlone is the Hooks Distinguished Professor of STEM Education in the Teacher Education and Higher Education Department at the University of North Carolina, Greensboro. Dr. Bell conducted the interview on behalf of the CAISE task force on evaluation and measurement.

A video of Dr. Carlone's interview, as well as interviews of other researchers, is available at InformalScience.org/identity.

Tell us about the projects you've done, or are currently working on, that focus on identity.

Since 2000, probably every study that I've done has to do with identity in some form or another. I'll give you a few examples here. I've looked at a comparative ethnography of two groups of high school girls in physics. One group taking a traditional course, and one group taking a reform-based course. And looking at their meaning-making in both courses, we had some interesting results there, in that the girls embraced the traditional approach and resisted the reform-based approach. And, the construct of identity helped us understand what was going on there.

Another example is a comparative ethnography of two fourth-grade classrooms. Both teachers who taught each classroom were equally committed to reformed-based instruction. Students in both classes claimed to really like science, but students in the different classes affiliated with science differently. In other words, the girls of color in one class were really strongly saying, "I like science, but I don't want to be a scientist," and "I'm not like the science kids in this class." And, the other class just kind of uniformly adopted and took up this identity that was being promoted in the classroom. So, again, there we had this construct of identity

helping us explain how two really great teachers, doing hands-on, minds-on science could have outcomes that were really different in terms of identity.

Another example is the study of diverse high school students who did not, necessarily, fashion themselves, or unevenly fashioned themselves as science people. Some of them really affiliated with science, and others just came because their parents thought it might be a good way to spend a week in the summer. This was a longitudinal, this was a study of students in field ecology. It was a field ecology enrichment program, which had out-of-school components and summer components. And, these students, these youth, really did not affiliate with overall, they fashioned themselves as "I'm not a snake person. I'm not a reptile person. I'm not an outdoors person." And, through the course of the week, and some follow-up days, they begin, kind of, playing with this notion of, "well, maybe I am that kind of person." So, we noted this idea of identity boundary work. Or, how does one define oneself as in or out, and what are those spaces of where they might intersect as both in and out? And then what are the structures that support that kind of identity boundary work?

We're getting ready to publish a series of articles about elementary students as they engage in engineering. And, we're also doing a longitudinal study of those students, those high school students, in the field ecology course to see whether or not, and what ways, those kinds of really finite triggered experiences in field ecology may, or may not, have had some sort of long-lasting effect on their STEM-related identity work.

We also have one more project, a new project, funded by the National Science Foundation, that's going to be tracking middle school youth STEM-linked identity work, as they participate in a series of after-school and summer enrichment programs that integrate science, engineering, and computing, and focus on socioenvironmental problems. So, I'm sticking with this identity construct, even though it sure is a murky and difficult terrain.

Which program funded that project you just mentioned?

That one is NSF iTEST. It's called Bridges Broadening Identities for Diverse Youth in STEM Through Socioenvironmental Problem Solving.

Do you work from the same definition of identity across projects, or do you define it differently, depending on the context?

I make certain assumptions about identity in most of the studies that I'm doing. So, it's really difficult to provide a simple kind of definition for identity, and it's easier for me to think about some assumptions that I'm making about identity that help me operationalize it, and make it concrete for my studies.

Overall, the first thing that I would say is that my work examines identity in concert with the study of culture. So, I cannot completely address the question [of] who an individual is becoming in a setting, unless I also address the question [of] who are youth obligated to be in the setting. And so, I'm always looking at individual's performances in relation to what the setting demands, celebrates, and marginalizes. Those two things—I'm looking at those things together.

This idea that identity is studied in coordination with culture, in doing that I'm making assumptions. So, let me draw out those assumptions. First, I make the assumption that people are formed in practice. Asking a question, like, "what does it mean to be smart? What does it mean to be struggling? What does it mean to be a discipline problem, a genius?" The meanings of these—the answers to these questions—are context-dependent. The labels of self and labels of others are only helpful if we understand the local context—the obligations, and the norms, and the practices that are celebrated and marginalized in those contexts.

One must also understand not only the local context and what's demanded there and how that implicitly positions certain kinds of students and youth (and celebrates some performances and marginalizes others) but we also have to look at macro-level structures. This is another kind of aspect of the work. That's the first thing, that people are formed in practice.

