

# What is STEM Engagement?

## An Interview with Eric Klopfer

On July 20, 2018, [Martin Storksdiack](#), Director of the Center for Research on Lifelong STEM Learning at Oregon State University, interviewed [Eric Klopfer](#), Professor and Director of the Scheller Teacher Education Program and the Education Arcade at Massachusetts Institute of Technology (MIT) as well as a co-faculty director for MIT's J-WEL World Education Lab. His research—using a design based research methodology to span the educational technology ecosystem, from design and development of new technologies to professional development and implementation—has focused on computer games and simulations for building understanding of science, technology, engineering and mathematics. A video of Dr. Klopfer's interview, as well as interviews of other researchers, is available at [InformalScience.org/engagement](http://InformalScience.org/engagement).



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### *Can you describe the work that you do?*

I'm a professor at MIT. I'm the Director of our [Teacher Education Program](#) and a group we call the [Education Arcade](#). I do research and development of new educational technologies, which includes a lot of work in games and simulations.

### *How do you include the concept of engagement in your work?*

It's certainly a part of our work. It depends on the context in which we're doing our work or the particular product that we're developing. Even in cases when it's not an explicit goal, it's something we think about. Our work falls into three categories: we work in school, we work with schools, and we do work totally outside of school. Certainly in the latter two categories engagement is critical. I think

about engagement as people voluntarily participating and sustaining their interactions with some of the work that we do. In those spaces where there's choice, almost unlimited options—you can do this project or not do this project, go do something else—engagement becomes a critical measurement. But even in schools, we think about it as well. We want to have people doing the activities we create not just because they have to, but because they want to.

### *How do you conceptualize engagement in your work?*

I've been thinking about how I would define it. I think about engagement as voluntary, sustained participation in whatever kind of activity we've designed. It is voluntary; the person has to be able to leave if they want to leave, and it has to be

sustained. Sustained means the person can do it in one big dose: they're doing an activity and they just don't want to leave it for 45 minutes. But it could also refer to sustained interaction over days or weeks or months, when the person might come back again and again. So we have to think about multiple time scales for things like engagement.

### *How do you think engagement differs from interest?*

In the case of engagement, at least the way I think about it, a student or a participant doesn't necessarily need to have defined the activity as a prior area of interest. We've created a scenario or an environment that has maybe piqued their interest, but it isn't something they would necessarily identify as one of their particular interests. Sometimes we do that through narratives, sometimes through identities, sometimes through the kinds of tasks they're doing within those kinds of spaces. But they're ultimately engaged with that experience, even though they may say "Well, it wasn't an interest of mine that I identified beforehand or maybe even now." We hope it becomes an interest of theirs that they identify later on, and that's one of the reasons why we do these things: to help people realize that they may have interest in things that they don't necessarily pre-identify.

### *What role does engagement have in science learning?*

There are so many ways that engagement plays a role. One of them is simply that when we create experiences, we often expect that somebody is going to use it for some amount of time, for a relatively longer period of time. They might need to work through several levels where we really challenge them with new content. The exhibit might need to cover several different subject areas. It might be simply that it takes a fair amount of practice to gain mastery in some area. So for all those reasons, it's important to be engaged over time. But perhaps more importantly, the activities that they're doing become something they're doing voluntarily, something that they want to do, and that feeling is engagement. They then begin to develop

ideas around their own self-efficacy, their own identity with respect to those activities or concepts. We want people not to do those things just because they're fun but because they ultimately have some attachment to them. They start to value and identify with the ideas themselves.

### *How do you measure engagement, and do you see tradeoffs regarding your approach?*

We do measure engagement in various ways, some of which we think are more reliable than others. They each are probably measuring some aspect of engagement that matters, and ultimately we triangulate meaning out of those things. I'll start with things we don't do. We don't do biometrics or pupil dilation or anything like that. I think there's some value in that approach, particularly as it becomes less invasive as you can do things with cameras. But even cameras can make people feel like someone's invading their activity and can affect their personality. We do the most obvious approach, which is also probably the least reliable: surveys. We do surveys with the people who participate in our activities, and we do interviews and ask them about ways in which they've engaged. We ask them about their choices that they made along the way. That's somewhat more reliable, but obviously it's hard to scale those things, so more and more we do rely on metrics from the digital technologies that we use. We look at how frequently someone will come back to an activity, how long each session is, and how those factors relate to the activities that they were doing in that space. Are they coming back simply because they had success, or are they coming back in spite of failure? Time and frequency are some measures of engagement, but I think actually the more complex way to measure engagement has to do with the specific activities that someone's doing within that space. Those become more interesting measures of their sustained engagement. Are they going back to places that ultimately challenge them? Are they spending time in that [zone of proximal development](#) where we, as researchers and designers, think that they would be most engaged, or are they doing things in other places?

