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What is STEM Interest?

An Interview with Adam Maltese

On April 13, 2018, Martin Storksdieck, Director of the Center for Research on Lifelong STEM Learning and Professor at the College of Education at Oregon State University, interviewed Adam Maltese, to understand his thinking and work on the topic of STEM interest. Dr. Maltese is an Associate Professor and teaches courses in secondary science methods and graduate seminars at the School of Education at Indiana University around making and the development of interest in STEM education. A video of Dr. Maltese's interview, as well as interviews of other researchers, is available at InformalScience.org/interest.

What led you to study the concept of interest?

It originated with work that I did as a graduate student. To start the interviews that we were doing with scientists and graduate students, we came up with a question that we wanted to be an easy way for them to start the conversation, and that question was, "How did you first get interested in science?" And I got so intrigued with the responses that they gave. Then that rolled into the survey that we developed and then it went from there, but that's what initially triggered my own personal interest in this topic.

Tell us about some of your specific projects that focus on aspects of interest.

It's hard for me to find projects that I'm working on that don't look at interest. There are a few, but most of the work that we do is trying to figure out what triggers interest, what starts that interest in individuals, and how that interest is maintained or lost over time. And we do that a couple of different ways. So we've done work where we surveyed younger children and we asked them to look forward and talk about what careers they might have, as well as their current experiences, what they're doing in their science classes or their activities, and what they think about that. Or we go toward the other end of the spectrum where we ask adults. Often we've done this with undergraduates, graduate students, faculty, and other professionals, and we'll ask them to look backward and tell us what they remember about their experiences and the pathways to where they've gotten to now. We typically do that with survey instruments; and we'll create some surveys and ask these questions of these different groups, then try to evaluate those data and see what we can learn from it. There are limitations with either approach. The younger kids typically lack some perspective, and sort of smaller events might influence their responses, from what we can gather. With the adults, often their memories might be hazy and they're not

remembering key things when we ask them about that. But we try to use both of those approaches to give us the best sense of the contract of interest that we're looking at.

What is your working definition of interest, for the purpose of your work, and how does your concept of interest potentially differ from that of others?

I think we came to interest through the colloquial regular understanding of the word that most people have. And only after trying to do some research and using that term and not finding a better word for it did we encounter scholars who focused specifically on interest and some of these other attitudinal measures. They were very polite about educating us on different models, ideas, and constructs that are related to this. I still think that I use a pretty basic definition, which is this: *interest* is somebody's desire to reengage with a topic, to want to do more of it, to learn more about something, or to do more of an activity. When we are talking about it, that's typically the way that we are thinking about it. There are definitely other more complex definitions, understandings, and models of it, but that's the way we think of it. It's hard to separate it out from things like engagement and fascination, but I typically, in my mind, put a lot of them in the same area that we're all focusing on. You can divide them, but for me it's more the bigger set of them that's the important thing to think about. We're looking at positive attitudes toward science or STEM or whatever, that make somebody want to seek out the possibility of reengaging in that if given the chance.

How do you measure or assess interest, and what are the tradeoffs of your approach compared with other approaches?

We typically default to survey methods. There's a host of limitations, because not only do we have our own interpretation and way of measuring, but the respondents, whether they're kids or adults, interpret this word "interest" in their own way. As we've tested that, it generally seems that interest is a nice construct and people do seem to have a generally similar definition and understanding of it. Sometimes we've asked bluntly, "Are you interested in science, and can you rate your interest in it versus something else?" But often we ask things like, "If given the choice, would you participate in something like this?" Sometimes, to assess STEM career interest, we might ask, "What job or what career do you think you want when you get older?" So we try to come at it a couple of different ways. We do not do as much observation, in which we examine, for example, videos of a classroom or an informal activity, or in some other way try to distill whether or not somebody is interested in a topic. So, typically, we're asking questions about their positive attitudes toward the topic or asking if they have interest in a given area.

Do you normally use ad hoc instruments or build off existing instruments?

We build off things that we've generally created ourselves. When I talk about the inquiry cycle, what that means in my research is that we do a continuous cycle through qualitative observations, interviews, and informal discussions with people. Sometimes we might collect data from a few people or 100 people or so. Then we'll use those data to inform further survey developments, and then we iterate on the survey from there. One of the current surveys that we're doing with adults has been in existence for probably close to 10 years, but we've modified it each time we've used it to look at different aspects of interest. We've kept some of the questions the same so that we can compare across those waves.

Why and how do you think interest matters for STEM or science learning?

