Between the Lines: art, code, and making

Erin Riley
Greenwich Academy
Greenwich, CT
United States
greenwichacademy.org
eriley@greenwichacademy.org

Kristen Erickson
Greenwich Academy
Greenwich, CT
United States
greenwichacademy.org
kerickson@greenwichacademy.org

Monica Ortiz, Ph.D.
Greenwich Academy
Greenwich, CT
United States
greenwichacademy.org
mortiz@greenwichacademy.org

ABSTRACT

In the fall of 2013, this independent PK-12 girls' school opened a digital fabrication space to support making and learning. Currently in its sixth year, the Engineering & Design Lab (hereafter referred to as "The Lab") is utilized by teachers across departments and grade levels as a place for students to engage with ideas through hands-on work using low- and high-tech tools, digital design and fabrication, and computational and physical building materials. The Lab's location at the "heart of the school" is a fitting metaphor for the space's impact on a community of learners as much as it is practical; the space has become an important nexus for ideas and interdisciplinary work across subject areas.

This article describes a collaboration between an art history and a computer science class rooted in a large-scale art piece executed by the school community, and the use of the school's makerspace as a critical site where students discovered connections among seemingly unrelated disciplines, blending art, code, design, and making. The project highlights the critical role makerspaces can play in schools by casting traditional subjects in a new light and providing the conditions for alternative understandings of content. In this example, students used methods drawn from computer science to craft their own rules-based work of art, expressed in both words and a drawing ultimately executed on a t-shirt. Code was used as a tool for understanding art, and art-making became a way to understand algorithms. The ability to move between these domains and to develop tools for connecting the technical and human fields of computer science, communication, and design are critical skills students need in our increasingly interdisciplinary world.

Keywords

Digital Fabrication; Rules-based art; Integration; Computer Science; Humanities; Conceptual Art; Art History; Coding

Fig. 1. (left) One student wears her rules-based art t-shirt while standing in front of Sol LeWitt's *Wall Drawing #797*, on loan from the The LeWitt Estate and installed in the school's dining hall. Rules for execution of the student's design appear on the back of the t-shirt, while the finished design appears on the front. (right) Upper School student executing Sol LeWitt's *Wall Drawing #797* according to the set of rules written by the late artist Sol LeWitt. Photo credits: Erin Riley, Kristen Erickson

1. PROJECT

1.1 Description of school and making ethos

The school setting for the project described in this article is a suburban, PK-12, all-girls' independent school. The school has an on-site digital fabrication lab which serves as a hub for integrating ideas and academic concepts and putting them into practical use. The Lab educates children in a different way from conventional school, focusing on learning through the creation of, reflection upon the process of, and sharing of artifacts. Through the school's maker program, art, design, and humanities are equal partners with STEM education, bringing ideas to form and finding larger context for the work.

1.2 Project description

The project was a coordinated effort between humanities, computer science, and design for high school-aged students (Table 1). The impetus for this collaboration was a work loaned from conceptual artist Sol LeWitt's estate, *Wall Drawing #797*, and executed on campus in the school dining hall by students, faculty, and staff (Fig.1). The project, built upon these events, challenged art history students to create their own rules-based works of art, writing algorithms that were in turn translated into code by computer science students. Each group - first the art historians, then the computer scientists - engaged in an iterative design cycle: 1) writing code, 2) testing their results, 3) refining code, and 4) ultimately creating a final graphic. In the case of the art history students, their rules and the resulting graphics were cut out of heat-press vinyl and pressed onto t-shirts in The Lab (Fig. 1). In the case of the computer science students, their products were collected as part of their course grade (Fig. 3).

