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What is STEM Engagement?

An Interview with Douglas Clark

On July 20, 2018, Martin Storksdieck, Director of the Center for Research on Lifelong STEM Learning at Oregon State University, interviewed Douglas Clark, to understand his thinking on the topic of engagement. Dr. Clark is Professor and Research Professor of Design Based Learning at the Werklund School of Education at the University of Calgary. His research investigates the design of digital learning environments and the learning processes through which people, particularly middle school and high school students, come to understand core science and computer science concepts in the context of those digital learning environments. A video of Dr. Clark's interview, as well as interviews of other researchers, is available at InformalScience.org/engagement.

What led you to study engagement in your work?

Well, my work focuses on designing digital game environments and other digital environments that support kids learning science. In that context, I see engagement in terms of motivation and motivation to learn. Research in educational psychology and the learning sciences in other fields has tried to identify what motivates or engages people in learning. For instance, there was an excellent synthesis article a while back by a noted expert, and he frames the research outcomes in terms of five major headings about what motivated and engaged people in learning. It was interesting to me that almost none of those characteristics were represented in traditional schooling. Traditional schooling is actually really bad at engaging students, at least in any kind of intrinsic sense. Traditional schooling tends to focus more on extrinsic motivators, like grades and punishments. I also became interested in the fact that digital games, at least in the commercial world, are very good at motivating people to learn. What people learn as they master many popular digital games, in terms of the underlying models driving the game, are far more complex than what we try to teach in schools, and the games don't have any formal leverage over players. In fact, they're trying to entice players not only come play the game but actually to pay money to do so. So it was interesting to me to compare those differences. What was even more interesting is that even though the game designers were probably completely unaware of all these researchers who have been studying motivation to learn and engagement, there were heavy parallels between what educational researchers and psychologists have demonstrated is important for

motivating people to learn, and what the game designers had built into these games.

How do you conceptualize or define engagement?

Engagement is a tricky term. It seems to have a great deal of overlap with motivation and with interest. The distinction is that engagement tends to focus on a very present commitment to being engaged in the moment, whereas interest doesn't necessarily do that, and motivation could be for all kinds of reasons. If you're engaged in a given task, you're doing it because you're really interested in it or you really find it immersive to you, but that's not necessarily the reason underlying motivation for a task.

If you imagine a traditional science classroom, you envision a teacher standing at the front of the class going through a set of notes and outlining information that students are meant to make sense of or at least memorize. The students probably don't look like they're really enjoying what they're doing. At best, some of them are hard at work scribbling away, but a lot of them probably look fairly disengaged. So that seems problematic at multiple levels, but for engagement I think we'd all want to have learning environments where people were more actively involved in their learning and have at least some level of intrinsic desire to do it. So in contrast, when you think about games, people see them as, "Oh, they're colorful, they're pretty, they give rewards or they're fun," some sort of narrow idea like it's happy happy all the time. But researchers in education and learning sciences, as well as game designers, don't agree with that view. The former chief creative officer of Sony Online Entertainment, who was in charge of making their games, wrote a book saying that that's not really what fun is. Fun is really about being engaged, and from the perspective of Sony Online Entertainment at that time, fun was about learning. It was solving puzzles, and learning things. So many times when you're playing a game, you may be actually gnashing your teeth because you're stuck on something, but overcoming that challenge and figuring things out is what fun and engagement are about, both from the perspective of game designers and also for researchers like Paul Pintrich, who was an educational psychologist at the University of Michigan.

So when we think about engagement, we need to think how to get people more actively involved in something they care about and want to be doing. So much of our design focuses on that. It means providing players or students with more agency. It involves providing them a clear sense that they're making progress. It also tries to instill an idea that learning is more about a growth mindset—if you were to think more along the lines of Carol Dweck, who's a professor of psychology at Stanford—than it is about some fixed capacity like somebody's just a smart kid or not a smart kid. And schools are very bad at that. Schools tend to have a single end-of-unit test, and if you don't do well on that, you never have a chance to try to do better. Everything is very much about measuring, measuring what and how good you are, but you have no sense of agency and no chance to explore, experiment, and refine in tight cycles of feedback. So I think there are a lot of different aspects that can contribute to agency and engagement, and I'd say that's the major thing that we're interested in.

How do you measure engagement in your work?

