Motivating youth through authentic, meaningful and purposeful activities: An examination through the lens of transformative activist stance

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Abstract: An ongoing and at times seemingly intractable issue in science education and STEM fields is the underperformance and underrepresentation of marginalized youth. This is often attributed to disconnect between school in general, school science specifically and the cultures that youth enact and experience in their daily lives. Although research demonstrates that youth become engaged in STEM when it is relevant to their well-being and that of their community, the question of what motivates underrepresented youth to pursue STEM interests is still not fully understood. This white paper argues for framing program development, evaluation and research within a transformative activist stance. Such approaches give voice to youths' perspectives on how and why they participate in STEM programs, enabling the design of youth-centered STEM programs that more effectively develop and sustain interest in STEM careers and pursuits.

Problem

The National Science Board (2010) states the key to the nation's success is to invest in its human capital, particularly the next generation of STEM innovators. Towards that goal, they recommend that as a nation we "cast a wide net to identify *all* types of talents and to nurture potential in *all* demographics of students" (p. 3). We also know that in order for youth to succeed in the future workforce, they must be competent in 21st century skills (www.p21.org); specifically they need to be able to think creatively and critically, while also being able to communicate and collaborate.

Although an important goal to nurture the potential of *all* types of students, it is also tremendously challenging tall order 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). This is often attributed to disconnect between school in general, school science specifically and the cultures that youth enact and experience in their daily lives (Lemke 2001, Roth & Tobin, 2007). Although research demonstrates that youth become engaged in STEM when it is relevant to their well-being and that of their community (Connell, Halpem-Felsher, Clifford, Crichlow, & Usinger, 1995; Rumberger, 2004; Edelson et al. 2006), the question of engagement—what initially motivates underrepresented youth to become interested in STEM, and what contributes to sustained interest over time, is not fully understood.

Appreciating that motivation is a dynamic, situated, and domain-specific phenomenon, a process that can be inferred from observing youths' actions (Schunk, Pintrich and Meece (2008), we posit that youth-centered, goal-directed activities can increase underrepresented youth interest and engagement in STEM, while also building their 21st century skills. Goal-directed activities empower youth to respond to issues in dynamic,

situated, and domain-specific ways. Merging this view of motivation with a transformative activist stance (Stetsenko 2008) of learning and identity development, we recommend that youth engagement activities emphasize participation in activities in which youth are simultaneously producing, reproducing and transforming others and themselves through the process, all with the goal of contributing to society in some small way. We find this approach to thinking about motivation and identity development useful because our central thesis is that youths' STEM motivation will increase if the OST programs in which they participate engage them in real-world activity and problems of consequence, positioning them to be generators of and contributors to the STEM enterprise, as well as contributors to society. Youth want to matter and belong and contributing to society is one way that youth can do so. Such contributions can include creating something to engage, excite or interest their peers or to improve the quality of life in their immediate community. What matters is that there is a goal that affects people beyond themselves.

The objectives of the paper are to 1) frame the development of ITEST project activities through the lens of transformative activist stance (Stetsenko, 2008) thus beginning a dialogue for how activities designed and implemented in this way can potentially motivate youth to develop long-term dispositions and identities as STEM practitioners and 2) describe how participatory research methodologies can be integrated into ITEST activities in ways that support both the goals of research and the implementation of more effective programming for youth.

We describe how a specific project engages a diverse group of high school students to participate in a meaningful, purposeful activity that allow students to exercise both STEM and 21st century workforce skills. We ground our work in socio-cultural perspectives because we recognize that learning is a social activity, mediated by institutional and cultural factors. We also recognize that learning, identity development and motivation occurs when people engage in activities that are meaningful and valued by themselves and others. The described project is considered a transformative activity because one not only engages in the process of learning—learning the collaborative practices of a community and finding their role in it—but also in the process of Becoming, which Stetsenko (2008) describes as, "[humans becoming] agents of their own lives, agents whose nature is to purposefully transform their world" (p. 12).

Methods

Increasingly many ITEST projects have a central component which positions youth to participate in meaningful, purposeful activities that contribute to the well-being of society, for example through environmental activities or by supporting others to develop an interest in and engagement with STEM topics. In such activities, youth play a major role in deciding how they will engage in STEM and what tangible products will result. We will describe and interpret one specific ITEST project, Virtual Hall of Science (VHOS), within the transformative activist framework, demonstrating how taking such a purposeful stance can motivate students to engage in STEM activities and potentially pursue and persist in STEM education and careers.