Then, a second assumption that I make is that identity outcomes of any given set of practices, or any local context, are often heavily shaped by larger social structures, like race, and class, and gender. These societal structures constrain, but they don't determine, an individual's STEM trajectories and pathways. People have a choice in who they become, but it's not an unrestrained choice. So, that's another tricky part to this, that despite the power of larger social structures, people, actually, can author themselves in really creative and imaginative ways. This aspect of studying identity makes room for cracks of possibility, and agency, and transformation.

So, to summarize what I've said so far, these perspectives highlight the explanatory potential of identity, and that's why I love the construct. I keep saying to myself, and maybe I shouldn't say this on this interview, but it's absolutely honest. I keep wondering whether or not I should give up this construct of identity, because it is so murky and complex, but it has such strong explanatory potential, because it opens up this space and tension between structure and agency.

The other thing it does, it allows us to pay attention to multiple time scales. Now, so, we have multiple contexts. So, it's what's happening locally and what's happening cognitively for the learner; and then what's happening locally, in terms of the local cultural context, and what's happening more at the macro level that's been historically enduring (so, those kinds of things). But, it also allows us to look at historical, local, current, immediate future, and generational futures. These different time scales, okay?

So, studying identity might involve paying attention just to moments of authoring one's self in imaginative ways in a setting. Okay, that could be one way to do it. But those little sparks, and imaginative ways of offering oneself, might lead to more enduring changes over time that become habitual performances. So, that's more longer term. And, those habitual performances maybe have the potential to influence the culture in which those youth are performing, which then can change the meaning of what counts as a science person, and become resources for generational kinds of transformation.

It's ambitious to think of it that way, but I do think thinking about identity has this kind of potential for understanding multiple time scales and multiple contexts.

When I study identity, what am I thinking about? I have to say I've been struggling with this one lately, because I am trying to look at identity longer term.

However, I do kind of want to emphasize that identity isn't a final form achievement. It's not a static accomplishment. So, in many of the studies I discuss this idea of identity work, and this is the way youth position themselves, and get positioned in relation to the normative practices in a setting, or in relation to social structures. Let's [say] an example of this would be a youth who gets positioned as a good science participant in a setting. And that—what that means is that person is able to, and willing to, fit in, or see oneself inhabiting the celebrated subject position, this kind of ideal science student in a setting. And, these are cultural models for who counts as a legitimate science person, and what counts as legitimate scientific performances in a setting. And, these are shaped by historical and local practices.

This is the kind of work that students have to do. Kind of, what is the celebrated position, and how do I fit into that? Do I even really want to fit into that? And, in what ways am I going to perform myself to do that?

To get really concrete, what I've talked about so far is a lot of theoretical assumptions, and it's hard for new researchers to take those kinds of big ideas and put them into concrete, "okay, I've got it, blah, blah, blah." Identities are formed in practice. Tell me how I go about it if I'm entering a classroom setting, or an out-of-school setting, or a really innovative after school program? What do I look for? How I know identity when I see it? Well, you know, you're keeping these other principles in mind that identity is not just an individual construct, right? But, you can also look at individuals and what they're doing. And that gives you hints about how the individual wants to and/or is performing themselves and doing the identity work in a setting. One is bids for recognition. Who are they trying to get attention from? What are they trying to get attention for? Holding the floor is another one. These say something about what the student think[s] counts in this setting about whose favor they're courting, what is worth speaking up about, what is worthy of celebration or derision. Those two things are really nice things to look for when you're in a setting. Another thing that I look for is others' positioning of a youth. So others' positioning says something about the success of their bids for recognition. So when someone's holding the floor and others ask questions of that student, they're taking up this kind of local expert identity that others are also recognizing.

Another great identity marker in a setting is conflict. I like the construct of conflict because it helps identify how there are conflicts in what the setting demands and how the youth want to position themselves. And so those kind of tensions help illuminate both the culture of the local setting but also the identity work that the youth are trying to do to either fit in, resist or, you know, transform the setting.

Those markers above are also helpful for me to study identity longitudinally. We found some youth make similar kinds of bids no matter what the context. That gives us hints about their habitual performances and their more thickened identity work over time. The interesting thing is that those performances can take on new meanings and new settings so that who I am in fourth-grade science, for example, as someone who claims space and claims voice and participates is lauded and celebrated in this one setting, but those same performances, especially if I'm an African American girl, can take on shades of being difficult and argumentative and loud instead of being a productive member of the group.