Table 1. Project Sequence

	Who was involved	Where	What happened
Sol LeWitt's Wall Drawing #797	Students, faculty, staff	Dining Hall installation	During a month-long period in fall 2018, 136 students, faculty, and staff members participated in the installation of a wall drawing by Conceptual artist Sol LeWitt. The drawing (or really a set of instructions for how to recreate the drawing) was loaned to the school by The Estate of Sol LeWitt and installed in the school cafeteria. A representative of the Estate drew an initial black line, and community members responded with a sequence of red, yellow, and blue lines that, following instructions, could not touch previous lines. Inevitably, variations in drawn lines occurred. The re-installation at our school is now a documented as part of the work's history, on file at the Estate of Sol LeWitt. In keeping with the loan, the drawing will be painted over in June 2019.
"Summer Look" Assembly	Upper School	Auditorium	Each summer, Upper School students are encouraged to look deeply at a single work of art sent to them by email. This summer, that work was a Sol LeWitt wall drawing. Upon their return in the fall, Upper School students convened for an all-school art history assembly that placed the newest iteration of LeWitt's *Wall Drawing #797* at Greenwich Academy in its historical context. Teachers also demonstrated the rules-based art project and related computer science coding, framing the art history/computer science connection.
Rules-Based Art	Art History students	Humanities Classroom	After participating in the recreation of *Wall Drawing #797* by renowned Conceptual artist Sol LeWitt, art history students were invited to create instruction-based art of their own. Limited to three, simple instructions, they were forced to arrive at precisely articulated "rules" that would result in drawn design. Swapping instructions with a classmate, their "rules" were tested and refined, then turned into vector graphics for printing on a t-shirt.
Coding Rules-Based Art	Computer Science students	CS Classroom	Each student group was assigned a set of instructions from an art history student to recreate in code. Using Python Turtle, students conceptualized the instructional art in code, working to reproduce the artist's intention on a computer. A visual output was collected from each group.
Rules-based art t-shirts	Art History Students	Digital Fabrication Lab	Students' rules and designs were converted to vector graphics, cut in heat vinyl, and pressed onto shirts - instructions on the front, designs on the back.

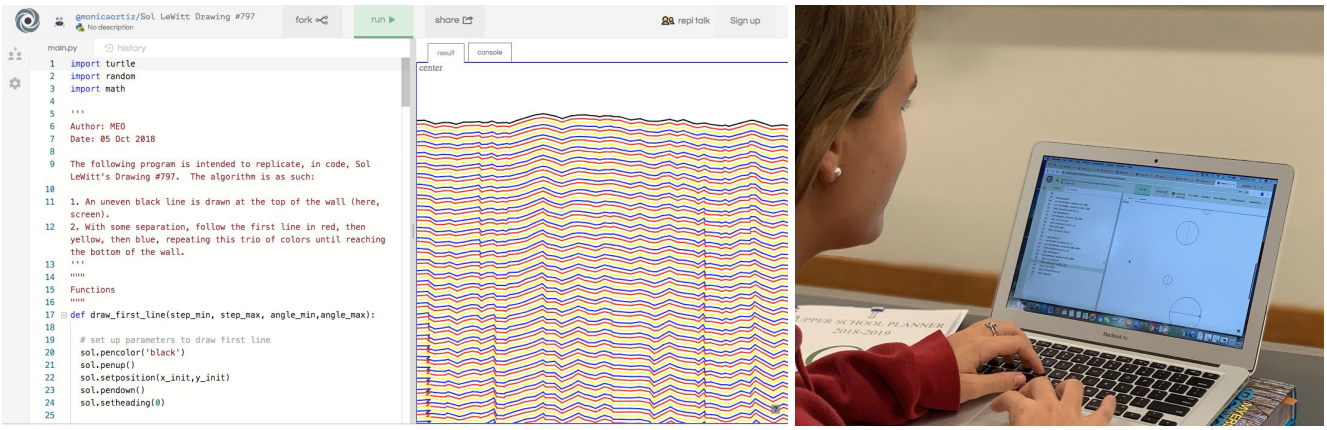

Fig. 2. (left) Computer science teacher Monica Ortiz's code demonstration for the Summer Look Assembly replicates Sol LeWitt's *Wall Drawing #797*, introducing the design variance inherent in drawing something by hand via use of a random number generator. (right) Computer Science students work to realize, in code, the instructional art of Art History students. Photo credit: Monica Ortiz

Fig. 3. (left) Art History teacher Kristen Erickson working with students in The Lab creating rules-based art t-shirts. Art history students pose with their customized shirts in front of the Sol Lewitt wall drawing. Photo credits: Erin Riley and Kristen Erickson

2.1 Results

In a Sol LeWitt wall drawing, the art lives in words. A set of simple rules provides a framework for a reproducible artifact, yet each iteration of the work is different, depending on such factors as the size of the installation space and the number of drafters. A parallel could be drawn in the graphics built with code. In a LeWitt wall drawing, the hand, even when intended to run alongside the line above it, inevitably travels a slightly different path, influenced by human gestures, stance, fatigue, and focus. A computer program can be written to reflect this variance by setting parameters and passing numbers that mimic what happens with the hand. Working across disciplines (in this case, humanities and computer science) allows students to recognize the creative, human side of coding, and the creative potential of making art through constraints.

