

"I LEARN MORE HERE THAN I DO IN SCHOOL. HONESTLY, I WOULDN'T LIE ABOUT THAT"

CREATING A SPACE FOR AGENCY AND IDENTITY AROUND SCIENCE

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ABSTRACT

An ongoing issue in science education and the STEM fields in general is the underperformance and underrepresentation of marginalized youth. This is often attributed to a disconnect between school, school science and the cultures that youth enact and experience in their lifeworlds. However, science education research has demonstrated that these very youth are able to successfully participate in science in spaces that lie outside of the formal structure of schooling. This article uses a framework that merges a transformative activist stance of learning, knowledge and identity development with a place-based framework through a sociocultural lens to describe the experience of youth working as floor facilitators in a science center where their role is to facilitate learning interactions between visitors and exhibits. Over a three-month period we used cogenerative dialogues as praxis to improve facilitating visitor interactions and study the youths' identity development. We learned that this youth-centered context has empowered the youth in science leadership roles both in and out of the science center. They were able to reflect on power issues embedded in formal schooling, and they grew to respect difference and appreciate the multiple perspectives that the general public and their peers bring to science learning experiences.

Keywords: informal science education, out-of-school time (OST), youth agency

Being an Explainer taught me exactly [who] I was. I had a very special gift—I could talk to people of all ages from all backgrounds and explain concepts to them in a way that they could understand and that’s when I realized that I was meant to be a teacher. Now I have the honor of teaching teachers, students, and parents from all around the world different ways of teaching science. (Ronald)

This reflection comes from a student who might be stereotyped as unsuccessful in science. He has all of the characteristics that we ascribe to an at-risk student—minority, low-income, public housing, family history of substance abuse and becoming a father as a teenager. Yet, this student found his place in science in an informal science institution working as a floor-facilitator, a role called “Explainer” that we will later describe. He entitled his reflection essay, “Being an Explainer Changed My Life,” and described how being a part of a collective in an informal science setting enabled him to develop an identity that he could not see for himself prior to his employment in this context. As he participated in this science-related context and co-created it as a place of science learning for others, he realized his gift for teaching.

This article examines the experiences of students like Ronald, who work as Explainers and have found a place in a science museum. These students, who often find themselves on the periphery of the classroom, are central to the functioning of the New York Hall of Science (NYSCI). They are vital to providing positive visitor science-learning experiences, and through the process, contribute to the museum being a particular *kind* of place of science learning. We will discuss how informal science settings—institutions that are “off the grid” of mainstream schooling—can provide the context and experiences for students to not only “become on the radar of science” in ways that recognize them as central participants in a scientific community, but also “operate the radar” to illuminate science learning experiences for others.

The National Science Board (2010) notes that the key to the nation’s success is an investment in its human capital, particularly the next generation of science, technology, engineering and mathematics (STEM) innovators. They recommend that we “cast a wide net to identify *all* types of talents and to nurture potential in *all* demographics of students” (p. 3). Although an important goal, it is also tremendously challenging since we face an ongoing and, at times, seemingly intractable issue of attracting youth from underrepresented communities into STEM fields (National Academies of Science, 2007). Research has revealed that difficulties in recruiting and retaining youth to pursue further STEM education and careers can be attributed to the lack of opportunities they have for engagement with real-world problems in school-based courses (Rumberger, 2004) and the disconnect between school science and students’ day-to-day lived experiences (Roth

& Tobin, 2007). While this is the general case for American students (34% and 27% of high school seniors are ready for college science and math, respectively (Curry, Traill & Rao, 2012)), this is more pronounced amongst underrepresented and immigrant students (Rahm, 2008). However, many of these same students who are disenfranchised by school science experience success in science in informal contexts (Basu & Calabrese-Barton, 2007). Unfortunately, there is a dearth of opportunities for these students to take that interest beyond the project and into a STEM career pathway. Compounding these problems are the general issues of urban schooling: large class sizes, issues of violence and surveillance, a lack of prepared and licensed STEM teachers and a lack of funds for resources to teach science (i.e. equipped labs, replenishment for expendable items) (Adams, 2007).

