Mindful makers: Question prompts to help guide young peoples' critical technical practices in maker spaces in libraries, museums, and community-based youth organizations

Leanne Bowler *, Ryan Champagne

University of Pittsburgh, PA, United States

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ABSTRACT

This study examines question prompts as a means to scaffold reflection and reflexivity in the design, development, and use of technological artifacts in maker spaces for youth at public libraries, museums, and community-based organizations. Qualitative analysis is applied to data gathered in four focus groups with teens, three semi-structured interviews with adults who facilitate maker spaces, and six observation sessions. Outcomes include a rich description of critical thinking in the context of technology practice, and secondly, a set of eight activation questions that serve as a tool kit to encourage reflection and scaffold mindful and critical practices in community-based maker spaces for youth. Results from this study support the development of nstruments and practices to support mindful making and critical technical practice in maker spaces for youth.

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1. Introduction

Libraries, museums, and many community-based organizations support lifelong learning. One influence in the realm of informal learning is do-it-yourself (DIY) culture, a key ingredient being the maker space—a physical place where informal, collaborative learning can happen through hands-on creation, using any combination of technology, industrial arts, and fine arts. Other terms used to describe maker spaces include learning labs (Koh & Abbas, 2015), and fablabs, hackerspaces, and techshops (Calvalcanti, 2013). Irrespective of the name applied, these spaces are akin to a laboratory and the kind of learning they afford is hands-on, iterative, and experimental, targeting a wide array of science, technology, engineering, and mathematics (STEM) competencies.

Many in the world of informal learning, including library and museum staff, have enthusiastically embraced the maker movement. Proponents of maker spaces argue that such environments address a unique package of complementary 21st century skills and aptitudes such as creativity, innovation, transmedia navigation, visual literacy, and (if based in technology) computational thinking—the kind of skills identified by the Institute of Museum and Library Services in their report on museums, libraries, and 21st century skills (2009) and also in the report on learning by the Partnership for 21st Century Skills (2011). Underpinning these competencies is the set of skills and aptitudes associated with critical technical practice, which is the ability to think deeply, critically, mindfully, and with a sense of responsibility, about the

technological artifacts that we design, make, and use. This is an essential competency for those who will design and build our future technologies. Can this type of thinking be supported in the context of a maker space for young people and if so, how? The study tackles this question through an examination of three maker spaces for youth in Pittsburgh, exploring how the adult mentors and the young people they work with use question prompts to scaffold deeper thinking about making technology and digital media.

The question prompt is a verbal tool that can reveal variables associated with self-regulation, self-awareness, reflection, and reflexivity, opening a window of thought processes during the making process. Question prompts can also, if skillfully applied, provide a metacognitive scaffold to help steer novice makers toward a critical technical practice in maker spaces. In this study, the qualitative analysis of question prompts used in maker spaces for youth resulted in a rich description of what critical thinking looks like in the context of technology practice that engages verbal tools to encourage reflection, and secondly, a set of eight activation questions that serve as a tool kit for scaffolding mindful and critical practices in community-based maker spaces for youth.

2. Problem statement

As we move into a world where digital capabilities are built into the everyday objects in our lives and where anything that can be automated will be, a critical and self-aware stance toward digital artifacts is needed more than ever. Young people, as the inheritors of this world, will need to be able to think creatively, metacognitively, and with a deep self-awareness vis à vis their relationship with the technologies and media

* Corresponding author.

that they create and use. How might we develop this critical attitude in young people? How can young people's experiences as digital makers[1] go beyond product-oriented activities focused on procedural "how-to-do-it" learning, to include notions of reflection, critique, assessment, and agency in relation to the technology that they make?

The materiality of learning in a maker space suggests that some exploration of the relationship between the maker and the technological artifacts they create is needed, as well as the ways that this relationship can be made transparent to the maker. As an emerging area of study, the body of empirical research in maker spaces for children and youth is small but growing. Maker spaces for youth have been explored principally from the perspectives of learning (Brahms, 2014; Sheridan et al., 2014; Wardrip & Brahms, 2015), sense-making (Koh, 2013), or the competencies and training needs of the adults who work in maker spaces (Koh & Abbas, 2015; Moorefield-Lang, 2015). There is a gap in the literature in terms of critical technical practice and young people. More specifically, there is a dearth of work that investigates tactics or methods to support critical approaches to the creation of technology. This study fills such a gap, presenting research into the use of question prompts as a scaffold to critical technical practice.

