

Connecting with Computer Science: Two Case Studies of Restorying CS Identity with Electronic Textile Quilts

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Abstract: Recent studies for developing CS identities promote interrogating dominant narratives about CS while learning computing in order to better understand how minoritized youth negotiate who they are and who they want to be in relation to computing and technology. In this study, we propose “restorying” as an approach to engage minoritized youth in examining dominant CS narratives while designing interactive, electronic textile quilt patches. Through analyzing interviews and participant artifacts, we present two case studies highlighting youth’s reimagining of dominant narratives of CS as “boring” and for “only white men” as well as their future connections to computing. We discuss how engaging minoritized youth in restorying who they are becoming in relation to CS might help researchers and educators better understand ways to design learning environments that support their computing identity work.

Introduction

While major efforts are underway to bring computing into K-12 education, most have focused on examining how *all* students learn computational thinking concepts and practices. However, we cannot ignore how Black, Latinx, and Indigenous youth have been systematically denied access to quality computing learning opportunities (Margolis, Estrella, Goode, Holme, & Nao, 2008). Disciplinary learning is embedded with political and ethical values that promote particular ways of being that can support or limit minoritized youth’s disciplinary learning and identities (Vakil, 2020), especially during an age when youth are asking critical questions about the roles computing and technology play in their lives and who they want to become. If we are to expand youth’s connections to computing, we need to design learning environments that support the computing identity work of youth whose disciplinary learning experiences have been marginalized (e.g., raced, gendered, and classed) based on the dominant cultural values of that discipline (Bell, Van Horne, & Cheng, 2017). While CS identity has been a research focus since early computing education, it mainly focused on describing racial or gender demographics of research participants; what is less understood is how youth’s multiple social identities shape learning processes and trajectories of future engagement with computing—both theoretically and empirically.

Recent studies have taken more action-oriented approaches towards developing positive identities in computing education. One approach uses STEM contexts to leverage minoritized youth’s political and cultural identities by promoting critical reflection of equity in order to develop their critical computational literacies beyond technical skills (e.g., Lee & Soep, 2016). Another approach towards developing Black girls’ interest and identification with STEM and computing involved researchers and youth co-designing counternarratives about girls in a parallel program who differ from dominant computing stereotypes as girls from different racial/ethnic backgrounds with diverse interests and computing experiences (Pinkard, Erete, Martin, & McKinney de Royston, 2017). However, youth provided feedback on narratives originally created by the researchers rather than constructing their *own* original narratives based on their own computing experiences.

We propose restorying as a novel effort for integrating computing identity work with the learning of computational concepts and practices through youth’s creation of counternarratives about CS. An analytical concept prominent in literacy research, restorying is defined as individuals “[narrating] the word and the world, analyzing their lived experiences and then synthesizing and recontextualizing a multiplicity of stories in order to form new narratives” (Thomas & Stornaiuolo, 2017, p. 318). In addition to challenging the reproduction of dominant CS narratives, restorying also provides youth the space to *imagine alternate ways of being, thinking, and doing in computing* as they reimagine new connections to the discipline reflective of their multiple social identities and lived experiences. Here we want to examine how restorying as a learning practice can offer minoritized youth the opportunity to interrogate dominant CS narratives while learning computing so we can better understand how they negotiate who they are becoming in relation to computing and technology.

In this paper we present cases of Matthew and Layla, participants in a workshop we developed for a racially diverse STEM program at a local science museum, who designed interactive, electronic textile (hereafter,

e-textiles) quilt patches that restoried dominant CS narratives. Through combining crafting, circuitry, and coding, e-textiles creators connect sewable Arduino-based microcontrollers with conductive thread to actuators (e.g., LEDs and sensors) to make interactive craft projects (Buechley, Eisenberg, Catchen, & Crockett, 2008), and broaden and deepen participation in computing. Building on frameworks of identity as narrative through the stories we tell about ourselves, others, and our experiences (e.g., Sfard & Prusak, 2005), minoritized youth in this study combined e-textiles with the historical practice of quilting to develop counternarratives about who participates in computing. To this end, we ask: What is revealed about computing identity work when high-school-aged youth design interactive, e-textile quilt patches that restory dominant narratives about CS?