In addition, media and politics often portray these mostly brown and black students who find themselves in “failing” schools as disinterested, unintelligent and lacking in goals and direction (Giroux, 2009). As “stereotypical caricatures,” (Kress, 2012), these youth are described in terms of deficits; as “tragic figures” needing to be saved from themselves by a “hegemonic order” (p. 23). Upon a closer and more critical inspection are students who are unchallenged and not engaged because of the lack of relevance of their classroom education. There are also those students who are at the periphery and choose to stay there. These are the middle-performing and relatively silent students who do not actively resist the boredom but rather comply and do enough to just get by. These students, the disenfranchised and the jaded, sometimes end up as “truants” or dropouts. Those who remain often end up not performing up to their potential, which causes them to be locked-out of higher education opportunities (Delpit, 1988). These are students like Ronald who “do the right thing of attending school,” however are unable to see a college- or career-related identity for themselves. They may have a kernel of interest in science, but very few opportunities for those interests to be supported and flourish. It is for these reasons that it is important to examine spaces that are off the radar of formal schooling where students’ science interests and identities can be nurtured. These spaces provide opportunities to learn STEM, and more importantly the STEM learning experiences are often integrated in ways that allow for well-rounded learning and development (Curry, Traill & Rao, 2012).

DEVELOPING INTEREST AND IDENTITY

Informal science institutions can provide the space for such students to develop interests and corresponding identities as people who are a part of a larger STEM-related endeavor. Psychologists Hidi and Renninger (2006) describe interest as having affective and cognitive components, including positive emotional associations with an activity and negative emotions such as frustration and challenge that often accompany learning and self-improvement in a chosen pursuit. In addition,

they note that interest develops as a result of interactions between a person and a particular context, citing that while a person has interest, it is the context—including other individuals, the resources available and one's personal effort—that affords development of that interest. Thus, a student could have a triggered interest in a science topic from a lesson in class, but unless there are opportunities for that student to engage with others and relevant resources to fuel that initial spark, it is unlikely that a full passion will develop in a way that could potentially lead to a long-time hobby or career.

Interactions are essential to human growth and development, and it is through interactions with others and the environment through collaborative practices that we develop interests and identities (Stetsenko, 2008). As someone learns the collaborative practices of a community and finds her role in contributing to that community, an identity will develop to reflect that knowledge and corresponding role(s). As a person enacts a particular identity, people who view and interact with this person will ascribe certain characteristics to that person. Identity development is a fluid, transforming and transformative construct, thus ongoing activity in a given context will continuously shape identity.

Anna Stetsenko's (2008) transformative activist stance theory of learning and human development provides a framework for describing identity development of the youth in this study. Through this lens, we view the work of Explainers as an endeavor, a contribution to society. The activities within this endeavor mediate not only youth's own identity development, but also the cultural transformation of NYSCI; making it a particular kind of place to engage with and learn science. Activity is at the center of human development because it is not only how we learn about ourselves and make meaning of the world, but it is also the process by which we transform our world. As Stetsenko (2008) describes: "...human nature is a process of overcoming and transcending its own limitations through collaborative, continuous practices aimed at purposefully changing the world" (p. 13). In other words, our identity development does not happen in silos, but rather in the ongoing interactions with others, and especially in concert with others around achieving collective goals through collaborative work.

In this framework, which borrows from Anna Stetsenko's (2008) transformative activist stance on development, knowledge is not an end-point but rather it is a process; it is an ongoing transaction between individuals and their world, and what people enact when using meaningful tools and culture. Our individual ways of making meaning are different not only according to the communities in which we are connected, but also in which roles we choose or are assigned by others, how we present ourselves, and how we are seen and treated by others. Thus, knowing and knowledge are highly contextual—what counts as learning and knowing in one place may not count as such in another, although the knowledge created in one place can be accessed and adapted to fit the resources in a different place

through human agency. Furthermore, people's enactment of culture creates the visible and invisible structures that shape places. These structures not only enable particular activities to occur but the activities also shape the structures, thus shaping the place. Place becomes a social artifact that both shapes and is shaped by peoples' activity and corresponding identities (Kincheloe, et al., 2006; van Eijck & Roth, 2010). In this context, our place—the science center—is structured by physical things like exhibits and people in the form of staff and visitors, but also by invisible structures of the job description and other job-related structures that we will later describe. In this study, we look at a science center and the resources it has that afford the building of a science-related identity for youth. More specifically, we examine the Explainer youth employment program and the role that it plays in both place-making and identity-building for the participating youth.

