

What is STEM Interest?

An Interview with Nichole Pinkard

On April 5, 2018, [Jamie Bell](#), Project Director and Principal Investigator of the Center for Advancement of Informal Science Education (CAISE), interviewed [Nichole Pinkard](#), to understand her thinking and work on the topic of STEM interest. Dr. Pinkard is an Associate Professor in the School of Education and Social Policy at Northwestern University in Chicago, Illinois, and Faculty Director of the Office of Community Education Partnerships. She is the founder of Digital Youth Network. Her research interests include the design and use of pedagogical-based social networks and socio-technical systems to support community-level ecological models of learning. A video of Dr. Pinkard's interview, as well as interviews of other researchers, is available at InformalScience.org/interest.



Can you tell us about some of the projects you have designed that are addressing interest?

One was the [Digital Youth Network](#), which was our initiative to engage underrepresented youth in developing media literacy skills. That led to a [book](#) that I co-wrote with [Brigid Barron](#), [Kimberley Gomez](#), and [Caitlin K. Martin](#), called [The Digital Youth Network: Cultivating Digital Media Citizenship in Urban Communities](#). It describes five years' worth of work to close the gap in participation between urban youth and others. Then there is [YOUmedia](#), which we co-founded with Chicago Public Library, supported by the MacArthur Foundation. YOUmedia is a new vision for youth libraries. We created a main one in Chicago, and then we created four other versions around the city. That model was taken up and

supported by the [Institute of Museum and Library Studies \(IMLS\)](#) to lead to [learning labs](#), with support from the [National Writing Project](#), to promote scaled implementation around the country. Now there are 30 or 40 of those. They're the precursor of the [Intersections](#) project.

The final large-scale project is the [Chicago City of Learning](#) work, which started out trying to figure out how to document out-of-school learning in Chicago. I don't want to use the word "interest," which is an intriguing area to explore, because I think of the out-of-school space as a place where kids with resources are exploring their interests in a more wide-open space. Even in schools that have multiple pathways, they're probably only allowed to pick one to three classes in their whole high school

in their interest area. But outside of school is that space of exploration. So we did that with Chicago, and we then created and supported platforms that were used by Los Angeles, Dallas, Pittsburgh, and Dallas, as a way of making visible to communities the opportunities that are out there to support kids in their interest exploration. That work really opened our eyes to how the invisible structures that exist in communities really constrain or afford opportunities for kids to engage in interest development.

Another smaller project is the [Digital Youth Divas Project](#). The other projects went from one school to a community, to a city. For this one, we have been putting a lot of effort into trying to engage girls in STEM. It's not just curriculum, it's not just spaces, it's really a core set of interconnected focus areas that need to be brought together if we're going to create an ecosystem that can truly support and engage middle-school girls in exploring STEM without feeling that they're entering a space that is not designed for them.

What led you to study interest in your research?

Most things for me are probably my own form of therapy. So I was trying to understand why I, as a young African American girl from Kansas City, Kansas, ended up exploring and really becoming passionate about computer science. Did it just happen, or was there something in the environment that led that to happen? If it was environmental factors, I believe you can learn from those and create environments that support others. So I wanted to understand what existed in Kansas City, Kansas, and look at the spaces where I've chosen to work to see if we can recreate that, not just for girls but for whole underrepresented communities. No one told me I needed to be engaged in computer science, I just was fortunate to have opportunities both in school and out of school, back in the early 1980s, to engage with technology. I didn't have to come in saying, "I want to be a computer scientist." Or "I'm committing to a long-term pathway." For me it was just a place to play, and opportunities kept

being put in front of me that led over time to engagement, so I developed an interest and a passion for it. I believe that schools matter, but I also believe that the out-of-school space is critical, and I'm trying to understand what's that secret sauce and who are the players. I think we often simplify STEM by only talking about it in school or only talking about it as what parents are doing, I think we're leaving out the role of peers and the role of out-of-school activities as connective tissue that link both home and school together in ways that matter and are meaningful for kids. I'm interested in creating other spaces, not just one or two examples, but 10, 12, 20, to show that you can create environments that are reliably producing underrepresented youth who are engaged and motivated in STEM. We can all show one or two kids in our work who are the jewels. But we have to be able to show more than one or two, and that to me shows that there's an ecosystem at work and that's what I'm trying to understand.