Those are some things that I think about as I think about how I'm defining identity and how I go about studying it.

To make explicit the assumptions, I think, is probably more helpful, in some ways, than having a definition, because a definition can be complex and difficult. And the markers that you mentioned as being the trackers or indicators of what's developing in the youth.

Could say a bit about how other identities like gender, race, socioeconomic status, and other factors intersect with STEM identity?

I think that most of the stuff that I've already said aligns with that, as we're thinking about identity and the fact that identity is not constructed solely by the individual. In early work we looked at three major constructs that define an identity. If we're again looking at what matters for STEM identity trajectories. We looked at performance, competence, recognition of self, and recognition by others. That was [the work that I did with Angela Johnson](#). And, in that work, what got highlighted was the importance of this recognition by others, and recognition by scientific others, and the ways that could either thwart—well, it's not either/or—could both thwart and/or encourage women of color science trajectories. I think understated in that was the role that race, class, and gender played on the women's trajectories. We did try to do a good unpacking of that but we did a better unpacking of that in an article Angela took the lead on, on intersectionality. So we really tried to look at how and why did women of color move through and work through all of the difficulties and unascribed, undesirable ways that they were getting positioned. How did they work through that? And so I think that we really looked at where they were located along the matrix of oppression. I like thinking about this idea of a matrix of oppression because if you're a white woman from an upper middle-class background you have one kind of set of issues to work with and one or more sets of larger social structures to contend with as a woman in STEM. But if you're an African American woman who is a lesbian and from a working-class background you're located very differently along a matrix of oppression than a white woman from an upper middle-class background. You're facing a lot more kinds of ways to be oppressed, marginalized, and there are so many ways that you do not fit into the kind of historically celebrated ways of being scientific. And so there are a lot more ways to be thwarted along your trajectory because of that.

What about socioeconomic status? Has that come into your work?

We haven't done a lot with socioeconomic status, but we've done some. The best example that I have is a study of boys' trajectories. We looked at scientifically talented boys, four boys from fourth grade to seventh grade, and we looked at their identity work as they did school science. What we found is that there were some intersections of class that thwarted one of the youth's trajectories in that his way of performing himself was very aligned with a hyper authoritative, hyper masculine way of performing himself that actually didn't play well with the desired model of masculinity in these settings, which were performing muscular intellect. This cool, confident, doesn't really matter, "it's okay, whatever, I got this," kind of identity, which did not align at all with the ways the boy from the working-class background was wanting to assert and power through and get his ideas well-known in an authoritative way. This kind of preferred masculinity with the muscular intellect was less—was not as accessible to the boy from the working-class background. He just couldn't manage that.

Either he didn't want to do it that way or it wasn't a fit for who he was and what he thought needed to happen in that setting.

To help others who may be approaching this for the first time or just beginning to think about differences of approach, is your work different from what you know others are doing? In terms of how they may be defining it or the assumptions they may be making…

I think there are other people doing what I'm doing, but I don't think that it is widespread. So I think the major difference or the major distinguishing aspect of my work that others share too is that I approach the study of identity tied to the study of culture, and so in doing so, I'm eschewing individual explanations for problems that are inextricably connected to local and global contexts. I have to say that that aspect of doing both at the same time has become a little bit problematic for me, thinking about studying longitudinally. For example, the work that we're doing in studying youth's identity work as they're narrating it, three to five years after the HERP project, which is the study of youth's identity work in the field ecology enrichment program. We were able to study the norms and practices and the culture of the setting there, but then we're asking the youth to narrate their meanings of those experiences three to five years later. So I'm asking them and really getting a sense of their meaning-making, which is much more cognitive than cultural, three to five years later. That's forced me into a different way of thinking about and identifying identity than has been in the case in my previous work.

How are you measuring identity in your work?

In that original model that Angela Johnson and I came up with, we had this performance, competence, recognition of self, and recognition by others. If you would have asked me how I'm measuring identity five years ago, I would have been like, "uh, I don't measure identity. I am an ethnographer. We don't measure, you know." And yet there has to be some accounting for, even if you just give all the caveats and say okay, these are just snapshots, okay? We're gonna try to figure out in the moment how to capture or characterize the identity work that youth are doing and then over time what kind of identity work are they doing.