Well, in our own work, we have focused more on building in features and structures that might engage people, and then looked at how that affected learning. Our measures of engagement tend to be fairly standard, such as the engagement surveys that use the Likert Scale. Some researchers use more intrusive means of measuring engagement, such as periodically interrupting people and asking them to report on their levels of engagement. We haven't done something as intrusive as that because what we're doing tends to be fairly complicated already, and we don't want to break the flow of what people are doing. That's another conundrum; a lot of the research on games notes that surveys interfere with the flow aspect of engagement, and you don't want

to break people out of that. So instead we've done a lot of post-surveys, coupled with observational work, like field notes. We haven't done a lot of sophisticated measuring of engagement. Instead we look at environments that are considered to be more engaging and see what kind of learning happens in them.

What are some other ways to assess engagement?

There are some that are simple, like just measuring off-task kinds of behaviors versus on task behaviors, and those are pretty easy to do relatively objectively. You can also try rubrics that are even more fine-grained, distinguishing within people who are on task between those who are showing some commitment and investment in the activity, and those who aren't. Some people like Ryan Baker and other learning analytics people who try to induce various affective observations of students' levels of engagement, motivation, or interest through the data traces in digital environments. We have not done that, but there are people who do study that. Some people have even gone so far as to measure posture, galvanic skin measures of conductivity, and pupil dilation. So there certainly are a lot of ways to try to infer levels of engagement. But as I said, that's not my area of research.

How would you advise practitioners who want to apply your findings on engagement to their work?

I think I would go back, particularly in an educational setting, to Paul Pintrich's 2003 synthesis of research on motivation to learn. That synthesis concluded that adaptive self-efficacy or adaptive attributions, as well as competence or control beliefs, motivate students. Also, higher levels of value motivate students, and goals motivate and direct students. I would recommend that practitioners think particularly about the roles of agency and what providing students agency and social structures can do for them. All people are very social, and this traditional school arrangement in which students have to sit and perform in isolation quietly at an individual desk doesn't seem to fit well with any research on engagement or motivation. So the trick is to figure out how to structure activities in the classroom or informal settings that productively provide students with the opportunity to work with others, to have agency, and to work on things that they find personally meaningful. These have been rallying cries for reform in education for a long time, but the fact is that if you look at most classrooms, they're either very traditional in structure and these things aren't in effect, or it's being done very haphazardly like "Let's just put the students in groups and leave them alone and hope that something good happens." I think we've all heard kids saying, "Oh, not more group work! I don't want to be punished because my group member didn't do his or her part." So there's been a partial implementation of some key ideas in the design of learning environments, but probably not following the thoughtful, careful design that is needed. But it's hard for us to imagine what such a classroom might look like because we have all come through the traditional system. Teaching may be the most heavily apprenticed job in the world. We all had 13 years of K–12 and then probably at least six years of undergraduate and then a couple years for a master's, so by the end we're pushing 20 years of watching what school is. And our parents did that too. So thinking what school might look like beyond that and rethinking what the goals of school might be is very challenging, and those very entrenched mindsets make it hard to develop engaging activities within school that serve the purposes of school as defined. It often ends up feeling artificial.

What are the big questions in informal science education, science communication, or formal education science education in the next five to 10 years with respect to engagement?

A huge question would involve rethinking what school is about. I think we have a real problem, particularly in science education, in terms of the traditional framing of science education as learning science concepts that scientists know. That's a very

archaic perspective of *tabula rasa*. There's stuff that scientists know, and we need students to memorize that stuff. And there are changes like in the Next Generation Science Standards (NGSS), which accord importance not only to learning concepts but also to learning and engaging in the practices and processes of science, and developing identities as people who might have a career in science. And to think about what makes things work in a very concrete way. NGSS seems to provide a great opportunity to make a shift, but it's so radically different from what we've always done that teachers and researchers are having a really hard time thinking about what the curriculum actually looks like, and how to do this thing. I'd say the big question is how to rethink our goals for education in a way that supports an experience for students that is engaging for them, provides agency for them, and in which they see value.

Is there anything else you want to share about engagement?

I think it's really important to look at informal settings for science learning or other learning. Looking in homes, looking in afterschool or neighborhood clubs, seeing when people go and learn something really complicated just because it's important to them and they find it immersive, where they're clearly immersed in working hard for the pure pleasure and desire to understand and be more proficient in doing something. We need to figure out what that is, how it's happening, why we don't see it at schools, what it would take to see that kind of engagement in schools, and what it would mean for redesigning schools. We do see engagement in clubs or in some of the traditional archetypes, like, for example, a rocketry club. But we also see it in games. Look at what people are doing when they're playing games. Or look what people are doing in terms of even more typical household or daily living tasks, like learning to cook, learning to read, or learning to talk? How is it happening, and what are the characteristics of those learning environments that lead to such engagement? Then we have to rethink why schools are so different from that.

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