NYSCI Explainers

Enter the New York Hall of Science on any given day and you will see young people wearing red aprons. These are high school and college-aged youth who are a part of a formalized youth employment program called the Science Career Ladder Program. The red aprons are visible symbols of their role as Explainers*. They comprise a diverse group of youth with the age range between 15-24 years; 50% are male and 50% female. With an ethnic make-up of 18% African American, 25% Asian American, 27% Latin American, 18% West Indian/Indian, and 12% Caucasian, the diversity is reflective of the approximately 29 New York City public high schools and 23 colleges from which they are recruited**. The Explainers represent the diversity of New York City and are reflective of the visitors to NYSCI; almost all of the Explainers are recent immigrants or first-generation Americans. Walking around the museum you will hear both the Explainers and visitors engaged and speaking in many different accents, languages and sometimes even dressed in styles from their culture.

Students who apply to work as Explainers are simply looking for an interesting job and are often not concerned, at least initially, with developing expertise in science. When hiring, NYSCI considers the following factors: the potential of the applicant to work regular hours throughout the year, interests in working with people, teachability and ability to teach others. Student grades are not a factor in the decision-making process, but rather it is the students' motivation to work and effectively communicate with people that ranks highly, as is their enthusiasm and potential to learn and grow. Students are asked to perform several activities during

* While the title Explainer is inappropriate for the role ascribed to floor facilitators as it implies a transmissionist model of teaching, it is a historical construct with recognition in the museum community. Additionally, it is a formal title as designated by a capital "E." From hereon, we will use this title to describe the floor facilitators at the science museum.

** Statistics are from 2008 records.

the interview to assess their ability to communicate and engage learners. However, a lack of ability to communicate science concepts at the time of the interview is not a liability; in fact, many Explainers who are now the best science communicators were not experts during the time of the interview. Students in the program work an average of two years at which time they either graduate from high school and enroll in a distant college, graduate from college and get a full-time job, do not have the time to continue as Explainers, leave for personal reasons, or get promoted into a higher position at NYSCI.

Employment at NYSCI implies certain structures different from students who may engage with a science center through a traditional after-school program, such as one where students meet every Saturday for a whole year either at a community-based organization, school or at a museum. As an employee, Explainers must follow workplace rules and develop workforce skills such as coming to work on time, being accountable for their job responsibilities and supporting the overall operations of the center. As an employee, the Explainer is not one who is receiving services from the museum, but rather provides services to the visitors. This initial difference of being an employee of the institution brings with it an identity of group membership with NYSCI, a sense of accountability and certain degree of power over the enactment of the Explainer role.

Youth as Co-researchers

This study was a part of an ongoing qualitative study of high school students working as Explainers at NYSCI. We were interested in learning about their lived-experiences in this context and the connection of this experience to their day-to-day lives in school and their community. Researching on the Explainers as opposed to with the Explainers would have been a disservice to this study as the multiple meanings, perspectives and standpoints would not have been represented. In a study designed to make claims about identity development, only one-sided patterns and contradictions would have emerged from research on the Explainers' experiences, void of the richness that comes with the voice of the Explainers discussing their teaching and learning experiences from their collective interactions. Kenneth Tobin (2005) states that it is important to consider how the research questions are answered for the different stakeholders and the types of meanings they are constructing from the experiences. Thus the Explainers were invited to be co-researchers. With the Explainers in the role as researchers they brought in different artifacts they valued as resources for learning about their identity development and provided insider perspectives not only for examining identity development, but also for improving praxis for us all (Elmesky & Tobin, 2005).