In seeking to discover more about the use of question prompts in maker spaces for youth, the study was framed by four research questions meant to reveal the types and nature of questions that makers might ask themselves (these prompts revealing the presence or absence of mindfulness, critical thinking, and self-reflection during the making process):

- What are the questions that adult mentors (expert makers) ask themselves when they create technological artifacts?
- What are the questions that adult mentors (expert makers) ask young people when they (youth) create technological artifacts in maker spaces?
- What are the questions that youth (novice makers) ask themselves when they create technological artifacts in maker spaces?
- What problematics and self-reflective thinking are captured by these questions?

3. Literature review

3.1. The maker movement

Maker spaces, places for work and play that foster inventive production and expression in a communal environment, offer individuals opportunities to experiment with digital and analog technologies as conduits for creation and essential learning (Bagley, 2012; Britton, 2012; Catalano, 2013; Martinez & Stager, 2014; Scott, 2012). Informed by a credo asserted in Hatch's, 2013 *Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers and Tinkerers*, maker spaces embody making, sharing, giving, learning, tooling up, playing, participating, supporting, and changing. Britton (2012) distills this mix of actions into a shorter list of actions that emphasize the co-creation and collaboration realized in maker spaces.

Two activities emerge from the literature and recur often in nascent discussions of maker spaces: creating and learning. Maker space advocates assert a shift in users' experience from one of passive consumption to another of active production during visits to library spaces (Bagley, 2012, 2013; Britton, 2012; Koerber, 2012). Production offers value beyond an end product for makers; they develop new literacies by engaging with tools and processes that may not surface in conventional learning environments. Such learning shifts skill building onto the maker, crafting expertise through producing artifacts and technologies

rather than relying on existing products (Bowler, 2014; Britton, 2012; Catalano, 2013; Koerber, 2012).

Makers benefit from the communal nature of maker spaces, engaging with diverse groupings of co-creators. Maker spaces democratize production and increase access to the technologies behind the making of creative and technological artifacts (Koerber, 2012). Consequently, maker spaces attract multidisciplinary, multigenerational audiences that convene to create and learn together. Community settings often play host to maker spaces, benefit from a diversity of community members, and create new, smaller communities of makers that contribute changes to society (Bagley, 2012; Britton, 2012).

3.2. Critical technical practice

This study in community-based maker spaces for youth is situated within the broader context of critical technical practice (CTP), a perspective on technology that arises from the field of human computer interaction (HCI). Critical technical practice questions our assumptions about how people interact with technology and emphasizes the role that designers have in mediating that interaction (Dourish, Finlay, Sengers, & Wright, 2004).

CTP presents a process-oriented perspective on making and refers to the use of reflection and reflexivity in the design, development, and use of technological artifacts. The broader goal of CTP is to develop positive technologies that speak to an authentic and rich human experience rather than to the narrower focus of productivity and efficiency that is often the currency of discourse in the field of technology development (Boehner, David, Kaye, & Sengers, 2005). This study takes an expansive view of critical technical practice assuming, first of all, that it has metacognitive elements of reflection, self-awareness, and self-evaluation, and secondly, that these processes occur within the broader context of our material, social, and cultural worlds.

CTP does not consider the skills and knowledge needed to create an artifact as disconnected from the creator's sense of self. When humans use computing to make technological objects, we do not become "disembodied cyborgs" (Floyd, 2005, p. 211)—separate from our physical and emotional needs, from our cultures and values. Further, CTP suggests that the process of making a technological artifact can be a political act with social consequences that impact not just the maker and final end user but also larger society, the suggestion being that makers who are unaware of themselves as actors in the making process are, in some way, working blind. In this regard, the development of intrapersonal and interpersonal knowledge—in other words, a deep awareness of oneself as a maker and in relation to society—in today's young makers might help to contribute to a more socially-aware technical practice tomorrow.

As Floyd suggests, the key to developing a critical technical practice is "authenticity, making our own values explicit, respecting those of others and reflecting so as to find common steps that we can take" (p. 211). Reflection is key and it is often prompted by the questions that we ask ourselves. Young makers, as with anyone who creates an artifact for human use, need to ask questions about themselves as makers and about their role in the making process: What assumptions do I have about this object and how it will work? Why do I like this? Or, why does it bore me? What do I know about this technology and equally, what do I not know?

3.3. Mindful making

Beyond the concept of critical technical practice, various perspectives and methodological approaches to the interrogation of the relationship between humans, society, and the technological environments that we build have emerged: value sensitive design (Friedman, 1996, values-in-design (Knobel & Bowker, 2011), reflective design (Sengers, Boehner, David, & Kaye, 2005), critical computing practice (Floyd, 2005), and critical making, which invites reflection on the

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[1] The authors use the term "maker" to describe people who create digital and/or analog technical artifacts in formally designated maker spaces.