To be honest, I think that the evidence for positive outcomes is still a little bit mixed. But here's one of the ways that I couch this for my pre-service teachers whom I teach here: I've asked some senior educators what challenges they still face in the classroom. These are award-winning teachers, and they say, "engaging all learners in a topic." Bringing them in, making them engaged in the topic, keeping them interested. And so, I think that often interest

gets couched as just something that might be associated with them wanting students or youth wanting to participate in an afterschool club, a robotics club or a competition, or getting students to make the choice to go to a museum or something like that. But one of the things that research seems to suggest, and one of the things that I share with my future teachers, is that there's pretty good evidence that if you can get your students or your learners interested in the topic that they're working on, and often that's by making that topic relevant to them, about them, or about a topic that they're interested in, then that can lead to all these other positive things. So, it's not just me saying, "Oh, if you want to be the best teacher, teach good content and keep them interested." The interest does seem to drive engagement with the material, and that can lead to a whole host of other positives that we want from our learners, because they're going to engage deeper with the content and that typically leads to deeper learning.

How do you think science interest is connected with identity, motivation, or attitudes? How do you distinguish science interest from these other concepts, if at all?

It's funny you ask this, because for an upcoming conference we are going to be sharing a tool that we've started compiling, and the tool is mostly focused on measuring science interest for engineering, but we've also done work in making makerspaces. What I'll be talking about there is taking this tool and shifting it. The tool is part a survey on interest and identity in making makerspaces.

I think there's a decent amount of overlap, and I feel like I will always be thinking about how to disentangle those topics. I think they're definitely related, but I'm not sure how much they are related. In terms of identity, which is its own ball of spaghetti in terms of intersecting ideas, I think that one of the ways that it's absolutely connected is that without some amount of interest, I have a difficult time understanding why somebody would want to identify themselves with a given area, topic, or field. So, I think that's one of the ideas that we're trying to explore. We've been educated by some of our colleagues who do work in this area on things like being recognized for your work in a given area or being recognized as an engineer or a scientist. That is important, but I see a number of these topics as feeding back into themselves. So, the way that I think of the model is that we often want to draw these models either for statistics or for papers, where we plot something on the page and we draw arrows and say, "Thing A impacts thing B," and maybe, "Thing C is influencing that as well." In my mind, I view them over time as a motion picture where it's a consistent thing, where that image is not fixed, and interest and motivation and engagement and identity are constructs that are consistently ebbing and flowing. If you measure them at that next time point, that's fine and you can use those data to write up a paper, but then it continues to move and flow; those things are still moving and changing. So, it's not just a single static condition where one thing always influences another. There's this sort of consistent interplay.

I think one of the things that we've looked at and talked about is when students are making their choice to pick a major, let's say, at a university. We used to think that some of the data indicated that people choose majors primarily because of what they're interested in. It makes total sense. It seems logical. And there are data to indicate that that's true across fields. If we separate it out into STEM people and non-STEM people, both groups indicate that interest was the main reason why they picked their major. Based on some other research, we thought that people might change majors because they start losing interest in a given area. But based on some interviews and some other surveys that we collected, it seems more like what happens is there's a relative shift in interest. Our focus is usually science. For example, a student might come into college. They think they want to do biology, and their first year they're taking some biology classes and they're taking some foreign language classes. And they like the biology, but they're sort of working their way through it and maybe it's not increasing their interest. But they have a really great

experience in a foreign language class or a history class or something like that. And at that snapshot, at a critical time when they're making a decision, they're really gaining interest in say history or foreign language, while their interest in science is staying stable. So, that triggers them to think, "well, maybe I would enjoy it more if I went into these other fields." And it seems that that's why some students make these shifts. I have to imagine that that happens throughout our lives. That's where I think it's interplay in the timing, and all of those things come together in a complex way to really make these feelings manifest into different activities that we do and choices that we make.

People tend to say not that they're interested in science, but that they're interested in biology, chemistry, or physics. Instead of foreign language, they're into Spanish or German. What do you think about being specific in order to capture interest?

There's a parallel to this question that we've been dealing with, which is creativity, and the notion of domain-general creativity or domain-general ingenuity, versus domain-specific. I think there's more of a chance for domain-general interest than domain-general creativity, just as a comparison. My area of focus is science education. I taught earth science and I taught physical science, which involved chemistry and physics. I like biology as well, but I just don't have the depth of knowledge in that area. But I generally really like science across all of those aspects and really like STEM broadly. We absolutely talked to people whose interests are more domain specific. As an example, let's say, undergraduates are really interested in biology, but if they never had to take another chemistry or physics class in their life they would be more than happy about that. My thinking is that that's more the fault of the education they've received than it is a result of a specific interest that they have. They just haven't been turned on and shown how those other fields can be fascinating and interesting. And this goes back to the notion of identity. Sometimes people will identify as an arts person or a science person or something like that. And I do think that there are probably subareas where people have greater amounts of interest, but I think that they can have a broader level of interest across a number of related fields. It doesn't have to be so super specific into one sub-discipline of an area.

What kind of practical recommendations do you have for people from your academic research on interest?

