Fabric-based Computing: New Materials for Learning Computer Science

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Abstract: When embroidering fabric into tessellation structures, crafters sew algorithmic patterns and program folding mechanics. Fiber crafts could become an alternative context for computer science education. This research aims to understand computational concepts and practices of fiber crafts and the uncharted computational products and learning processes they foster.

Vision

Inclusive of weaving and electronic-textiles (Buechley, 2006), fabric manipulation is a compelling yet uncharted context for reinvigorating the historical connections of fiber crafts and computing. Fiber crafts that incorporate the algorithmic patterns into fabric to create three-dimensional textures could become an alternative context for learners to intimately (and perhaps more profoundly) engage with Computer Science Education (CSEd). The goals of my dissertation are to research three aspects of fiber arts: (1) the computational concepts and practices, (2) the emergent computational forms of CSEd, and (3) the range of design process(es).

Through design, materials become "objects-to-think-with" for learners to internalize inherent ideas of physical objects through understanding their own bodily actions (Papert, 1980). New computational materials, like fiber crafts, therefore have the potential to create new and transform existing learning opportunities. New materialist theories can extend constructionist assumptions beyond material mediated internalization by flattening hierarchies among materials and people and negotiating learning through routines and variations (Barad, 2003). This relates to fiber crafts because artifacts form through human movement, and changes in movement can produce changes in the performed computation. My dissertation draws on the framework of Goode and Chapman's (2016) CS curriculum that includes concepts (e.g., algorithms) and practices (e.g, debugging) that map on to observable aspects of fiber crafts (e.g., defining input/output commands).

Pilot studies showed fabric manipulation as a compelling context for computing, including practicing core computational concepts (e.g., intuiting algorithms, defining conditionals), and demonstrated that in fabric, participants performed pre-computational practices. Crafters became an intimate part of live computational performances instead of controlling a computer. This kindled questions about which CS concepts and practices are inherent to fiber crafts and which computational forms and learning processes they produce.

I will investigate these areas in the context of a fiber-crafts public school course for youth (age 11-13) through qualitative and performative analyses (Barad, 2003) of video data, think alouds, and artifacts. The analyses will include iterative coding for computational concepts and practices, graphic abstractions of material computational expressions, tracking routines and variations in computational units, aesthetic deliberations (e.g., integrating patterns), and what facilitates or prohibits them (e.g., fold and movement potential) to demonstrate design process(es) during computationally relevant moments. This dissertation aims to contribute to scholarly efforts that investigate fiber crafts for disciplinary learning, extend material-mediated conceptions of learning by theorizing learners as part of computational products, and expand CS learning processes. This promises implications for broadening participation in CS and for integrating low-cost computation into low-resourced settings, which could have ramification for gender representations and rupture inequities within CSEd.

New materialist theories are new to the Learning Sciences. To help advance my dissertation, I seek to solicit methodological guidance to better align my analytical techniques and theoretical framework, and to explore implications of my work for the Learning Sciences.

References

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