So my biggest challenge right now about capturing identity, because I don't want to use the word measuring, is—and characterizing—is identifying what constructs are prominent for youths' meaning-making of their experiences in these science programs. I'm just gonna use the HERP project as an example. What seems prominent for their meaning-making? We started off riffing on this performance, competence, recognition model. I said, okay, let's unpack that a little bit more. Let's look at disciplinary engagement and competence. I still think this idea of engagement in disciplinary practices is important. And how they engage and kind of what they're being held accountable to be engaging in. Recognition of self, still important. Recognition by others, still important. There's also this disciplinary agency, e.g., can they take up these practices and use them in their everyday life and/or in their STEM trajectories as they kind of move over time? This idea that they're taking up their knowledge, experiences of the work that they did with the HERP project, and can and do they apply it to new settings? Did they see it as relevant, et cetera? So that's another one. We've got disciplinary engagement and competence, recognition of self, recognition by others,

disciplinary agency. We also have this idea of social affiliation and belonging, which is "are these my kind of people? Do I fit here?" And then there's this other one about habits of mind that was these were the original six—these were the original that I riffed off of the original. So these are the next iteration, the six. Those are the competencies—or the kind of components of identity—that I thought might become relevant to youths' storied meaning-making about the HERP project. It turns out that—we're still in the middle of this study, by the way—some of these are becoming way more prominent than others, just as a preliminary hint about our findings. I'm not finding a lot about habits of mind, for example, and our program may not have cultivated that. But I'm finding a ton, even for youth who don't want to pursue science as a longer-term endeavor in a disciplinary way. They now have pets that are amphibians and reptiles, and they have worked in this kind of field ecology thing into their lives. They go herping on weekends, et cetera. But, interestingly, for almost all the youth this disciplinary engagement and competence becomes a primary way that they're storying their experiences, even three to five years later. And we know that. They're not just talking about, "I remember when I did that activity where we went out at night, and we were looking for frogs." No, they're like, "oh, I remember when we did the frog hunt, and we were doing the calling amphibian frog protocol, and we were identifying the different frog calls." For example, now I can identify a spring peeper, and they were identifying the actual species and the way that the frog call sounded, and they could really pull up some really specific examples of those disciplinary practices three to five years later, which I thought was fascinating.

Those are the six components that I was looking at, and we're in the midst of deciding which of those are becoming more prominent for the youths' meaning-making. That's one way we were looking at what was triggered by the HERP project. But we're also looking at identity over time. So we're looking at historical disciplinary identity, triggered disciplinary identity, i.e., what they come with. What they came to the setting with. We have that data. What got triggered with the HERP project. And then emerging disciplinary identity, i.e., do they take what happened in the HERP project and pursue STEM opportunities that they wouldn't have otherwise pursued had it not been for their HERP experience? So, some of them joined a club that they wouldn't have joined. Some of them joined another summer STEM program. Some of them pursued a scientific major that they wouldn't have pursued. Some of them decided to get a salamander as a pet. So different kinds of ways. And then we have the sustaining disciplinary identity, which becomes much more thickened and stable. Kind of like claiming the STEM identity. Like, "I'm a science person through and through and this is what I want to do forever and ever" or "I'm not gonna pursue this as a career, but herping will always be a part of what I do with my family and/or my future kids."

Those distinctions are really, really helpful as a model for thinking about how to measure and parsing the different aspects of it like that. I'm thinking about the other constructs that we're also going to be conducting interviews about in the future, some of which are motivation and interest. I wonder what you think about those and if those are useful in terms of intersectionality?

I think they're useful. The differences between those constructs like interest—although interest I still think is part of the identity work too, by the way, and so is motivation—any of those kind of more psychological constructs, the difference for me—and I don't know if

educational psychologists or learning scientists would argue with me about this, and they might and that's okay—is that they feel much more. They're much more cognitive—what's between the ears. And if you think about the tension between agency and structure—like how people position you and how the norms position you and how you position yourself and how you think of yourself—so if you think about that tension between the individual and the context, the motivation and interest feels to me like it privileges the individual above all else, right? Yeah, the context influences it, but at the end of the day what's most important is the individual is the driver. And I will admit in some of my studies—and this has been still an ongoing struggle with my work—is that sometimes in my work the structure becomes too deterministic. So the individual's agency is squashed a little bit. In some of my colleagues' work, I think the individual agency gets blown up. Like these moments of beautiful identity work get blown up, and I'm wondering about really the significance of those individual moments, over time.