The Broader Context

Situated in one of the most diverse districts in the country, the New York Hall of Science (NYSCI) employs local youth to work as Explainers to facilitate learning interactions with visitors that allow them to explore scientific phenomena. This program directly addresses challenges of motivating young people in STEM by working with them through a graduated program that enables them to advance as they master STEM knowledge and skills required for them to take on increasing responsibilities. Explainers are recruited based on their interest in having a job, rather than on their academic performance. Often Explainers hired are initially somewhat shy, but they demonstrate an interest in working with people. Many even claim to dislike or be afraid of science when they begin their relationship with NYSCI. Over time, Explainers develop an understanding that they are part of a bigger endeavor and that their actions and activities matter to the success of the science center, and to the experiences of the school and family visitors. The Explainers are motivated to learn science and understand the exhibits because they want to be well versed in the content before they interact with visitors. Working at the science center has even motivated some to considered careers in STEM and teaching. The quote below shows evidence for how one student attributes her career to her experiences at the museum.

> I am who I am because of the Hall of Science; I wouldn't have the Masters degrees. I wouldn't have all this. My career choice is directly related, I wouldn't have been working in [a] science institution without the museum. When I go to interviews for science organizations, I'm able to walk in and show how much I know, and show I have the ability to learn what I don't currently know." [Female Asian American, 31-35, professional]

Explainers are learning both science content and constructivist-pedagogy as they continuously improve their mediating skills. They are also engaged as constructivist learners—continuously scaffolding new content and ideas as they build their expertise. Both individually and collectively, the Explainers create and recreate a distinct practice of teaching science on the floor at the Hall. The structures that exist in this OST setting—interactive exhibits, and supportive peers and supervisors—afford the resources for their learning and identity development. Their ongoing motivation for learning is to make a difference by becoming better facilitators. They also gain self-awareness of how they and others learn, also an important 21st century learning skill.

Virtual Hall of Science

In order to extend the success of the Explainer program, NYSCI designed the VHOS, to support students in developing not just their 21st century skills, but also their ICT skills. While the ultimate goal of VHOS is to encourage young people to consider STEM careers, the immediate goal is to engage them in using these skills to contribute to an activity that has purpose beyond the walls of the classroom. In the VHOS project, approximately 40 high school Explainers work closely with scientists, educators and other professionals (referred to as project leadership team) to develop the skills to conceptualize and create STEM exhibits in a 3-D space which populate a virtual science center. Their goal is to create entertaining science learning experiences for visitors of all

ages. This space is not just a workspace for youth, but a "real" place that will be opened to the public where families and school groups can engage in the learning environment created by the Explainers. The students, both individually and collectively, contribute to the content of this space and are responsible for getting it ready for public use.

Working in groups of four, Explainers first decide the content they want to focus on. They learn how to design within the virtual world and then as they create prototypes of their interactives, they get feedback from their peers, from the NYSCI staff, from experts in the field of technology and museums. At key points throughout the project, Explainers have the opportunity to present face-to-face and virtual showcases to visitors to test the usability of their interactives. The Explainers learn both soft and hard work skills as they assume responsibility for each phase of the project. They are motivated by this responsibility because they know that the success of the visitor experience is in large part due to the quality of the experience they create.

Weaving Research into Practice

As stated earlier more recent social cognitive conceptualizations of motivation see it as a dynamic, situated, and domain-specific phenomenon (Schunk, Pintrich and Meece (2008), Such complexity creates challenges for the educational research community as they attempt to document the role of motivation. It is both difficult to determine the best ways to gauge motivation and to understand the many different factors that mediate what does or doesn't motivate youth to become interested in participating in STEM activities. Some factors are even beyond the control of youth such as access to opportunities, time, money, and more. Considering the complexity of this construct, we describe a set of strategies used in VHOS to document changes in participants and the role that motivation plays.

Cogenerative Dialogues. Cogenerative dialogue (Tobin & Roth, 2006) is the approach used to engage youth in collaborating and constructing their VHOS environment. Such dialogues are youth-focused meetings which give them voice and choice and afford equal participation of youth and knowledgeable adults. However, these dialogues are not only activities that engage youth in making key decisions about their activities, they also serve as a way to collect data on youth's perspectives about motivation and meaningful activity. Each participant in the cogenerative dialogue has voice and this supportive and open environment for discussion ideally minimizes power imbalances. By using a method in which participants work collaboratively with those in positions of power and expertise, youth are able to describe the difficulties arising within the project and co-create solutions. These dialogues also provide insights into the ways youth conceptualize STEM, STEM careers and the constraints and opportunities to pursue and sustain interest in STEM activities such as building exhibits in VHOS. These insights can greatly influence the education communities' ability to create more meaningful, authentic activities, which will motivate youth to pursue and persist in STEM activities, education and careers.

