

What is STEM Engagement?

An Interview with Christian Schunn and Paulette Vincent-Ruz

On July 11, 2018, [Amy Grack Nelson](#), Evaluation and Research Manager at the Science Museum of Minnesota, interviewed [Christian Schunn](#) and [Paulette Vincent-Ruz](#), to understand their thinking on the topic of engagement. Chris Schunn is Professor of Psychology, Learning Sciences and Policy, and Intelligent Systems at the University of Pittsburgh. Paulette Vincent-Ruz is a Doctoral Candidate and Student Researcher in Learning Sciences and Policy at the University of Pittsburgh. A video of Dr. Schunn and Vincent-Ruz's interview, as well as interviews of other researchers, is available at InformalScience.org/engagement.



What led you to study engagement or including the concept of engagement in your work?

Christian: We've been doing a lot of [work](#) to understand the affect or motivational dimensions of science learning in and out of schools. We really wanted to look at the experiences that students were having in a moment of time, and engagement was the way that we thought about capturing the important aspects of those experiences. It complemented what we were learning about with regard to the more long-term effects of those science experiences.

What specific projects have you done that focused on or included aspects of engagement?

Paulette: We've studied how the prior ideas that students have impact the way they engage in specific moments in time. So if they have high

science interest, are they more likely to be engaged during certain activities? Or if they have low science interest, are they more likely to be disconnecting from the activity at that point in time?

Christian: We've also looked at some interactions between those attitudes and the characteristics of exhibits, to try to understand why some kids are really grabbed by a certain kind of interactive exhibit but others are turned off—and then it changes as you go to a different exhibit. Why are these interactions happening that lead some kids to turn on in some exhibits but turn off in others?

What is your working definition of engagement, and how does your concept of engagement differ from that of others?

Christian: The word “engagement,” like many theoretical words, has a thousand definitions. Of all the versions, we focus on what is happening in the moment as a learner participant is experiencing a particular exhibit or classroom situation. It has to do with the characteristics of the experience. I think a number of others think about it in a similar way, and it can be described as the ABC model of engagement. The Affective engagement elements: Are you enjoying this moment or feeling bored in the moment? The Behavioral component: Are you actually doing the activity or experience, or are you off task? Then the Cognitive elements: You might have your hands on but your mind off, so are you really thinking about making connections, cognitively participating? That’s a consensus view among people who are studying engagement as the thing that’s happening in the moment.

How and why do you think engagement matters for science learning or science communication?

Paulette: Well, studying the in-the-moment reaction of students is really important, because they may come into our activities with prior ideas about science, interests, or belief in their competencies, but when they’re doing certain activities in a place that is new to them, they might feel that they don’t belong in that place. That’s especially the case if they belong to minority groups like girls or certain racial minorities. So, it’s really important to know whether the setting or the activity that they’re experiencing is actually affecting the way they perceive themselves (as scientists or not), or the way they perceive themselves as accomplishing certain activities or not. I think that’s the value of studying engagement.

How do you measure or assess engagement in your work?

Christian: We have explored a number of ways of doing it, and short surveys is the way we do it most regularly. It’s efficient in terms of providing timely feedback. You can do it with large sets of learners. You can get really into the “for whom,” who’s actually benefiting, who is really engaging, who is

not. And it doesn’t consume a lot of time, which is important because kids doing informal learning really don’t want to take a lot of time away from that learning. Sometimes in classroom settings they’re like, “Ah, I didn’t like this anyway, so if you want me to do this other thing, fill out this survey, I’d rather do that.” But in informal contexts, that issue of not detracting from the experience is really important, so short surveys seem to be the right compromise. They often give you insights. As you’re watching you might have some beliefs about what’s happening inside the learners’ minds, but often you’re surprised and find out that someone who looks like they’re thoughtfully engaged is actually totally off task. And somebody who looks like they’re in la-la land is actually just deeply thinking about the experience, and without asking you have no way of knowing.

Paulette: It’s convenient to administer surveys, because at the end of an activity it takes just a couple of minutes to reflect on what just happened.

And what are some tradeoffs to doing a survey versus some other kind of measure?

Christian: Well, there is some cost to it. Some people are exploring learning analytics kinds of automatic assessments. The learner literally does nothing to consciously report their feedback; instead, you’ve got a camera on their eyeballs, you’re measuring how much they’re pressing their butts into the seats, you’re looking at what they’re clicking on. That’s the cheapest method, but they’re all somewhat indirect. Our approach takes a bit of learner time, which is a cost, but it’s directly focused on the things we’re trying to learn about. And I think we’re a long way away from having a science of those automatic assessments where we can really trust that those measures are about engagement, as opposed to some other things.