We recruited a group of 6 high school-aged Explainers (3 males and 3 females) out of a group of thirty to participate in ten-1.5 hour Saturday meetings over 5 months. They were recruited based on their schedules and desire to participate

in the research. The students represented the ethnic and cultural diversity of the floor facilitators and visitors to the science center, most of whom are from the local community. We used cogenerative dialogues (hereafter cogens) (Roth, Tobin & Zimmerman, 2002) as a way to both structure the meetings and to collect data on the identity development of the Explainers. We chose this methodology because it was a way of equalizing the participation between youth and knowledgeable adults. Both of the adult researchers have had years of experience as educators and administrators in informal science education settings so we wanted to ensure that our perceived leadership/adult roles were not privileged in this space, but rather like all participants in the cogen we wanted to improve our knowledge about and practice of teaching and learning in informal science education settings. It also is in agreement with the culture of the Explainers that affords peer learning and support and provides a context for the Explainers to enact their goal of improving their practice with visitors. Students videotaped each other as they worked on the floor with the general public and selected vignettes to be shared during the scheduled meetings to help focus the discussions. During the meetings, we discussed the vignettes with the goal of learning from each other's experiences in order to improve facilitation skills and experiences for the visitors. Additionally, within the context of the discussions, the researchers asked questions relevant to identity development as they emerged. These meetings were also videotaped as additional data sources to address the overarching research questions. The data collection methods relied heavily on video analysis, which was supported by field notes and participant observations. Additional data sources included written reflections of former Explainers.

We used a constructivist grounded theory approach to the analysis recognizing the centrality of all researchers' prior experiences with and perspectives of the phenomena and relationships to participants in the field in the research process (Creswell, 2007). As mentioned above, both authors have had extensive experience of teaching in informal science settings with Preeti being an employee of the science center at the time of research. In addition, she worked as a floor facilitator in that same science center earlier in her career. In line with the praxis of cogens, she videotaped her interactions with visitors during the study so that she could continue to improve her own practice and also used these interactions as opportunities for initiating a discussion. As reflexivity of all participants (students and researchers) was central to the research process, our ongoing findings were openly discussed both for member-checking and as a source of discussions during the meetings.

THE RED APRON: THE RELATIONSHIP BETWEEN PLACE AND IDENTITY

Place and identity, while not necessarily contradictory terms, are not always presented in a both/and relationship. An emergent theme of our research was real-

izing how place shapes identity, which in turn shapes place. Research with the Explainers has enabled us to learn the centrality that NYSCI plays as a particular place of science learning to the Explainers and their corresponding identity development. The NYSCI is not only structured by the multiple interactive exhibits covering a wide range of STEM phenomena, but also by the activity of “explaining,” the activity of the youth in red aprons facilitating interactions between the exhibits, scientific phenomena (through “demos”) and the visiting public. The youth and their red aprons become a visible symbol and this affords a particular structure for NYSCI as a place that has youth presence and is accessible. The red apron is a practical uniform because it is one-size-fits-all. It has pockets so that an explainer can carry a notepad, a pen, the staff schedule and small items that can be used to support visitor inquiry, such as a flip book that helps describe the ideas of persistence of vision, or a triangular bubble-making wand to help visitors realize that that bubbles are always round even if the shape of the wand is not round. However, the apron carries with it more than just a practical role. It is a marker of identity and group membership and carries a high degree of capital and power within the NYSCI. What follows is my (Preeti’s) reflection on the symbolism of the red apron as I participated in the research.

In this midst of this study, I decided to put on the red apron, something I have not done in about fifteen years. My goal was to assume the role of an explainer and re-experience what it felt like to interact with visitors in an official role as floor staff. As a youth employee, I was an explainer for five years and was promoted to the highest level that an explainer can earn, signifying that I was versed with the exhibits and demonstrations, highly qualified to interact with visitors and demonstrated leadership in supervision of my peers. As an administrator, I interacted with visitors as I went from one office to another, but by choice rather than job description. I was identified as staff because I wore a nametag and carried keys and if I saw a visitor struggling or interested in an exhibit, I walked over and interacted with her. In putting on the apron, my goal was to properly assume the role rather than taking action on my way to a meeting.