In the digital fabrication lab, making artifacts as an extension of the learning process while crafting something personal motivates students to engage in challenging work. Students feel rewarded by the process of making, tackling hard problems, and creating something uniquely "theirs." While this project was developed for high school students, constructing sets of rules and writing algorithms is an activity that young children can engage with. Composing drawing instructions and creating those designs in block-based coding environments is low-floor entry point for this project.

Each iteration builds on lessons learned in the last version of a project. Collaborating teachers build partnerships and learn from each other as they work together to support their students in a project. Workflow, file management, systems of the lab, and the weaving of classroom themes and curricular goals are better understood with each successive project. Each collaboration supports the next. So while the Sol LeWitt wall drawing was a one-time event that the school community could respond to and engage in collectively, the hope is that it will be a catalyst for new collaborations in the years to come.

The next version of the project might consider the following: 1) a quick skill building session in the lab where students could make something simple, like a sticker, that would help give them a big-picture view of the process from design to fabricated object 2) an

expansion of modes of expression where students in art history move from writing a set of rules to coding a set of rules, with computer science students fabricating their designs. Looking ahead, these two modifications of the project would deepen understanding and potential learning for art history and computer science students.

2.2 Broader Value

Conventional education models silo academic subjects, and students can limit their potential by self-selection out of subjects, whether contemporary art or computer science. A student may not see themselves as someone who might be interested in contemporary art or writing code. Integrated projects break down barriers, while working in makerspaces can open intellectual "doors" by providing the conditions for idea exchange, collaboration, and new possibilities for learning. They serve as incubators for new growth for students, faculty, and the broader school community.

2.3 Relevance to Theme

There is a sense that the challenges facing our future are mounting and students need a skill set that will prepare them for problems that are not easy to solve. It is becoming increasingly clear that technology alone cannot fix the problems that face us. Teachers should encourage opportunities for students to work with technology and practice inventing creative solutions to problems while exercising critical thinking, forming good questions, and reflecting on process. This kind of thinking will prepare students for interfacing with technology in a way that is creative, constructive and considers human impact.

2. BIOS

Erin Riley is the Mr. and Mrs. Alexander Jackson Director of the Engineering and Design Lab at Greenwich Academy, where she teaches classes and facilitates projects with faculty at the intersection of art, design and engineering. With a background in art and design, Erin works with artists in the CTC Certificate Program at Columbia Teachers College where she teaches a studio course in creative technologies and in the summer, a STEAM elective for REACHPrep, an educational access organization for middle school-aged underserved students. Erin is among the first cohort of Senior FabLearn Fellows where she writes on the topic of maker education and curriculum design, and creates tools and resources for educators.

Kristen Erickson's background as a museum curator has shaped her vision as an educator. She looks for opportunities to disrupt conventions, to activate spaces in new ways, and to turn notions on their heads. She earned degrees in French and art history from Vassar College and the University of Oxford, working at the Ashmolean Museum, Smith College Museum of Art, and Museum of Modern Art in New York before landing at Greenwich Academy in CT. She teaches history, art history, and a seminar in Middle Eastern history; she's served as a dean and now as chair of the history department; and she runs the campus art gallery, bringing emerging New York and New Haven artists to Greenwich. During fall 2017, Kristen curated the first Shared_Studios Portal at a K-12 school, bringing hundreds of students into an immersive, global learning space.

Monica Ortiz, Ph.D. is the Engineering & Computer Science Department Chair at Greenwich Academy, where she develops and teaches engineering and computer science curriculum to, primarily, Upper School students. Her background is in Bioengineering and, specifically, Synthetic Biology. Recognizing the power of computing in her own engineering work, Dr. Ortiz works to make engineering and computing accessible for her students and to instill in them the confidence to tackle large problems.

3. REFERENCES

[1] Bonin, Christianna, Erica DiBenedetto, Charles Werner. Haxthausen, and Sol LeWitt. *Sol LeWitt: The Well-tempered Grid*. Williamstown, MA: Williams College Museum of Art, 2012.

[2] Cross, Susan and Denise Markonish. 2009. *Sol LeWitt: 100 Views*, New Haven: Yale University Press.

[3] Tavel, Philip. *Modeling and Simulation Design.* Natick, Mass: AK Peters Ltd., 2007.

[4] "Wall Drawing 797," Website of the Massachusetts Museum of Contemporary Art, massmoca.org/event/walldrawing797 (Date of Access: September 1, 2018)