Paulette: We made sure that all the questions we’re using with learners are meaningful. We interviewed a really small set of them first, before doing it at a big scale, about what they thought the question meant. We also took a long time to figure out that

the way the questions were worded was actually interpreted by the learners the way that we wanted, and that they were actually understanding the things that we wanted them to be thinking about when they were reflecting on their activities. So, it's not only that other assessment measures are indirect—to get the best results from surveys, it's important to make sure that the way learners are interpreting your question matches what you're looking for. We have done a lot of work on that too.

Christian: There were a lot of questions that we thought in advance, “Boy, these are awesome questions,” and they turned out to be horrible. So it isn't easy to come up with a survey of engagement that really works. I think in this case I would highly recommend relying on the validated instruments, because there are so many ways to have bad questions that you would have thought were fine, but they just don't mean what you think they mean to learners.

What advice would you give practitioners who want to integrate your findings about engagement into their work?

Paulette: I think that often it's seen as a does-it-work-or-not kind of approach or like the average engagement sort of thing. I think that if we truly want formal and informal experiences to change the way learners perceive science and their own trajectories in science, we really need to start looking more at the “for whom” aspect of it and how people have differential interpretations of the same experience. Girls overall won't have the same experiences as boys; there are components related to people's family life, their race, and their past experiences that will influence the way they are engaging in a certain activity. We are looking for those sorts of differences, and understanding how learners experience something differently will allow us to make changes that will have a huge impact on learners.

Christian: I would also add that we consistently find that affective, cognitive, and behavioral engagement don't travel together. That is, some

experiences work really well on one of those dimensions but very relatively poorly on the others, and those have long-term consequences. If you're not measuring each of the elements, you might not even notice that your designed experience isn't working for some other aspect, or at least not for a lot of learners. You're thinking, “Boy, they look so engaged, and they're totally doing the activity—”

Paulette: But they feel like they're not part of the community, or they feel like it's not fun and like you're just having a really huge detrimental effect on them in the long run.

How do you measure the three different aspects of engagement?

Christian: The survey has separate questions that really try to focus on one aspect separately from the others. We also do a lot of careful measurement studies to make sure that we include all the aspects in the survey. We also, through the interviews with participants, make sure they're interpreting the questions about each aspect individually and not just overall. That actually is one of the ways in which you can come up with bad questions, questions that you think are about one thing and they interpret it in another way. That's especially the case for questions related to boredom being about affect versus being about cognition.

What are the big questions in informal science education, science communication, or even formal education for the next five or 10 years regarding engagement?

Christian: Well, I think there's a “designing for subgroups” question we need to explore—how to help people navigate through things that are likely to be good experiences for them. We also want to take on personalized learning in informal contexts that use engagement as a way of framing what that personalized learning should look like. But there's a challenge there, which is supporting multiple aspects of engagement, not just the affective side. Sometimes free-choice learning leans heavily toward the affective side of things, and to have all the long-term outcomes that we want, I think we want to

support choices toward experiences that are deeply engaging across the board. To do that, we need to figure out how to predict who will engage in what way and how to direct them in ways that they feel like they got a good deal, in both the short and long term.

Is there anything else about engagement in science learning that you want to share?

Paulette: I think one of the things that we have seen consistently is how past attitudes are not likely to change fast. Attitudes like whether they are interested, and whether they feel like they can do science or not, have a huge impact on how they engage, and that is something we usually don't think about. We sometimes think that just making something fun or free choice is going to automatically allow them to be super cognitively engaged or super affectively engaged, when truly they have such a long background of prior experiences that affect their engagement now. This is a really hard thing to not only keep in mind but to manage in practice. How do we design experiences that account for this, because it's really hard to know what they have done before? Maybe they went to a museum where they had a terrible experience, and then they come to your library or your school and they carry this background about this horrible experience, but you don't even know they have it. It's really hard to design for that, but we have constantly found that it matters, so I think it's still something that we need to figure out how to measure better or how to avoid so that those negative prior experiences do not affect their current experiences.

Christian: Some people have talked about [agentic engagement](#). There's not much known about it or how to fit it into the package, so I think that will be a big open topic for the next five years. We need to figure out how to conceptualize that notion of agency in an experience. How should we support it? How does it relate to the other aspects of engagement?

Paulette: I think in the same way, we're also not sure how to fit social engagement in the package. We don't know if engaging socially should be something separate or should even be part of the way we conceptualize, because the way it's measured right now is really personal. Are you happy? Are you engaged? Are you thinking about the activity? Those questions don't consider how teens are working together or how students are collaborating. The maker movement often matches people up to have someone with experience working with someone who does not have experience. We don't have a good way to measure that kind of interaction to determine whether those interactions between people are truly productive or not. Again, if you're just observing, you may think that they're talking in an engaged way and one of them is explaining while the other is following instructions, but you truly don't know how is it working or not. I think that's another thing that people are starting to talk about, but we still don't have a good consistent way of studying it, looking at it, and understanding the impact it has on activities.



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