How do you conceptualize interest when you're designing your research?

I think where I'm a little different is, I don't see myself as an interest researcher. I see myself as an ecosystem designer. I look at interest by looking at how kids choose to spend their time. I also understand in looking at the data for most things that kids are interested particularly in STEM, and for underrepresented youth there aren't a lot of activities or opportunities for them doing STEM-related things. So I think it's hard to look at interest for underrepresented youth in coding or making, because they're not surrounded by opportunities to engage in those things in the same way that they are surrounded with sports. Even if a kid on the South Side or West Side of Chicago doesn't have an interest in playing basketball, they're going to constantly come into contact with basketball and have to make a decision to play, not to play, just play a little bit, or go deep in it. Every kid has made a decision around sports because it's in their environment. They understand the social capital value of it. They see it on TV, they see it in their neighborhood, they see it at school. So if we want

to look at STEM in that way, then we can't say they don't have an interest in STEM if they don't have opportunities to come into contact with STEM learning opportunities besides the tech class at school. So I actually don't like to talk a lot about whether these kids have interest in this, because I feel like we haven't given them the opportunity to discover their interest. Now, if there's an ecosystem and opportunities and learners are choosing not to engage in them, that's different, then I can say, "Yes, they don't necessarily have an interest." But right now I don't even think we have enough communities that have opportunities for kids to explore their interest in STEM to be talking about who does and who doesn't. I think we need to talk about whether we have the ecosystems developed that provide the opportunity space to see if kids can participate or not.

What are some of your other thoughts about the ecosystem of opportunity versus access?

Well, we've used [Hidi and Renninger's](#) four-phase model a lot in trying to understand interest development, more through the lens of looking at girls and STEM than looking at race and STEM. Where we worked in Chicago, you often can't really look at race because the communities aren't diverse. Everyone in the community, or 99%, are African American. But for gender you can do some comparison. Here's one thing that has perplexed me in some of the work we have done and what I've taught in our DYN work, where I was the video game mentor. I was teaching the class and having problems getting girls to engage in the video game class. And when I talked to them about it, they were saying, "Hey, there's nothing can do to help me, as an 8th grader, want to sit in this class with 6th boys. You can't create one space that works for both of us." So girls might want to work on this and be willing to do it at home or whatever, but you can't create one space that works for them and the boys. I was trying at that point to create one environment that would work, and that interaction with them really got me to focus on the the signifiers in a space that signal to someone, "This program is for you." Of course, it's who the instructors are, and

who the other participants are, and the types of activities that are there. All those things matter in terms of who gets to come into a place. So Hidi and Renninger's four-phase interest development model states that initially you can't develop an interest unless you're willing to be in a space long enough to even know what the "it" is. So they focus much more on the situational aspects of interest. Initially you have to understand whether the environment is engaging enough to make someone want to come back to be in the space long enough to even determine if they have an interest. Over time, you can start reducing some of those environmental situational factors, because their engagement and interest in a topic can develop enough that they can persist beyond needing it to be a place full of their peers. So we've taken that work to heart.

If you add in some of [the work of Flavio Azevedo](#), he layers in that you also have to understand history to understand how someone encounters a space or why they perceive that something is engaging or not engaging, because of historical factors. It's particularly relevant in matter of race and things like that. So we need to think about how—and I think this is hard for some educators—how not to hit someone over the head on day one in a program about STEM, all the STEM stuff. Create spaces where they want to be and that are engaging; be clear that it's a STEM space, but help them develop relationships and a connection to the place, the mentors, and the peers, and then increase the STEM over time. And know that some kids are going to stay and some kids are never going to get past that environment. We owe it to kids to start reducing the environmental comfort to make sure that they understand and they can persist in communities that aren't going to be as inviting. Because what we do know, particularly in the STEM areas, is that as you move out of these manufactured environments, particularly if you're a woman or a person of color, most likely you're not going to be in spaces that are dominated by you. So there's an important step that has to happen where if you're working with kids in comfortable environments, you owe it to help them get

comfortable in spaces that aren't intuitively designed for them. At the same time, you work with those spaces to try to make them more comfortable.

Do you think interest matters for science learning?