With a red apron on, I walked towards the microbiology exhibits, one of my favorite areas, and as I got closer, I finished tying the apron around my waist. All of a sudden, I felt a sense of panic. In thinking about why I felt this way, it wasn’t that I was unsure of the science of the exhibits or how to facilitate the exhibits. Rather, it was a sense of responsibility. If a visitor were to approach me while I was wearing the apron, it was my job to help her and I would be accountable for providing her with as best an experience as I could offer. I knew that visitors viewed the Explainers as smart, knowledgeable people who knew all about the exhibits. Even veteran teachers look to the Explainers as exhibit experts. Being recognized as that kind of person was what panicked me when I first put on the apron. Two minutes into the facilitation, I felt right at home as I conducted myself as an explainer.

When a person dons the red apron, she becomes an Explainer and assumes the identity and enactments—a certain embodiment—that the role entails. This can be empowering for a young person because not only does the red apron assume a certain degree of knowledge around the science behind the exhibits, but also because she has the agency and ability to shape visitors' sense of fun and science-learning while at NYSCI. Unlike in school where she is often in the role of a passive recipient of knowledge, as an Explainer she is an active co-producer of scientific knowledge and one who guides the science learning experiences for others. The role is also exciting because of the positive emotional energies that are associated with the act of Explaining. This includes feeling competent in their role and having membership with a like-minded group (Collins, 2004). The knowledge of science and being able to *explain* that science to others is capital that is valued both by visitors, peers and administrators at NYSCI. As such, the students take the role and responsibility of being ascribed that identity seriously. While knowledge of science could be considered capital in a school setting (it affords high test scores and possibly teachers' favor), school structures do not allow all or even most students to develop this capital with the level of confidence the informal setting affords (Lemke, 2001). In addition, in some schools students who have an affinity for science may not feel comfortable revealing that interest for fear of being marked a "nerd," an issue that came up during several cogen discussions. In contrast to the school, at NYSCI being a science savvy person is a source of pride. Within their community of Explainer peers, science conversations are a part of the social milieu. These conversations happen not only during formal times like training sessions, but also during "off the clock" time like during lunch and breaks. And, it is these ongoing science interactions that help to structure NYSCI and build Explainer identities.

EACH ONE TEACH ONE

The Explainers learn science because they have to teach science to others. Research has shown that for many students, underrepresented ones in particular, STEM learning, interest and motivation increases when the goals are collective-oriented and towards improving the lives of others (Roth & Lee, 2007). The Explainers aim to improve the immediate lives of visitors to NYSCI by facilitating fun and engaging science learning experiences. The Explainers also realize that although they may individually facilitate exhibits and enact science demonstrations, they are a part of the red-apron collective who shape and define the overall visitor experience at NYSCI. As such, there is positive peer pressure to learn science and excel at the act of explaining, and the Explainers develop knowledge about learning science in this informal context.

Explainers are required to participate in weekly one-hour training sessions intended to help each person improve his or her facilitation skills. This means both gaining a deeper understanding of science content and expanding one’s repertoire of ways to engage diverse learners. They do this by both practicing with the general public and learning from one another. Explainers who have a particular content knowledge and skill set are often sought out for peer-to-peer tutoring, observations and discussions on improving practice. As they learn and practice they continuously transform their identities not only as Explainers, but as learners. In this context, the Explainers develop reflexivity— they become aware of how they (individually) learn science and are able to relate it to how peers and visitors (collectively) best learn science. It is in this dialectical relationship that the youth floor facilitators build their own identity as knowledgeable about science and develop local theory (and corresponding practices) about how people best learn science. They learn to recognize the importance of learning by doing and the need for making science relevant. We present a vignette featuring two Explainers, Victor and Paul, that provides evidence of how Explainers develop their understandings. Both Victor and Paul have been Explainers for more than two years, attended local public high schools at the time of this study, and do not consider themselves science experts. In what follows, Victor and Paul are discussing how they use the demonstration on the science of sports to first engage visitors and then teach content.