So I do think that if I'm thinking about interest and motivation, it feels like those don't account as much for issues of power or issues of race, class, and gender. For issues of historical ways of doing things it privileges the individual in context. It's still important.

We found a real continuum across the folks we've interviewed about identity in terms of what people believe is inextricable or what happens in a moment versus over time and how the other factors like culture, a key point, play into it.

Are there resources or tools that you think people should be aware of as they grapple with this construct? Any particular scholarship?

I have lists and lists of scholarship. I am intrigued and inspired by [Zahra Hazari's work](). What I like about her work is she's trying to do this large scale. It's complementary to my work, which is so local. She's worked with some of the constructs that we've worked with and says, okay, how can we develop a survey where we can take these snapshots but that are informed by the ethnographic work that my colleagues across the country and I have been working on? So I am intrigued by that because it's not a competition. It's not a clash between trying to understand this construct in a larger scale with larger-scale populations and with smaller scales. I think her work feels really complementary with the work that I've done and very respectful of it, and I also respect her work. I'm learning from her work as I'm trying to do what she's doing on a little bit of a smaller scale. I think that's the number one person right now that is inspiring me to think about my work differently.

I'm wondering about the articles that have come out of the HERP project. I looked at the website while we were talking, and the [project description]() of HERPS on InformalScience.org, and I noticed that there was a *Connected Science Learning* [journal article](). Have there been other products out of there that we don't know about yet or are coming out?

Well, we have two articles that we're working on this semester, but we do have [one article in *International Journal of Science Education* on the identity boundary work](). I can send you that reference. And then we have a couple of book chapters, so we're still kind of cranking that out.

Are there any books on identity that you've found useful?

Well, I really like Maria Varelas's book, which is a compilation of researchers studying identity. The only thing is that I worry about [in giving examples out of context] is that here's how I did it, and here's how I did it, etc. We're not making clear what the underlying assumptions are about the different ways of studying identity. So what do I gain—for example, when I'm studying identity in ways that are intimately tied to culture and what am I losing, right? What am I able to see, and what am I not able to see? And so I think there needs to be some sort of guide moving forward about conceptual differences in how to study identity and what are the underlying assumptions. If you're studying identity this way, what are the taken for granted assumptions you're making about learners, context, learning—and a good education is another thing, and a good informal space, for example. And then what do you gain by studying it this way, and what are you ignoring by studying it this way? And so accounting for those differences, I think, is really important. So I love the *Learning Science in Informal Environments* National Academies' Report. I thought that was really, really well done. But we're still not there yet. I don't know. The thing that I use the very, very most is Lave and Wenger's 1991 *Legitimate Peripheral Participation*. I used that as a launching pad to thinking about this notion of identities in practice, and my second one is Dorothy Holland's *Identity and Agency in Cultural Worlds*. It's 1998 though, right, so it's time to work on thinking about continuing that work. Did you interview Margaret Eisenhart?

We didn't. It's interesting you bring her up. When I was in graduate school I was such a fan of her work. But that's a good suggestion.

She was my advisor. And then Dottie Holland was her advisor. But she's much more culture than identity. She's at Colorado, Boulder. But she's retired now. But she's still working.

Is there anything else that you wanted to say about identity?

One of the things I just thought about as you were talking about resources and people whose work inspires me, I also want to mention, and somebody's probably already mentioned this before, but the recent special issue from the *Journal of Learning Sciences* on disciplinary-linked identity, that was outstanding. Every article just blew me away. I did one of the commentaries on the articles, and the reason why it was interesting is that I think it represents the next—and I have to say scary iteration—of one strand of this identity work in that it's not going to be okay just to look at what a setting does and study the unfolding of identity work. That work is much more design-based research and actually a social design experiment, which is much more critical. We know that these are the things that keep kids away from STEM. We are going to design settings that explicitly contest those historical meanings of STEM and STEM person. We're going to pop it in the face real quick and put it out there, and we're going to study what happens in these designed settings, these revised designed transformed settings. It is incredibly ambitious work, but it is also really both theoretically rich and kind of practically inspirational. So I am really intrigued by and inspirited by the work that's represented in that special issue.