Well, I don't know if interest matters for science learning, I think it matters for science identity. So the data show us that if girls and underrepresented youth do not engage in out-of-school STEM in the middle grades, that they won't major in STEM in college, regardless of how well they do in high school, particularly for girls. So to me that shows how learning and identity are connected, because I think you can choose to do well academically because you just have to. I did well in some subjects that I hated, but because I was committed as a student; I had that identity as a student, and I chose to do well in those classes. In college, I think it's more about your future, what you want to be, and at that point it's not just about learning, it's about who you are. That's where part of the challenge comes in, because I don't think we situate what it means to be in these roles enough in K–12. So when you get to college and you begin to understand what it means to “be” a STEM person for your career, then you might feel like, “I don't really want to do that.” For example, do you really want to put yourself in an all-male environment? I'm a female computer scientist from Stanford and I don't work in Silicon Valley, so who am I to say that I or someone else should be there, right? So I think interest matters for identity and careers, but I wouldn't say it necessarily matters for learning. It should, but I think you can do well without necessarily having any interest.

So having an identity as a good student is a very different thing from having an identity as somebody who is interested in STEM or has a STEM career?

Yes, you might not be interested at all in STEM. But you think, “I'm gonna get that A.” And so that's where we're looking at the informal space, because the informal space is still a choice.

As a kid, you choose how to spend your time, unless you have a parent who's going to tell you, “You gotta do this.” So I think this is what's problematic in our society: We know nothing about what kids do out of school, systematically. We might know what they do in one program or another program, but there's no record of kids' participation outside of school. So when we look back at anyone who has been successful—let's take Bill Gates. It wasn't school that led to his success, it was the out-of-school hanging with his friends who happened to have access to a mainframe, where he put in all the hours that are connected to who he became. We as a society don't track that at all, so some of our work is really focused heavily on the out-of-school activities. I think we can learn a lot about the patterns of participation in out-of-school activities to help us understand who truly is engaged and has an identity in something. Then we can know how to be more targeted in the resources we provide. We know some kids just want to do this because they're good students, and that's okay. But often we allocate resources to students who are just good academically, not the students who really have an interest.

Do you measure interest in the work you're doing?

Yes, in terms of participation. What we've been focused on is the work of my colleague [Ugochi Jones](#). She worked for me as a research associate, but she got her PhD from Stanford. And one of the “ahas” that she brought to our work was the concept of movement—that we can't even look at outcomes until we look at whether we have gotten the forms of participation that we need. So we now look at movement, but we also want to understand the choices that kids have. I'm going to use an analogy of a video game, Super Mario. You think when you're playing Mario that it's endless choices but it's not. The designer has sat there and said, “You can do all these steps.” Now when you try to do something that they haven't designed for, you “die” and you come back to the beginning. So every community has subconsciously or has actively created out-of-school learning spaces where there

are options. You might live in a community that has a lot of parks and has sports everywhere, or you might live in one that has [U.S. First Robotics](#). So not every kid starts out with the same set of options. You have to understand how kids are engaging in their movement, what the opportunity map is against, and what they're operating for. So that's why the opportunity maps matter, because it's one thing to say "I'm interested in robotics and I joined the U.S. First team because there's a U.S. First Robotics team at my school," versus "I'm interested in robotics and my parents drove me 30 minutes every Saturday to another community because there is no U.S. First Robotics at my school." So how do we understand interest when there might be another kid who doesn't have access at all, who has the same theoretical interest but isn't participating? Or a kid who has the same options but chooses not to participate? I don't think we have a way of understanding it yet, but I think once we have a representation of what the choices are, then looking at choices kids and families make can give us a better way of understanding interest and a better way of helping parents make choices about what to do. It can also help communities to make decisions. I would guarantee that if you show most communities their opportunity maps, particularly in more middle-resource places, you will see a lot more programming intentionally taking place. People will say, "Oh, I didn't realize we don't have opportunities for kids to engage in that." Particularly that we don't have opportunities for *their* kids to engage in it.

Is it challenging to put together these opportunity maps?