Vignette 1

Speaker	Dialogue	Gestures
Victor	But the sports demo? You guys (unintelligible) sports... well like (she) was saying, once you get down to the, once you give them something basic to understand and they understand, you could like throw some hard information and they wouldn't listen to then they take that home with them. That kind of relate to me with the sports demo, 'cuz the sports demo is basically facts right?	sits back and gestures with hands
Paul	Yes, its like aero:::	Collective agreement (yesses and head nods)
Victor	Yeah, like aerodynamics blah, blah, blah. But then, once you make something fun then you just tag on those information and they understand it, they listen to you, I think (trailing)	

Preeti	So, do you do that at sports?	
Victor	Yeah	
Preeti	Is the sports demo designed to do that or you would do that?	
Victor	No, you <i>should</i> do that, because once you don't do that, you're just basically stating facts and they lose interest and they just go.	Gestures with hands “go away”
Paul	When you keep your audience and you could throw in that little information, oh you made them kind of smarter, like you made them understand your point. Like with Bernouli's principle and magnets (unintelligible) they would never think, “Oh that's a part of sports!” but once you like show them like how its related then they, “Oh”	Raises eyebrows

The students realized that in the science center learning has to be fun in order to maintain the visitors' interest. This is evident when Victor noted, “once you make something fun then you just tag on those information and they understand it, they listen to you.” While the scientific facts are important, the students realized the importance of keeping the visitor engaged and eliciting that “oh!” factor by adding the facts behind how or why something works. They were also able to compare it to school learning where, to them, facts are learned with little connections to context and therefore not retained. The students were able to view the science center as a unique place for learning science in a particular way; they collectively work hard to maintain that culture. This ongoing peer-to-peer support and learning continuously structures and restructures the science center as a place for science learning.

The students cited their sense of responsibility—their central role in creating a fun and meaningful visitor learning experience and creating and maintaining a place for science learning—as a motivation to “be good at” science. In this case, Victor was not only able to maintain the visitor's interest (an indication of fun and engagement), but was also able to teach the visitor something that caused her to make a connection between the exhibit and a scientific principle. Success at NYSCI means having successful interactions with people around science. Paul, in the vignette, refers to the “oh” factor, a reaction that visitors have when they make a connection between the science and their daily life. Paul is noting that once an Explainer creates the “oh” in the visitor, a successful learning moment has occurred. The Explainers learn how to make science-learning fun through peer-to-peer learning and supportive leadership. They build a collective understanding

of a) how to create fun science learning interactions and b) the indications that the fun learning is or is not happening. This creates the invisible structures that shape the science learning that happens at NYSCI, which creates a particular science learning place. In turn, this place influences the Explainer's commitment to learn science while simultaneously developing science-related identities.

The Explainers in the study were able to reflect on the differences between working and learning in the NYSCI environment and in the school setting. Prolonged engagement with science topics emerged as a key difference between the learning in a museum compared to a school. One of the co-researchers, Joanie, noted during one of the cogenerative dialogues that the structure of working as an Explainer allowed them to review concepts over and over with their peers during trainings and informal discussions and with visitors:

We are here every Saturday and like, we get to learn stuff over and over again, and we are able to teach it to others everyday we work, and like, you keep using it and we have training and we always learn something new about it and you are always able to ask questions and always able to learn new things about that exhibit and you are always reviewing it and that could be another reason why it is more... like at school they teach something and move to the next topic. They don't go back and you like, stay with it, you like take the test, and forget about it. (Joanie 11/08/10)

Joanie, like Victor and Paul, has worked at the science center for two years and attends a local public high school. Through her work as an Explainer, Joanie recognized the importance of ongoing engagement with a topic, including adding new knowledge and being able to ask questions in a low-stakes but goal-oriented environment. These structures allowed the Explainers to become more knowledgeable in science and to begin to view themselves as capable facilitators of science learning. In this context, science content is a form of capital—something that is of great value to all participants in NYSCI.

Essentially, Explainers were re-creating for themselves the best practices of science teaching and learning without having any exposure to science education research literature. Much of their learning was peer-to-peer apprentice-like learning, unlike teacher education in which candidates learn theory disconnected from what they experience in the field (Darling-Hammond & Sykes, 2003). The Explainers have had little to no exposure to science learning research and theory, but yet their knowledge of teaching science rivaled that of traditionally trained educators. Through their interactions, they learned a) the importance of social interactions in learning, b) the value of prolonged engagement with a topic, c) the need to differentiate instruction to meet the needs of different visitors/learners, and d) the importance of having visual and physical resources to demonstrate science phenomena to learners.