Blogs. Building social networking spaces within this project to gather notes, make decisions, identify conflicts and accomplish work across time has been another effective,

although unintentional way, to document which youth serve as motivators for others and who are not as engaged within the project as others. The blogs are part of the activity and were not originally meant to be a data collection strategy for research. However, the richness of some of the posts indicates that these online conversations are potentially useful data sources for documenting motivation. Entries that have more detail and create an atmosphere of teamwork and community have been good indicators of the levels of motivation of the students. The following post from one student demonstrates how he has taken the initiative to make roads within the virtual space to create order,

> Hello all!, just here to say that I have created our towns infrastructure if you were wondering. I took one night to do it and I made it so that the roads pass through in front of almost everyone's house. It also turns into a bridge at one point passing over a few of the houses :). when you get a chance, you may want to take a ride along the road...no telling in where it might take you...there is always more to explore my friends...(posted 3/16/2010)

This student was motivated to make roads because he needed to create organized ways of working in the virtual world. He knew that this space was going to be used and eventually would be visited by the public and took it upon himself to make roads. Utilizing these entries, we are able to determine which youth are motivated to participate and who are not. For those that seemed uninterested, we are able to take a step back and address the situation by adjusting different elements of the project. While this is a time consuming mechanism for documenting motivation, it is one that becomes part of the activity itself. Thus the blogs serve as a window for educators who design these activities to understand which elements of a program motivate students to persist and work through challenging moments.

Findings/Impact

The notions of identity and activity are dialectically related. As a person engages in social activity, her identity continues to form and transform mediated by the resources and tools she uses, by how she chooses to use them and by how others view her. As her identity continues to transform, the activity continues to be transformed. A person who sees herself as one who is an expert in science will approach the activity of facilitating science experiences differently than the person who does not. Therefore motivation is linked to participation in activity and consequently to identity formation. As one engages in meaningful activity and grows in the identification of self as an expert in that activity, it impacts the level of motivation. Youth in this project identify with being an Explainer, a person with some level of comfort and expertise in facilitating science conversations. When faced with the opportunity to apply this identity to a new setting, they are not only excited, but somewhat equipped to begin the activity. With scaffolding from the project leadership team, they develop their skills and gain new tools and resources to apply towards the activity. In the following statement, an Explainer describes how she and her teammates work towards designing age-appropriate exhibits:

> So today, they let us work on expanding our exhibit idea on the VHOS 3rd Floor. I thought about the feedback I have been getting about the concern of the age group for the VHOS Preschool Place, so I decided to just create it as the VHOS Kids Place. And I also made a sign saying that the recommended age is 6 and UP. Today I only built the outside of this place but when I get home I will expand it even more! I'm excited, and I really hope this idea can be successful.

What we witness from this excerpt is knowledge gained from working at the New York Hall of Science is being used to design a virtual space. Explainers are engaged in the collaborative practices of the museum. Through their ongoing learning and participation in museum activities, they become more intimately familiar with the behind-the-scenes workings of the institution. They value that some exhibits are more suitable for younger children and belong in a separate space and are able to engage in the design of such a space with some degree of professional knowledge. In the statement above, the students enact this collaborative knowledge to help one of their peers to make her space more age-appropriate. Experiences like these mediate the developing identity as a designer of STEM exhibits. These developing identities in turn mediate motivation for continued participation in the activity. The following statement from a different student supports this claim. This blog post is from his initial participation in the program. One of the first skill-building activities that Explainers engage in is learning to build their own house in virtual world. In the process of building their house, they gain experience with different tools like Google Sketchup and learn foundational computer programming skills that they will then apply to building a virtual STEM exhibit.

> Today I was on [in-world] from 4-10pm, working on my house and after 6 hours I am almost done. These six hours went by pretty fast and I am adding some finishing touches to my house. The new house I built is 3 stories high on almost the edge of homeland. Today I was basically addicted and really could not get myself off.

Laptops were made available for students to borrow and use at home to continue their activities. This particular student expressed that he was "addicted" to the activity. From our perspective, in his "addiction" he was using digital tools and gaining ICT skills that are relevant to participation in the STEM/ICT workforce. As researchers and practitioners we are, in fact, aiming to addict kids to these types of math and science activities.