### *How would you advise practitioners to apply what you've learned through your research to their work?*

One thing I would note is that we do a lot of work using games, and people often associate games with a specific vision of "fun". What fun looks like in that vision is people smiling and giggling, like they're watching a silly cartoon. And that's not necessarily what engagement looks like, and not what we shoot for in our design. Instead we shoot for engagement, which often looks like people being frustrated. Some people call it "pleasant frustration"; my late colleague [Seymour Papert](#) called it "hard fun." The idea is that when you're being challenged, you're in that zone of proximal development, and you fail sometimes, but you ultimately get the feeling of fun. It comes from succeeding after a series of failures. So my advice would be not to necessarily look for people smiling and giggling, but to think about situations in which people don't want to give up on a task and persist in spite of failure. You want to find the activities that they persist with through challenging situations—and again, that persistence doesn't necessarily need to be continuous, they can revisit something. Many years ago, I remember being in a classroom doing a whole-class simulation, and the class was not making a lot of progress. They were still putting forth a lot of hypotheses, but they were not making progress on figuring out the system. And then my colleague and I went to the cafeteria, and an hour later these students came running in and said, "I think we have an idea! If you tried this, would this work?" We told them, "We don't know, you'll have to try that next class period." I think when the idea of the experience remains in the back of your mind and it's something that you revisit again, even if you leave the experience feeling frustrated, it's that pleasant frustration, that sense of "I'm faced with a problem and I really want to solve that challenge."

### *So how do you design an activity that provides that experience?*

You have to design challenges that you think are just out of people's reach and think about

experiences that progress so that each subsequent task is built on the previous task. It's something that game designers and level designers do really well. It's not a trivial task. We need to think about both the interaction or game design and the pedagogical design. We think about the literature on [learning progressions](#) and the way that informs some of our work, more so in some spaces than others. But it's important to incorporate all those simultaneous states. If we're informed by only one of those at a time, we're missing something.

### *Thinking about formal education, informal education, or even science communication, what do you think are the big question for the next 10 years around engagement?*

I think engagement is more something that's lifelong than something that's going to last for the 12 years of your pre-college education, or maybe 16 years of your education if you go to a university. The role of science in our lives and in our careers is really increasing. As we think about a 21<sup>st</sup> century—ready population (and of course we're well into the 21<sup>st</sup> century already), we need to be thinking about a population that continues to be engaged with those ideas in science. We need to be thinking about things that start during the school years, perhaps very early on, that we've perhaps have ignored. We think of science as something that you do a little in elementary school, then you take it more seriously in middle and high school. Maybe we should push those experiences back further to the elementary grades, not just to make sure that students learn but to help them get engaged with those ideas early on and hopefully create lifelong attachments to those things. Similarly, maybe we should think more about keeping science relevant in the lives of people after they graduate from high school, people who are not pursuing science degrees but still use science in their habits of mind and their practices. Science can still be there for people who don't even go to college; it's something that they can learn more about, either through work experience, or through lifelong learning experiences that are outside of work.

*Is there anything that you'd like to add to the conversation around engagement?*

I want to note that you can't necessarily engineer engagement. I mentioned earlier the role of learning analytics and how we use them to inform what we do. But engagement isn't something that happens by engineering; you can't come up with the set of exact principles that will lead people to being engaged. There is a science to it, and we should be using data and informing our design space based on that. There's a really serious aspect of design in the social sciences, understanding the way people work,

the way they think, the way they collaborate, and the kinds of things that they enjoy outside of learning experiences in their everyday lives. And their lives are a constantly evolving space that is not uniform, that varies according to age, socioeconomic status, and where people live. There are so many different factors that you really want to think about your audience very carefully, interact with them, and understand what they like, so that you can think about incorporating those things in the designed experiences.



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