EXPLAINING ACROSS BORDERS

The capital that Explainers gained crossed borders into other settings. Erin, another explainer in the study, recounted a recent visit to a science center in another city with her family. Erin had worked as an explainer for two years at the time of the study, attends a local public high school and wants to study graphic arts. Unlike the others, she started her engagement with the science center in seventh grade through a year-long Saturday science program at NYSCI, which she learned about from her science teacher. She claims that before seventh grade, she didn't like science and she had bad science teachers. Her seventh grade teacher and the NYSCI experience made her love the subject. Erin described how she and her family walked around the other science center, and she encountered an exhibit that was similar to one at NYSCI. She immediately became excited and started to explain the exhibit to her family in the same way she would interact with visitors to NYSCI—by asking questions, eliciting thoughts and inviting them to physically interact with the exhibit. Her confidence with the content engaged other visitors. When she finished and moved on to another exhibit, she noticed that the visitors continued to tag along. Erin developed an explainer identity as she contributed to the collaborative practices of the red-apron collective (Stetsenko, 2008). Her interactions with her peers and visitors in NYSCI afforded her an embodiment of an explainer that travels with her to other spaces. When Explainers are outside of NYSCI and encounter a similar environment (like a science museum) or structure (a familiar exhibit), these identities can become evoked and made visible through their actions. That new space, with the right resources, *becomes* NYSCI and they *become* an explainer. As we will describe in the next section, this not only happened in other science centers, but also in the classroom where the structures are very different.

Students discussed “border crossing” of their explainer culture and identity into the classroom and other settings. While working as Explainers students develop a certain degree of science fluency and content knowledge. In school where the structure is very different from the science center, and often constraining (as the students describe it), particular science topics became resources for them to enact their science center identities in the classroom. The exhibits, although not present in the classroom, became points of references—a part of their schema of science knowledge—as they discussed related topics in the classroom.

During the cogenerative dialogues, the discussions were particularly lively when they discussed the science topics that came up in school that connected to exhibits at NYSCI. The following vignette is one such example of how this “border-crossing” often came up in conversation:

Vignette 2

Speaker	Dialogue	Gestures
Alison	Science like, after working here, is like pretty cool. Cuz, like, then I'd be like, I already know that I know that from the Main Level	snapping her fingers with a gesture of having command of a skill Group laughter
Preeti	What's on the main level?	
	Oh, like in chemistry, I was like, that's easy, I know that. The energy levels in the exhibit	
Paul	Yeah, like when it jumps to different energy levels	
Preeti	Where does that show up in your course?	
Paul	That was chemistry last year, because of <i>Realm of the Atom</i> , you can visualize it. Oh, you can come to the science center and oh, that's what [the teacher] means	
Victor	That reminds me. Cuz, we was doing Earth Science. And, um, I was telling them about um, ultraviolet light, and you know the upstairs, in <i>Seeing the Light</i> , I was like going into my gear now, I was like explaining like I do at the science center, talking about ultraviolet, infrared	
Preeti	But, you were in class?	
Victor	Yeah, I was in class! The teacher was like, "Ok" (tone of surprise) But honestly, I learn more here than I do in school. Honestly, I wouldn't lie about that.	Group laughter
Preeti	But, it looks like, what you learned here, you took to school?	
Victor	Yeah. But there are more topics to learn in school. But if I had school like this, I would probably do a lot better.	

In this exchange, Alison mentions "I know that from the main level," demonstrating how her knowledge is very connected to the structure of an exhibition at NYSCI. To a visitor to NYSCI, the main level represents just that, a floor with a set of interactive exhibits. To an Explainer like Alison, the main level represents a particular schema that includes not only the locations of specific exhibits, but also specific scientific references. At NYSCI, science content knowledge is not separate

from the context in which the knowledge was realized, unlike in school where students are expected to learn something quickly from a lecture and/or textbook and move on. At NYSCI, there is an ongoing interaction between the Explainers (individually and collectively), the exhibits, the science content and visitors, all of which contributes to the scientific knowledge production that happens in the science center. In Victor's border crossing experience, he uses the words, "going into his gear." He implies that he was assuming his identity as a person who knows this content and can relay it if he conjures up the structures where he learned it. Although the physical structures of NYSCI were not present, the invisible structure of the science content became a resource for him to be a facilitator, to explain the relevant science content to his teacher and peers, and to reference in his mind specific exhibits in the science center. A self-described "at risk" student became a central source of science knowledge in the classroom.