Methods

Employing a social design experiment approach (Gutiérrez & Jurow, 2016), we facilitated a workshop during Spring/Summer 2020 for 19 participants (16 consented) from a racially diverse program at a local science museum serving high-school-aged youth who are passionate about STEM. Demographically, participants in the program consisted of 9 boys and 10 girls, and the racial/ethnic breakdown of youth includes the following: Black or African American (8 youth), Asian (5 youth), White or Caucasian (2 youth), Hispanic or Latinx (2 youth), and Other (2 youth) (anonymous demographic data was collected from the program manager and reflects descriptions used by the program).

The first part (4 hours) of the workshop was initially facilitated at the museum, but due to the COVID-19 pandemic, the remainder (30 hours) was facilitated virtually. Workshop activities included youth designing various artifacts representing their personal relationship with CS and computing, as well as class-wide discussions about the dominant (and concealed) narratives about CS and computing technology (including its history and representation), the history of quilting as a tool used by minoritized groups to resist dominant narratives, and the appropriation of computing technology to resist systemic oppression.

Data collected and analyzed included participants artifacts (e.g., photos and videos of youths' quilts in interaction, reflection worksheets, and design journals), researcher memos, and post-interviews of participants. We have begun initial rounds of comparative, inductive analysis of interview and worksheet data in order to develop a codebook and framework for understanding what restorying while designing e-textiles quilt patches reveals about CS identity work. Having so far analyzed data from three youth, we present case studies of Matthew and Layla, whose quilt patches clearly restoried dominant CS narratives surrounding identity.

Findings

Engaging in the practice of restorying through designing e-textiles quilt patches served as an ideational resource for Matthew and Layla to (1) use computing to develop counternarratives about who can participate in computing (see also Figure 1), and (2) reimagine future possibilities for participating in computing.



Figure 1. Screenshot of Matthew and Layla's quilt patches and reflections on the patches' themes.

Finding 1: Reimagining dominant narrative of CS as only for nerdy, white men

Restorying afforded Matthew and Layla the opportunity to both discover and reimagine dominant narratives surrounding who participates in CS. When reflecting on the kinds of people normally thought to be computer scientists, both participants identified nerdy, white men, which reflects the dominant group whose values, norms, and practices have been historically privileged within computing education (Rodriguez & Lehman, 2018). "I'm going to be honest, every time I pictured a computer scientist, I pictured some white man with glasses," Matthew admitted in his post-interview, "but now, I didn't even realize I was doing it. I didn't realize how much of a dominant narrative that was." Layla echoes this sentiment by acknowledging that no one really thinks about dominant narratives. Furthermore, they identified how CS as a discipline normalizes this dominant narrative,

whether through dominant representation of white men throughout history (Matthew) or people being excluded based on their “sexuality, gender, color, and ability” (Layla). Matthew and Layla were able to tackle these dominant narratives by not only challenging how “they only show the men” as people working in tech (Matthew) but by also learning that “if I can [restory] in [CS], I can do it out in the world, I can do it at school, I can do it with friends. And I can be like, ‘This is my story, and I don't have to be excluded (Layla).’” By being exposed to counternarratives that challenge the dominant white maleness of CS [e.g., through learning the stories of (mostly white) women’s role throughout the history of CS], restorying served as an ideational resource for Matthew and Layla to imagine new ways of being in CS.

It is interesting to note that while the dominant narrative Matthew critiques used an intersectional lens in addressing race and gender specifically, his quilt patch only restoried based on gender. This might reflect a limitation in the diversity of examples of female programmers we showed during the workshop, highlighting a need in future workshops to explicitly address multiple levels and intersections of oppression (across gender *and* race *and* class, etc.) throughout CS and provide counternarratives reflecting those intersections. Through restorying dominant narratives about who belongs in CS in their interactive quilt patch designs, both Matthew and Layla reimaged CS as a field more inclusive towards people, despite their race, gender, ability, and sexual orientation.