With our platform, it's technically not challenging anymore. The challenging part is that there is no one in any community responsible for out-of-school learning. So if you have a hundred providers, each provider has their own set of rules and regulations. Some are funded by one agency. It's the wild, wild West. The challenge is having someone say what the incentive is for providers to put their stuff in places. And that's why you need either the city or a school district to say, "Hey, we believe out-

of-school matters and we want to understand it. We don't want to regulate it, but we do want to be able to know what our kids are doing." I think that's the phase we are in now, deciding who should be the authority to say that providers need to document what they're providing. I think each city is different, because every city has a different structure. So in Chicago, the mayor controls the parks, the libraries, and the schools, so he can say "We're going to document out of school," and then everyone else will. They're the big players. In other cities, the mayor has no control over those agencies, so for them it has to be the school district who says "Hey, we'll let you advertise your opportunities to our kids." I guess I am surprised that even though there's a lot of research on interest, there is a lack of big studies or studies that have tried to look at interest at a city level or even at a larger community level. I think we focus so much on interest within a vertical structure.

I think that's because we don't know how kids in different areas choose to engage. When we did our work we stumbled into this. Our approach of looking at spaces allows us to be in places where kids are there for multiple reasons, and we see the same kid act differently. When we created YOUmedia, it's downtown so it's no one's turf, and we could get kids to come there four days a week. On Monday they would come because they were part of, let's say, the video game pod, and Tuesday they were just there because they're hanging out. And Wednesday they were there because they were part of the spoken word activity. So if you were researching one individual kid and you only cared about video games, you would look at the kid on Monday and say, "Oh, he's actively engaged." Now let's say you study video (not games) and you happen to be there on Tuesday. You see that same kid just being a couch potato. Then you would define this kid as something else, because no one looks across the spaces, no one sees the different ways in which this kid interacts in this same space, coming to the space every day with a different set of intentions. He acts differently with the same set of resources in this space. When we saw that, we really understood the triggers of space, peers, and

mentors, how they combine to influence how kids chose to act day-by-day.

What tools or measures have you've seen that have been useful?

We've used [Brigid Barron's](#) instruments in our DYN work. (Check out her [technobiography](#).) So she was trying to look at depth and breadth within an area, and she took 16 artifacts that kids could create. I really value this approach because at you can participate in programs and do whatever, but at the end of the day, are you actually moved to create? And it's the creation that says you're putting time into something and choosing to do it. Brigid's work on looking at how many tasks someone had done, and how many times they had done something, is also interesting because schools often introduce you to something just once. A really good curriculum will introduce you to a concept more than once, but your choice to do six video games, six movies, six songs, or even 12, really has more so to do with your interest and access to work. If there's a time stamp, we can actually look at how repeated activities are bunched together, and you can see that kids' work interest goes in spurts and starts. It's not like they have an interest in video and want to do video games forever. They might do video games until basketball season starts, then they're playing basketball and not doing as much with video games, and then they kick it back up.

We need a study that looks at participation, not outcomes, and looks at what kids choose to do and what they choose to create. We only now have the data systems to do this. We need to follow a body of kids over, let's say, three or four years, and ask them about identity and interests to begin with, then ask the same identity and interest questions at the end and see if there is any relationship between their participation and creation patterns regarding identity and interest. We might also look at whether there are certain programs affecting the patterns. If we see that all of these kids in a community have an interest in robotics and they all did U.S. First Robotics, we know that's a program we want kids to do. Or if we see that, for example, the girls no

longer have an interest in robotics and they all did U.S. First Robotics, then we might say, "Oh, I need to think how that program is designed." So we need one or two places where there's an agreement for providers to document participation patterns. However, this gets us into trouble because the minute we say we want to look at the impact of a program on identity, that's when the out-of-school providers say they don't want to give us their participation data. That's been the challenge we face. If they believe that we're going to be able to look at who went through the program and look at the long-term value of it, that's where we begin to get challenges. They don't really want to share their data in that way. So I think we have to come up with ways where it's reciprocally valuable for out-of-school organizations to share without feeling that they're going to be pinpointed. At the same time, you can't do everything in the aggregate; you have to be able to look at patterns, and I think from a methodological standpoint it would be wonderful to have some conversations among multiple different researchers about the methodologies that can be put in place that are sensitive to the needs of organizations but do allow us to move forward in understanding patterns. And I don't think we're having those conversations. Maybe we need an NSF grant to try to go after shared methodologies.

How do you see identity, motivation, and attitudes as being connected? Do you make a distinction between interest and the other concepts?