During a different cogen, Victor described the irony of "someone who never participates in class [who] all of a sudden knows all of the answers" when a science topic in the classroom that connects with an exhibit in the science center is presented. Many of the students in the cogens described themselves as being shy in the science classroom; not participating, just doing their work and moving along through the day. Working at NYSCI gave them a voice in the classroom, enabling them to speak out more with confidence in an assessment-oriented climate where students are penalized for wrong answers. In one case, Joanie was confident enough about her science knowledge to correct her teacher when she said that there is no gravity in space, "no Miss, there is microgravity!" Because of her role as an explainer, Joanie had to ensure that her content knowledge was on-point in order to teach the general public. So although she described herself as a shy student, she had no problem with correcting her teacher in a respectful way. Gaining a certain degree of power and agency over their own knowledge acquisition in the museum transformed these students to become more engaged and focused in the science classroom. These students learned science in an authentic setting—a setting where the science had some immediate use and relevance beyond passing an exam—and thus became actively involved in their own learning. They are positioned as authorities in NYSCI. The structures at the science center ascribed to them identities as science-related experts. Because identity is embodied, they had very little problem with enacting their science-leadership identity in the classroom when the structures allowed. They shared their expertise with classmates and the teacher when topics connected to an exhibit at NYSCI and/or was one they have explained numerous times.

Looking Forward

This study demonstrates the role that particular places—with corresponding structures—play in building science-related identities in youth. In this case, a

science center provided specific structures that allowed the youth to play a central role in creating meaningful science experiences for themselves and dialectically shaping the nature of teaching and learning experiences of the science center. Science centers allow youth to have prolonged engagement with scientific ideas and often have programs that allow youth (older youth in particular) to develop science leadership skills and dispositions vis-à-vis others. This could potentially support them in developing their awareness of themselves as science learners, shifting their epistemological understandings of knowledge production and recognizing science as accessible and relevant in everyday life. The Explainers have experienced positive teaching and learning experiences and it is now possible for these students who have been voiceless in schools to learn modes of inquiry and communication that allow them to think deeply about their own aspirations and goals and the role they place in shaping and being shaped by society (Giroux, 2007). The youth in this study frequently discussed the differences between learning and participation in the science center versus school. Explainers often described school as a place structured by discipline and authority; however, working at the science center was about learning and teaching. While they acknowledged that school was necessary for advancement through life, they recognized that for them the real learning happened in their work as Explainers. They noticed this not only for themselves, but also the visitors. They knew that they had to make science learning meaningful and engaging to their audience and often wished aloud that their school learning experiences were more like what they experienced and facilitated at NYSCI.

As the youth in the study build science-related identities, these identities and corresponding activities shaped the spaces (NYSCI, classroom, activities with peers) that the youth occupied, thus transforming them into particular places. These hybrid spaces (Moje et al., 2004) may not always represent physical spaces but also the embodied sense of the identity(ies) they develop as they transform places, in this case the hybrid space they create by enacting a central role in an informal science institution. These hybrid spaces are dynamic and always being transformed; they are transformative because students' fluid identities are continuously being shaped as they shape and create place. Students, like the ones highlighted in this article, who often find themselves at the periphery of the classroom are immersed in a very central and visible STEM leadership role in a non-traditional science-learning environment. With their red aprons these students were ascribed as science-savvy by both their peers and the general public. In these off-the-grid science learning contexts, knowledge production is a collaborative activity and democratized in that it both emerges from the community and is shaped by the individual's socio-cultural milieu. In order to increase the diversity of students participating in STEM learning experiences, we need to create more of these off the grid spaces of science learning where students can develop a sense

of agency over their learning and take on leadership roles in creating STEM learning experiences for others.

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