Everyday Creativity in Novice E-Textile Designs: Remixing as Interpretive Flexibility

Yasmin B. Kafai
University of Pennsylvania
3700 Walnut Street
kafai@upenn.edu

Deborah A. Fields
University of Pennsylvania
3700 Walnut Street
stareyes@gmail.com

Kristin A. Searle
University of Pennsylvania
3700 Walnut Street
searle@dolphin.upenn.edu

ABSTRACT
We examine e-textile designs, a new domain combining crafts, circuitry, and programming with the LilyPad Arduino, to better understand how novice designers develop creative technical solutions. Our analyses draw from observation and interviews conducted with middle and high school students enrolled in e-textiles workshops. In the workshops, students created their own designs by re-interpreting e-textile creations from an online community or by re-purposing the conductive functionality of everyday objects. These remixes, popular in today's youth digital media culture, can also be seen as "interpretative flexibility" and promising indicators of the everyday creativity of novice designers.

Author Keywords
E-textiles, creativity, remixing, design

ACM Classification Keywords
K.3.0 [Computers and Education]: General

General Terms
Human Factors, Design

INTRODUCTION
Much of the research around creativity and technology has focused on understanding how software designers develop new solutions to overcome constraints. Smith [4] called this ability "computational flexibility," the capacity to invent software solutions when existing applications fail to solve new problems. While such flexibility can be expected of experienced designers, it is unclear how novice designers can engage in such creative designs. Yet though the creativity of novice designers may not look like those of experts, finding ways to recognize it may help us understand and promote the development of computational flexibility in design.

As a starting point for our investigations into the creativity of novice technology designers, we draw on Lewis' [2] understanding of creativity in the technology classroom and Roth's [3] suggestion of "interpretive flexibility" in his students' engineering designs. Lewis [2] argues that the technology classroom is an ideal site for creativity because it is not bound by traditional academic norms and provides a space for teaching problem solving, requiring creative thought processes. Similarly, e-textiles are a new domain that combines crafts, engineering, and programming with the LilyPad Arduino; students must combine knowledge from these multiple domains when problem solving. In the workshops, students created their own designs by re-interpreting e-textile creations from an online community or by re-purposing the conductive functionality of everyday objects. These remixes, popular in today's youth digital media culture, can also be seen as "interpretative flexibility" and promising indicators of the everyday creativity of novice designers.

Like the key aspects of the technology classroom as a site for creativity that Lewis discusses, e-textiles designers are put into an open-ended and ill-structured design situation where solutions are not pre-defined. The novice designers must match their desired designs with the affordances (and constraints) of the technology, combining old and new knowledge in creative ways. "Interpretive flexibility" [3], interpreting an object in different ways depending on local needs and the frames people bring to a situation is one way to understand young designers' emerging creativity in the new domain. The youth we studied were new to sewing, circuitry, and programming, all components of e-textiles using the LilyPad Arduino [1]. By analyzing the micro-changes made in their designs and expressed in their self-reflections, we study their remixing of materials and of images from an online archive and suggest these as a type of "interpretive flexibility."

CONTEXT
The case studies of novice e-textiles designers are drawn from a larger, ongoing study of creativity and computational design. As part of the study, we conducted a series of 6-8 week e-textiles workshops with middle and high school students from a range of racial, ethnic, and class backgrounds. With the 8 middle school students, we built simple circuits that required engagement with the crafting and circuitry domains. With the 27 high school students, we increased the level of complexity and included

C&C'11, November 3–6, 2011, Atlanta, Georgia, USA.
ACM 978-1-4503-0820-5/11/11.

the LilyPad Arduino, which required computer programming in addition to crafting and circuitry. Our data focus on participants' designs: careful documentation of design changes in their projects (daily/hourly pictures and observational notes) and interviews about their designs. We inductively coded the data with a focus on tensions and solutions as participants struggled to enact the aesthetic ideas they brought to the project and the affordances of the LilyPad technology they learned through the workshops. Finally, we compiled case studies based on particularly compelling examples that we found in the data set during the coding process. Here we share two of these case studies, one a 14-year-old high school girl and the other a 12-year-old middle school boy, engaged in design activities that illustrate the everyday creativity of novice e-textiles designers.