VHOS is in the beginning of its third year and is about to engage its final cohort of high school students. The actual virtual world is populated with numerous STEM interactives and the project team is planning how this 3-D space will move from being a workspace to becoming a public site for virtual visitors. The Explainers will lead the development of the facilitation plan in partnership with full-time NYSCI staff and the evaluation being conducted by Center for Children and Technology is centered on measuring growth in Explainers' ICT skills and awareness of STEM careers. Although the evaluation is not specifically measuring how the project is impacting motivation, the project team can clearly note that the Explainers are enthusiastic about figuring out ways to bring their expertise in facilitation to a virtual environment. This project has allowed them to extend

their Explainer identity to a new context and learn new roles in facilitating science-learning experiences for the public. The motivation is generated from within the Explainer group itself as they bring their prior experiences facilitating science with visitors to the physical NYSCI and share what has worked and what hasn't worked. Furthermore, they feel a sense of responsibility towards each other and to the project, which contributes to a collective motivation to excel. The following blog statement from one the students who has emerged as a leader from within the group demonstrates how students motivate each other:

> This is too [sic] all of my peers and colleagues. It has been brought to the attention of all of those who attended the in-world session at 6pm on today's date: 4/28/10 that we have been quite lax with our work. Lax in the sense that we are slacking. This is not what was expected of us, it isn't the duty of the leaders to keep you on track but you should want to keep yourself on track! SELF-LEAD! Please, I know we are capable of great things so lets get to it! FULL MOTIVATIONNN!; Oh and PLEASE look at the floor plans for VHOS, these are the plans we are going to build by so please adhere to them and try to construct your exhibits in the designated areas. Organization is key people, lets keep it up! Thank you, this is all I really have to say, OH! and please complete the surveys for the end of each week, these surveys should be completed before every Saturday, being that Saturday is the mark for the beginning of a new week. -Thank You,

We felt it was important to provide the entire blog entry in this paper because it provides evidence for this collective motivation. The student has pride in his group, knows his group's potential for success and does not want the project leaders to think otherwise. He encourages the other students to "self-lead"—an invitation to become proactive. He also reminds the others to complete what may seem like a repetitive task, to fill out the weekly evaluation surveys. This student is aware of the importance of the evaluation to the project—to the collaborative practices of the museum—and wants to ensure that his group is performing well in all areas. It is in these groups where the collective sense of motivation is quite strong. The project leadership team's role has been to harness this motivation and so that it not only supports youth in growing their skill set, but also meets the objectives of building a public virtual space.

Discussion

The process of engaging students in meaningful, authentic activities in which they are positioned in a central leadership/decision-making role can be a source of motivation. In this case, students build a 3-D interactive STEM learning space that will extend their role as Explainers into a new (virtual) context. The project team designed this activity for students to gain ICT skills while developing an interest in science, however the very nature of the project motivates students because they are doing something that will be for the greater good of the Explainers, the science center and ultimately the general visiting public. This project also opens up many questions to consider including:

- Given that motivation is dynamic, situated, and domain-specific and can be inferred from actions, what are some ways that we could observe and describe

actions that indicate motivation? How can we reproduce the conditions that lead to those actions that seem to specifically lead to motivation? While this question is pertinent to many, it is especially relevant for educators who are responsible for designing experiences for youth and for policymakers who influence decisions about which programs and projects get funded.

- Issues of workforce development are compelling the nation to examine our practices, our policies and our assumptions about STEM teaching and learning. In this political climate, what can we learn about student participation and motivation in projects like these that would support career-focused STEM education? The project featured in this paper is designed to investigate awareness of and interest in STEM careers, however we became aware that the context of the project spurred students to persist and surpass meeting the project goals. In other words, the collective goal of the group to build something of relevance to multiple stakeholders seemed to be a central motivating feature. In what ways could this motivation in this STEM context be linked to motivation to pursue STEM careers? Or perhaps we should ask, how could we make more explicit the connection of the STEM contents and skills learned in a project to STEM careers that contribute to the greater good? If this were a central design feature of such projects, would this motivate more students to pursue STEM careers? What kinds of STEM careers would these students be drawn to? How could we document this trajectory?
- We discuss some possible ways of weaving research into practice, but what are other ways that researchers and practitioners can work together to understand when and how an activity motivates youth? How can we involve the youth themselves becoming self-aware about their motivation? How could we document this in ways that strengthen the body of literature in this area and lead to practical application in program development and implementation?

These are some initial questions worth exploring as we work to advance the body of research and practical activities that aim to motivate youth to pursue STEM careers and interests. Hopefully such questions will help us to not only expand our definition of motivation and the factors that support it, but also to think about ways to purposively design activities and engage youth in ways that will contribute to their STEM-related motivation and persistence.

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