I see motivation as also communal, and a lot of it has to do with social capital value. We engage in things that we believe in. So I think interest and motivation come before identity. I think motivation can be extrinsic or intrinsic, the same way interest can be intrinsic and extrinsic. And I think for youth often there are some areas that a community, just by nature, values more. It's subconscious that you participate in those. I think we have to think differentially in how we support underrepresented youth and girls, particularly in STEM, to be aware that they have to develop the muscles to work against the community values in terms of how they

view their race or their gender in participating in STEM. This might be slightly controversial, but I think that often you're fighting against the perceptions of members of your own community. So in the case of STEM for African Americans, it's not just white society that has a perception about the value of STEM, it's also members within the African American community who have internalized values and aren't necessarily making a conscious decision. For example, I have a 4th grade nephew who's nationally ranked in basketball. I think he's gifted in his spatial literacy and how he builds things and robots and all that stuff. Now, my brother allocates the time to basketball, and my nephew has a private basketball coach, he plays on four basketball leagues. In their community, that's easily accessible. My brother would tell you that it's as important for my nephew to be strong in STEM as it is for him to excel in basketball, but if you look at his schedule, there's very little time put into the STEM work. We talk about this all the time because I'm the STEM instructor who pipes in from video or visits once every three months. My brother says he doesn't have the community in Houston that can help support the STEM. I have a community that helps support the robotics. So together we found a robotics coach to do a robotics class, and we did it out of his library. The parents weren't as willing to stick with it as they were with basketball. So we have to look at the outside forces and the internal forces within communities that make it difficult for the average kid to persist in STEM interest, and that make it easier for the average kid to persist in activities that are viewed as more the norm of a particular community group. We need to look at some of [Ricarose Roque](#)'s work and think about how we can create communities that can help parents and kids persist in STEM.

How might a practitioner use what you've been learning in your work to apply it to designing for or measuring interest?

First you have to step back and ask, "What are the support structures that exist in my school context and out-of-school context that I can connect with? Are there already existing programs, are there

already existing people? What is one activity that I'm doing and how is it going to onboard a kid to something else?" I would argue that if there's not, the next thing you have to think about how you are going to prepare the next thing or how you are going to partner to create the next opportunity, because just one activity is not going to launch someone into a career. So the initial question is, do you start with the one activity if there is no existing set of activities? Or do you try to create some others first, find a group of people and agree to create one or two or three? So that is a necessary next step. I think that those of us who want to make an impact default to creating programs, and I think that instead we need to ask what are all the things that need to be part of an ecosystem and understand what it makes sense to do. I'm trying to understand how to help create the ecosystem because there are enough programs. We don't need another "girls in STEM" program. There needs to be a way to connect the programs that already exist for girls so that if they leave one they can go to another one. So I think the right step could be professional development for parents to help them use what's there. It could be linking together the things that exist and bringing together the community of providers to share what we've done in other places. [Sybil Madison-Boyd](#), one of my colleagues, is leading the Chicago City of Learning work for us now. The mayor said, "We want all kids to code," and we were like, "Okay, let's let all kids code." Then we looked at the programs that existed and we saw that almost all of them are taught in the summer in the same month and they're all taught downtown, so really there aren't good opportunities for kids to code. So now she's working with those same providers because they didn't intentionally group their programs that way; actually, none of them know who else is doing what. So the first thing was to bring the providers together and share how we want coding opportunities to exist, and then empower them to come up with solutions for that. I think you have to make sure that you're part of a community of providers in the area in which you want to provide. And if it's just you, I would contend that it's going to be hard to really have sustained impact unless you're committing to

following a group for a long period of time, like from 6th grade to 8th grade, or 9th to 12th. If you can't follow the group for that long, then before you create a program you need to make sure there's a next step opportunity for them to transition into.

We described all this work in the Digital Youth Network book. We did this work with 8th graders, and we were able to close the gap between the kids in Chicago and the kids in Silicon Valley. Our 8th graders were in a community that had created a social capital value for being able to use media literacy skills. They got credit for being able to say, "Here's my video, here's my song, here's my whatever," as much credit as playing on the basketball team. Many of our young black males made choices to do digital video or video games as opposed to basketball because in their community it had credibility. When they left that school and went to high school, they would come back to us and say, "There's no community for us that values these skills, or there's no social capital value in doing them." And we're like, "Sorry, you graduated." So that's what led to YOUmedia to some degree.