So how to use this in a practical sense in a learning environment, whether it's formal, informal, or anywhere else, is something we've thought about a lot. As an example, one of my students who worked with me had a strong interest in zoos. We talked a lot about how she could maximize the interest and experiences of zoo visitors in order to give them a better experience and also to further their education, environmental stewardship, and so on. She didn't do a broad survey of zoos, but she found that often this opportunity to maximize interest is missed. It seems that people either go way too specific or they go way too broad. There's an assumption that everyone will be interested in a particular topic or thing, so the zoo makes it too specific and misses some visitors. If you think of a reptile house at a zoo, there will be people who choose not to go in at all because they're not interested or they're afraid. So you miss that opportunity to engage them at all. Instead you need a dynamic program that has more than just one facet to it, I think it makes sense to try to engage different audiences through different approaches. What I mean by that—and we would recommend this for classroom teachers as well—is to make the content relevant to the students and to the area that they live in. We talked about place-based education, and that notion makes sense. I've definitely seen some museums and some exhibits do a great job of making what you're seeing in front of you relevant to your city or town or the state or region that you're actually located in. That seems great, but there will also be people who don't visit or who visit from outside that region. For them, it might be a little less relevant or a little less engaging. But people bring all sorts of differences with them and all sorts of experiences. So, I think it's incumbent

upon an educator, whether it's a classroom teacher or somebody designing an exhibit, to really think about who it is that typically comes to their space, who they really want to bring into their space, and how the demographics or the experiences of that person or that group of people can be enhanced in an exhibit. Often we used the analogy of turning up the dials on a radio; it's not that you necessarily have to create a different exhibit or a different experience, but if you know that certain groups are your target or that you're trying to enhance their experience, you can turn up certain dials and turn down others to spotlight certain things or make it more relevant for this group than others. And generally, what we've seen is that if you can do that in an experience, and of course these experiences can span a whole range of things, you're going to see greater engagement. That might be dwell time at an exhibit, or that might be time that the visitors spent not paying attention. They're staring at their phone and they pick their head up because you've mentioned the location that they're from, an experience that they've had, or even just a question that they've had. We did a great tour at the San Diego Zoo not too long ago where the person giving the tour just did a great job of bringing up questions that people typically have about animals and asking, "Do people know why this exists?" and people would throw out their answers, and he gave some interesting response. That knowledge exists in a lot of educators, and using that knowledge to tie into different things that people have or they're interested in can be a trigger for them. It might result in paying attention for just a short amount of time or being interested for a short amount of time, but that should still lead to a better experience than if everything is passive. The understanding is, we need to do everything for everyone, and so therefore we do it at a very general level.

Do you think interest will be the big question in informal science education and science communication, or even formal science education, for the next five or 10 years?

I think the Holy Grail for me and particularly in the formal world is how this all unfolds long term. I was reading a paper from one of our graduate students the other day, another one who is focused on zoos, thinking about how a visit to a zoo or a museum, a class, an adult night experience where they're learning about the stars or something like that, how that might change that person in the long term. I think that's the big open question that some people have taken on, but it's a really hard question to take on, and getting funding for it is challenging. But I think we need to look past small shifts in a single one-off experience and how that might impact a learner. That can be fine and that can build up to a bigger thing, but we need to really think about how those experiences can influence somebody in the long-term and be realistic about the ecosystem that this happens in where they're getting engaged. People are engaged with lots of different media and lots of different experiences. So, your one experience that you're putting together might influence them in a really small and miniscule way, but if it nudges them in the direction that you hope to nudge them, whether that's to make a certain choice again about sustainability or environmental awareness, or to get more interested in potentially pursuing a career in a given topic, if you can keep the door open longer and what you're doing helps to keep that door open, then we consider that a win. If it nudges the door toward being closed, then it's probably not a win, and you need to think about how you can revise that. But I think this notion of how all of these experiences come together in the trajectory of somebody's life history is the most important thing that we can look at, and trying to be realistic about all the different ways they can interact with these experiences. I think that's the most important thing we can focus on.

Is there anything else about interest and science learning that you want to share?

One of the things that we were initially discouraged about but have become more excited about is that when we've asked about interest, what triggers people's interest, and how it was maintained over time, when we've shared those results with people, some of them have responded with sort of a

deflated feeling. I think the reason is that there is not a clear silver bullet so to speak. If it came out that if people engage in a great afterschool club or a science fair when they're young, then they're guaranteed to want to go on and pursue science, that would be easy, because then we could focus all of our efforts on that. While that might be frustrating for some people, we could focus there and we'd be guaranteed an outcome. Our results suggest that some things are more commonly reported than others. But across a pretty broad swath of experiences, we see people indicating all kinds of different experiences, from playing video games to going to museums to playing outside to reading books, were a trigger or at least important at some point along the way. Initially we were not sure how to deal with that, but now I think I'm more satisfied with that as a conclusion, that we need a number of different ways and opportunities for people to engage in these things. And maybe library programs are going to do it for some learners but not for others, because of access and just lack of interest. For others it might be spending time outside or engaging with their families or a variety of things. So I think the fact that our findings support this notion of diversity of pathways is a great thing, and it really does support the idea that we need all these institutions, and it doesn't make it easy. It actually makes the answer more challenging because there's no silver bullet, but I think it also gives credence to the fact that these organizations all play some sort of role at different times and different places for people.

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