FINDINGS

In the following vignettes, we highlight the interpretive flexibility exhibited by students in e-textiles workshops as they moved through the process of conceptualizing, designing, and producing their own e-textiles projects. Our findings focus on how participants created their own designs by "re-interpreting" e-textile creations from an online community or by "repurposing" the functionality of everyday objects. For instance, Bailey's original idea came from browsing the LilyPond website, an online repository of many e-textiles projects. Intrigued by a simple circuit robot patch, she began to draft her own design based on this image. However, over time she changed the design in several ways in order to incorporate a LilyPad: making the robot rectangular instead of rounded, putting two LEDs as eyes instead of one in the heart, and using the LilyPad to make the lights blink. Further, through repeated iterations of designing and crafting, she discovered that the conductive thread only needed to be on the left side of the robot. However, she re-interpreted the conductive thread as an aesthetic element, going to great trouble to sew matching (non-conductive) lines on the right side (see Figure 1). Thus she remixed the original design that inspired her while still holding on to certain elements (a robot with a heart), and flexibly interpreting the conductive thread as both functional and aesthetic.

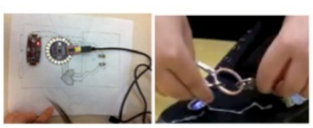

Figure 1: Bailey's robot design [left] and Aaron's shoe key [right]

In a different kind of remixing, Aaron repurposed everyday materials to build on his simple circuit design. In the workshop Aaron sewed a tri-color LED, a switch, and a coin cell battery on his a black canvas sneaker. Aaron's design is fairly simple, only sewing in one of the three potential colors of the LED, yet one aspect makes it a standout compared to many other designs: he used his own keys as a conductor to make the other two colors of the tri-color LED light up on his sneaker (see Figure 1). Most students worked solely within the confines of the e-textile construction kit, using the given switches, LEDs and conductive thread to make their designs. Aaron's repurposing of the key chain drew in his new understanding of what could act as conductive connector and allowed him to improvise with the color on his sneaker's LED. After his final project demonstration Aaron returned the key chain to his original place around his neck thus making it truly multi-functional.

DISCUSSION

These instances of youths' repurposing and reinterpreting designs and functionality can be seen as different types of remixes. Bailey's case suggests that remixing a prior design with new/additional materials can be a form of creative problem solving. Though there was imitation of the original robot with a heart, her design contained many different elements, including computation with the LilyPad that allowed the eyes to blink. Both Bailey and Aaron show interpretive flexibility in repurposing materials for non-traditional ends, the former using conductive thread both functionally and aesthetically, and the latter using a keychain as conductive material for improvisational lighting effects. While these remixes are not on the level of computational flexibility proposed by Smith [4], they do resemble Roth's "interpretative flexibility" [3]. This suggests one way to identify creativity in novice designers. Further, examining the hourly progress of the novice designers illuminated the ways their creative solutions emerged alongside their developing knowledge of the new domain of e-textiles. Indeed, we found that students' visual representations and physical manipulations of relevant objects made visible creative thinking that is often invisible in the final products. Finally, the cases suggest that the tension between aesthetics and function, perhaps most visible in youth new to specific technologies like e-textiles, may stimulate creativity. Studying how their original designs change as they learn a new domain, and how they 'solve' the dilemma of transforming their designs to be both aesthetically pleasing (to them) and functional with the technology may further illuminate novice creativity.

REFERENCES

1. Buechley, L. & Eisenberg, M. 2008. The LilyPad Arduino: Toward Wearable Engineering for Everyone. *IEEE Pervasive, 7*(2), 12-15.
2. Lewis, T. 2009. Creativity in technology education: Providing children with glimpses of their inventive potential. *International Journal of Technology and Design Education, 19,* 255-268.
3. Roth, W.-M. 1998. *Designing Communities*. Dordrecht: Kluwer Academic Publishing.
4. Smith, B. 2006. Design and Computational Flexibility. *Digital Creativity, 17*(2), 65–72.