That really taught us that you could give them these opportunities but we hadn't thought about how we prepare them to handle environments that are not tailored to them. That part is really critical. My father did this for me, in the 3rd grade—he made me be comfortable being uncomfortable. He was like, "Look, you're gonna constantly be the only girl, or the only African American, so let's get over it." And we have to help our kids get over that because they weren't always going to be in environments that looked like that middle school. They were comfortable in that middle school, so when they went off to high school they didn't have the armor for many of them to continue to persist with STEM. Now what's interesting is, in college they went back to those interests. They sort of went underground during high school, but when they got to college, many of them actually chose majors that relate to technology because it actually had social capital value, career capital. We are beginning to do some follow-up work now that they're graduating

from college. We want to look at their career choices and interview them around how environment impacted their pursuit of interest or not.

Are there any big questions in informal science education that you think need to be studied over the next five to 10 years?

I think it's how we communicate. We haven't done a good job of connecting. We use the term STEM, which is broad, but kids don't understand how what they're doing on a daily basis outside of school maps onto STEM. We've even struggled with how to communicate that in our Divas program. It can be a buzzkill all of a sudden when you have to connect the language in such a way that they see the connection of what they're doing outside of school to what they're doing in school. Initially we didn't introduce those terms in the way that helped them see these as connected to that. We'd say "Hey, by the way, did you know that what you're doing is STEM?" and we had girls saying, "I don't see myself in STEM." but then they said "I like to do all these design activities." STEM is a broad umbrella term; it covers everything. But normally when you're engaged in an activity, you're engaged in just one of the letters of STEM and actually a subarea within that. So I think there has to be some work on how we communicate around the multiple instantiations of STEM in a way that allows out-of-school providers to do that linking in an authentic way. When they do it in a way that's not authentic to the work that they do, it doesn't necessarily help kids see the connection. So I think there's a lot of work to be done linking out-of-school activities to what's taking place in school so that kids see the value. For example, when we were doing work in video, we were really adamant making students understand that you have to learn how to write. You've got to write a video script. You can't make a movie that doesn't have a beginning, middle, and end structure, so you don't just pick up a camera. We made them go and edit their script about 30 times before they started the filming so they would understand the structure. We didn't start off by saying, "Okay now you have to do a beginning,

middle, and end,” but we were able to situate the value of learning, of understanding, in the language. So how do we do more of the linking, like *making*—how do you take the science language and connect it to making? You can’t do half the stuff kids want to do in making spaces in an efficient way unless they truly understand what is being taught in science. But we haven’t quite figured out how to do that.

Is there anything else you’d like to share about interest that might help people decide to study interest in STEM?

Well, how much retrospective work have we done with people who have STEM careers, looking at how they got to a successful point in their careers? It’d be interesting to do some more retrospective work and to understand how much it was affected by environmental factors, parental factors, community factors, and peer factors? We’d like to have a better way of understanding all the factors. For any individual person, it’s going to be a different—that formula is going to have different values. But if we understood it better we could improve it. In some communities, for example, you’re going to have to overemphasize the use of online resources because you’re just not going to have the physical programs in place. We also might need to move or adapt some of the factors given the unique context in different places. Trying to do

something in Chicago is different from trying to do it in Kansas, Iowa, L.A., or New York. There’s no one way to do it. But the factors don’t change; it’s just understanding how you weigh them and adapt them to create the unique context that is needed for communities, families, and also individual kids.

What are some resources that you’ve published that could give people an entry point into your work?

There’s the [Digital Youth Divas](#) paper in the Journal of Learning Sciences that came out in 2017, which talks about interest and particularly the importance of attending to environment. There’s also the book that I coauthored with [Brigid Barron, Kimberley Gomez, and Caitlin K. Martin, Digital Youth Network](#), which was published by MIT. It has some really in-depth chapters about research methodology, and it’s methodology that can also be used in out-of-school space. It also has some deep dives about how we develop interest and some case studies of students. I think it’s a good book for helping people to say, “What does this mean for my context?” It’s not a book that’s going to tell you how to do it, it’s a book that’s going to help you see what things look like in your context. I can’t give you a framework that you can implement and it’s going to work. But it can help you see how to implement something in a way that works, in your context.



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