Creativity and Curiosity in STEAM Education

Abstract
Curiosity is a cognitive tool that can be cultivated to promote diversity within computing cultures. Creativity supports sensitivity towards multiple perspectives and collaboration promotes innovation within learning environments; these two principles are synthesized within STEAM education approaches to sociotechnical constructions of learning.

Author Keywords
Creativity; STEAM education; Diversity.

ACM Classification Keywords
H.1.2 Human Information Processing; K.3.2 Computer Science Education.

Author Biography
My interdisciplinary work within the areas of Human Computer Interaction (HCI) and Information Science (IS) seeks to understand how informal learning environments for children support the construction of gendered expertise in sociotechnical contexts. My research applies the theory of Science, Technology, Engineering, Arts, and Mathematics (STEAM) in order to better comprehend how we can create innovative pedagogical approaches that support diversity in terms of both varied gender expressions and multivalent learning styles. My research also asks how nonlinear
learning processes that incorporate playful engagements with technology disrupt traditional approaches to teaching the STEM disciplines, and how these performed disruptions support innovative, collaborative, and adaptable pedagogical approaches to diversity in computing educational practices.

**Sociotechnical Identity Formation**

Information science and HCI scholars have not yet discussed in depth how an examination of children’s playful engagements with technology potentially promote nonbinary sociotechnical gender identities to be both formed and visibly expressed in concert with the attainment of gendered expertise based upon varied skill building with both crafting and programming activities. This is especially important given how STEAM (Science, Technology, Engineering, Arts, and Mathematics) educational theories can support diversity in computing cultures. In light of this, it is crucial to understand the role of maker culture in an exploration of how STEAM skills in turn support understandings of how sociotechnical gender identity formation is embodied and performed.

**Theoretical Framework**

Weibert, et al. [31] explored the appropriateness of e-textiles for teaching programming to mixed gender groups ages 8-12. The result of their study demonstrated that e-textiles have the potential of promoting both genders’ computational literacy, thus disrupting binary gender roles. Kafai and colleagues [8] observe that coding is a crucial skill for all children as it can be a way to encourage “computational thinking.” They called for the conception of “computational participation” instead of computational thinking because “computational participation” moves beyond the individual to focus on wider social networks and a DIY culture of digital ‘making’. Kafai et al [8] argue children nowadays do not code for the sake of coding, instead it is an intrinsic skill for participating in computational communities. Much of this work is situated in a literature around making which is now part of a global movement of makerspaces and maker faires spanning the globe [8,10,12]. Maker culture as a movement supports exploration, playfulness, innovation, and skill building using creativity and nonlinear learning styles as ways of exploring self-efficacy and agency [8, 10, 12, 31]. As core elements all these define a movement that otherwise has been recognized as multi-faceted, as it unites designers, crafters, steampunks, and bricoleurs in their do-it-yourself approach to technology [10,13,16] which share common maker identity features. Research has identified them to be concerned with identity production [8], skill development and refinement, [10,12,13], participation principles and sharing norms [27, 28], and gender is a key, but understudied, component of identity formation [21,22,31].

Collaboration and curiosity are integral components of the creativity and playful exploration that comprises maker culture, and peer interactions create opportunities for young people to construct their own individualized sociotechnical identities. Furthermore, Lewis identifies technology education in the classroom to be the place where creativity is fostered, as children are introduced to the world of problem solving and invention [12]. Maker culture supports innovations that allow users to become designers, which permit them to
generate new modes of skill building that simultaneously support identity formation.

**Study Design**

My fieldwork, conducted in 2015, framed in the disciplinary tradition of anthropological ethnography focuses on a computer club held at Western Shore for teen girls in grades 6 through 8. Our computer club met on Mondays from 3:30pm to 5:00pm. In order to properly set up our equipment, including one laptop per each one to two girls, craft supplies, e-textiles equipment, and sundry other materials as appropriate. My research team consisted of two faculty members, two undergraduates and another graduate student. Some research team members taught the children programming, others focused more on ethnographic fieldnotes, all with varying degrees of participation observation. We offered our participants the opportunity to have snacks and homework help between 3:30pm-4:00pm. We hosted an activity for the girls from 4:00pm-5:00pm; these lessons varied according to the girls’ interests; additionally as the girls had different learning styles the lessons were not always linear and focused.

Our computer club taught e-textiles in order to promote skill building for the participants in the areas of programming, soft craft projects, and electronics. Our computer club featured weekly lessons including how to build a circuit properly, how to write simple code in Ardublock to control and mediate the functionality of e-textile project components, including LED light patterns, as well as ‘on/off’ functions. As the participants demonstrated different learning styles and paces, we adapted pedagogically in order to support feminist value sensitive design principles and STEAM approaches to sociotechnical learning. We had a range of projects that the participants engaged in during the course of the study.

In one of our projects, the participants worked on bookmarks with LED lights that provided skill building in the areas of learning to accurately lay a circuit, make aesthetic decisions and apply craft skills such as sewing, cutting, and drawing. The participants also engaged in creating their own projects; one of these was a bookmark that had a light sensor that responded increased amount of light present when the bookbag was unzipped, and turned on, illuminating the bottom of the bag. These projects support the synthesis of craft skills and programming skills, in order to better engage the girls through the practice of both participatory design, as well as value sensitive design, adapting our lessons and interventions ideationally and practically in ways that the girls will respond to positively and value, in ways that demonstrated their agency and interactive learning processes. Our philosophy of teaching in the computer club promoted the notion of STEAM education which incorporates creativity and curiosity as a cognitive learning tools that could be applied concretely, rather than as an abstract construct.

**Acknowledgements**

I would like to thank Dr. Jennifer Rode, Dr. Jennifer Booker, and Houda el Mimoni as well as the children, parents, community leaders, and teachers who supported this research. I would like to thank Volker Wulf, Anne Weibert, and Konstantin Aal for their methodological and theoretical guidance. This material
is based upon work supported by National Science Foundation grant number 1253465.

References