Finding 2: Reimagining present and future connections to CS

Despite having different prior interests in learning CS, the workshop provided both Matthew and Layla the opportunity to reimagine dominant narratives surrounding what CS is and the types of activities involved. At the start of the workshop, Matthew had no interest in learning CS due to assuming that CS learning environments consisted of “very boring” lectures and activities like “figuring out how to get past a firewall or something.” Further, when asked what type of student would enroll in an imaginary new CS class offered at his school, he pictured students interested in learning more about computers or pursuing a career in CS. Conversely, even though Layla was interested in learning programming prior to the workshop, like Matthew she said she would also not enroll in an imaginary new CS class offered at her school (due to being more interested in coding). She also noted that other students might fear enrolling in the class due to “the genius narrative.” These statements further reflect perceptions regarding the types of youth interested in learning CS, particularly the perception that CS courses would be attractive to students interested in more complex or *professional* authentic computing experiences (NASEM, 2021). However, after participating in the workshop, both participants expressed interest in participating in future CS workshops (if time permits) and shared that their feelings changed to seeing CS as a more artistic, intricate (Matthew), and accessible (Layla) field.

That being said, when asked whether or not they identified as computer scientists, both participants expressed identifying as computer scientists, but within limits. More specifically, Matthew identified himself as a “semi-computer scientist” but “on the artsy side, not the boring side.” Layla, on the other hand, recognized herself as computer scientist because she learned CS but on a smaller level at home where she could share what she learned with others. Restorying dominant CS narratives while designing e-textiles quilt patches also provided participants the opportunity to reimagine their future engagement with computing. Not only did Layla find the concept of interactive quilts innovative and interesting but she also appreciated learning how to program the Micro:bit, which she felt was the first step in programming a lot of other things. Furthermore, Matthew expressed that learning how to sew circuits and code his Micro:bit “enhanced [his] artist side more, by adding another style of art” (despite not seeing connections between quilting and computing in his post-interview).

Given that e-textiles prioritizes aesthetics, it provided multiple entry points for Matthew and Layla to engage in computing, whether it was Matthew’s prior sewing experience or Layla’s prior coding interest and knowledge of quilts. However, both participants noted how the CS they were doing in the workshop did not involve “going out in the world and doing these things (Layla)” or “it's not gonna be in the news or anything (Matthew).” Although exposure to materials like fabric, sensors and microcontrollers expanded their perceptions of what CS is, there still seems to be this separation between CS as a *professional* discipline that’s out in the world and the more *personal* side of CS that integrates personally relevant activities, like crafting (NASEM, 2021).

Discussion

By changing restorying from an analytical to a pedagogical framework, we provide a new approach for engaging Black, Latinx, and Indigenous youth—groups historically excluded in CS education—in discovering and challenging dominant narratives about CS while also developing their computing learning and identities. However, before bringing these activities to youth, we as researchers and educators first need to reflect on the extent to which we may be perpetuating dominant CS narratives in our own epistemologies and pedagogies. For example, by not distinguishing between “CS, the broad discipline focused on programming, computing theory,

and data structures" and "computing, the designing computational devices" in our workshop, we see how Matthew and Layla associated CS learning with pursuing a career in CS, working in technology, or engaging in CS activities out in the world. Consequently, we see parameters placed on their identification as computer scientists based on their perceptions of CS done in the world (e.g., at technology companies), despite engaging in a practice of restorying the dominant ways of being, thinking, and doing in CS during the workshop. This highlights an opportunity for us as researchers to also engage in restorying by interrogating our desire for youth (particularly minoritized youth) to identify *with* the discipline as opposed to identifying as an individual leveraging computing to make transformative change [e.g., technosocial agents (Ashcraft, Eger, & Scott, 2017)]. Finally, in reflecting on the use of quilt patches in K-12 CS education, we understand that building on the history of quilts and fabric arts as media for self-expression and resistance presents a unique learning opportunity for e-textiles research. Currently, the e-textiles unit developed for the *Exploring Computer Science* curriculum includes a classroom-wide mural project where pairs of students created portions that each incorporate two switches to computationally create four lighting patterns (for more details, see Kafai & Fields, 2018). Normally themes for these murals focus on school or popular culture references; however, by leveraging the collective storytelling roots and aesthetic elements of quilting, we see potential for e-textiles quilts to serve as collaborative artifacts that reflect the CS learning experiences of youth from groups who have been historically excluded from CS. As we conceptualize what equity and inclusion means for computing education, our study hopes to expand minoritized youth's computing practices to involve critical interrogation of the discipline as well as speculative practice to reimagine computing as a tool for social transformation.

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Acknowledgments

Special thanks to Danielle Maurino for her help with recruitment of participants; Gayithri Jayathirtha and Luis Morales-Navarro for their help with data collection; and to GaYeon Ji, Yi Zhang, Ammarah Aftab, and Renato Russo for their valuable help with data analysis.