Researchers teach kids to code with cultural research and embroidery machines

March 14 2024, by Stefan Milne

University of Washington researchers taught a group of high schoolers to code by combining cultural research into various embroidery traditions with "computational embroidery." The method teaches kids to encode embroidery patterns on a computer through a coding language called Turtlestitch. Here, a student stitched plants with code, then hand-embroidered a bee. Credit: Kivuva et al./SIGCSE

Even in tech-heavy Washington state, the numbers of students with access to computer science classes aren't higher than national averages: In the 2022–2023 school year, 48% of public high schools offered foundational CS classes and 5% of middle school and high school students took such classes.

Those numbers have inched up, but historically marginalized populations are still less likely to attend schools teaching computer science, and certain groups—such as Latinx students and young women—are less likely than their peers to be enrolled in the classes even if the school offers them.

To reach a greater diversity of grade-school students, University of Washington researchers have taught a group of high schoolers to code by combining cultural research into various embroidery traditions—such as Mexican, Arab and Japanese—with "computational embroidery." The method lets users encode embroidery patterns on a computer through an open-source coding language called Turtlestitch, in which they fit visual blocks together. An electronic embroidery machine then stitches the patterns into fabric.

The team will publish its findings on Mar. 22 in *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*.

"We've come a long way as a country in offering some computer science courses in schools," said co-lead author F. Megumi Kivuva, a UW doctoral student in the Information School. "But we're learning that access doesn't necessarily mean equity. It doesn't mean underrepresented minority groups are always getting the opportunity to learn. And sometimes all it means is that if there's one 20-student CS class, all 3,000 students at the school count as having 'access.' Our computational embroidery class was really a way to engage diverse groups of students and show that their identities have a place in the classroom."

In designing the course, the researchers aimed to make coding accessible to a demographically diverse group of 12 students. To make space for them to explore their curiosities, the team used a method called "co-construction" where the students had a say each week in what they learned and how they'd be assessed.

"We wanted to dispel the myth that a coder is someone sitting in a corner, not being very social, typing on their computer," Kivuva said.

Before delving into Turtlestitch, students spent a week exploring cultural traditions in embroidery—whether those connected to their own cultures or those they were curious about. For one student, bringing his identity into the work meant taking inspiration from his Mexican heritage; for others, it meant embroidering an image of bubble tea because it's her favorite drink, or stitching a corgi.

Students also spent a week learning to embroider by hand. The craft is an easy fit for coding because both rely on structures of repetition. But embroidery is tactile, so students were able to see their code move from the screen into the physical world. They were also able to augment what they coded with hand stitching, letting them distinguish what the human and the machine were good at. For instance, one student decided to code the design for a flower, then add a bee by hand.

"There's a long history of overlooking crafts that have traditionally been perceived as feminized," said co-lead author Jayne Everson, a UW doctoral student in the Paul G. Allen School of Computer Science & Engineering. "So combining this overlooked art that is deeply technical with computing was really fun, because I don't see computing as more or less technical than embroidery."

The class ran for six weeks over the summer, and researchers were impressed by the interest it elicited. In fact, one of the main drawbacks

researchers found was that six weeks felt too short, given the curiosity the students showed. Since the technology is affordable—the embroidery machine is $400 and the software is free—Kivuva plans to tailor the course to be approachable for kindergarteners to 5th-grade refugee students. Since they were so pleased with the high student engagement, Kivuva and Everson will also run a workshop on their method at the Computer Science Teachers Association conference this summer.

"I was constantly blown away by the way students were engaging when they were given freedom. Some were staying after class to keep working," said Everson. "I come from a math and science teaching background. To get students to stick around after class is kind of like, "Alright, we've done it. That's all I want.'"

Additional co-authors on the paper were Camilo Montes De Haro, a UW undergraduate researcher in the iSchool, and Amy J. Ko, a UW professor in the iSchool.

More information: F. Megumi Kivuva et al, Cultural-Centric Computational Embroidery, *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1* (2024). DOI: 10.1145/3626252.3630818

Provided by University of Washington