Generative STEM
Culturally Situated Design Tools

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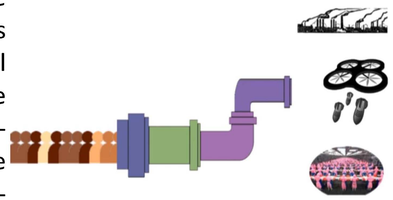
C-STEM

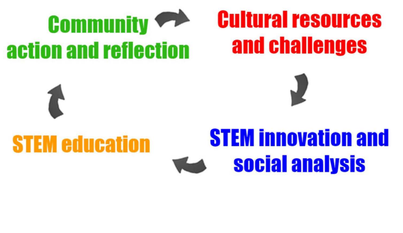
Generative STEM

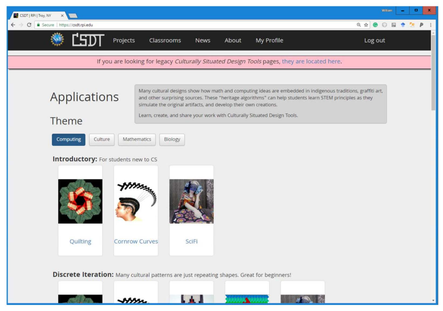
The lack of diversity in STEM is a major concern for our era. We have made some improvements in the diversity of students going into the STEM pipeline. But what about the stuff coming out of the pipeline?

As long as STEM continues to create industrial pollution, labor exploitation, and the weaponization of everything from drones to social media, it will fail to achieve its full potential to create a just and sustainable world. And these failures alienate underrepresented students, diminishing the STEM diversity we need to create solutions.



Generative STEM replaces this extraction with the circulation of unalienated value, bringing those benefits back to the communities and ecosystems which support it.



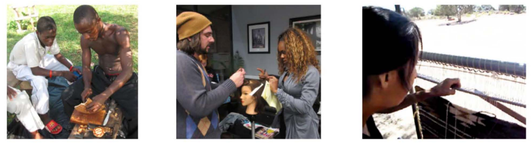


Culturally Situated Design Tools, or CSDTs, began with the selection of heritage arts that are both connected to underrepresented students, and that have some inherent computing, math or other STEM concepts embedded in them.

Creating a CSDT always follows four steps. Step 1: After speaking with elders and other community representatives to ensure that this will be considered a respectful use of the material, we start by interviewing the artisans: African carvers, Navajo weavers, urban cornrow hair braiders, Latino drummers, and so on, making sure we understand the practice from their point of view. Step 2: This clues us into the kinds of local algorithms, geometric concepts and other STEM ideas that have analogous constructs in the classroom. In this way, the CSDTs are not imposing our knowledge from the outside, rather they "translate" indigenous and vernacular knowledge into software, hardware and other instruments, situating student investigation, discovery and design in a cultural context. Step 3: Developers create simulations, games, "maker" practices and more, for use int he classroom. Step 4: We then expand to generative practices in the local economy, environment and other domains. Value created in a community circulates through the community.

Process

Step 1: interviewing elders, artists, activists, and other community representatives

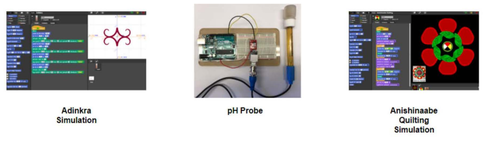


This ensures that we will be making respectful use of the material. African carvers, Navajo weavers, urban cornrow hair braiders, Latino drummers, and so on each need to have their voices heard, so that we understand the practice from their point of view.

Step 2: "Translate" indigenous and vernacular knowledge into software and hardware for the classroom

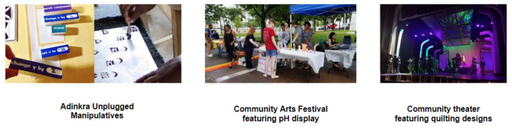
Using an ethnomathematics lens, we find logarithmic spirals in adinkra symbols and geometric transformations in Anishinaabe quilting. C-STEM summer interns at RPI helped develop the pH CSDT. The CSDTs situate student investigation, discovery and design in a cultural context.

Step 3: Develop software and hardware for use in the classroom



Once the STEM content is identified in the cultural practice or artifact, software and hardware developers set to work creating simulations, games, and "maker" practices. The Arduino Microcontroller and compatible sensors are also used in lessons such as testing the pH of hair care products, performance art electronic textiles, and photogate jump height detectors.

Step 4: The value generated circulates within the local community



Generative STEM replaces the extractive nature of corporate STEM with a community driven model that circulates unalienated value, bringing those benefits back to the communities and ecosystems which support it.

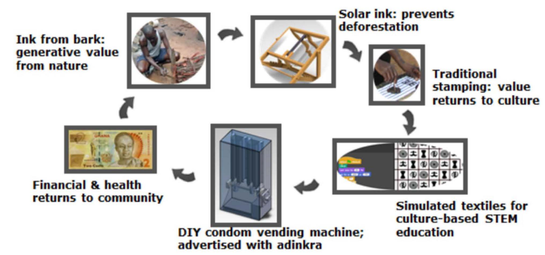
The driving idea behind Generative STEM is that low-income communities should not only flow into the STEM pipeline; they should also be direct beneficiaries of its output.

Case Studies

The Generative Cycle in Cosmetology

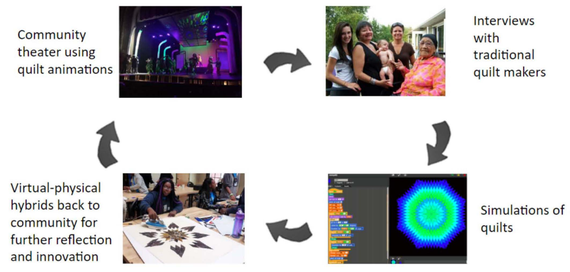
The Generative cycle in cosmetology started with interviewing local cosmetologists and a collaboration with a local cosmetology teacher. A cornrows simulation and pH probe were created for use in the classroom. The student designs were 3D printed and placed in a local salon to create interest around the collaboration at the local school.

The Generative Cycle in Adinkra



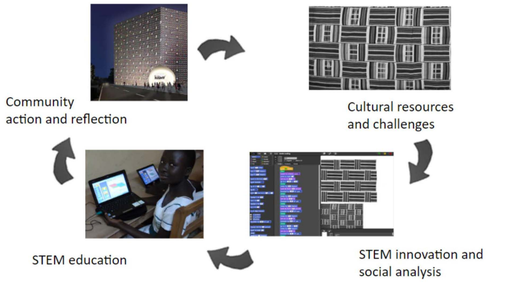
The generative cycle in Adinkra started with interviewing Adinkra artisans and collaborating with a local Ghanian teacher. The Adinkra Computing software, physical stamp manipulatives, and diluted ink were created for use in the classroom, which supported local sources of environmental sustainability and wealth generation.

The Generative Cycle in Quilting



The generative cycle in quilting started with conversation with Anishinaabe quilting expert, Minaachimo-Kwe. A quilting simulation and an appliqué process were created for use in the classroom. The student designs were show in local schools and public places.

The Generative Cycle in African Fractals



The generative cycle in African architecture started with mathematics research on the African origins of fractal geometry. A fractal simulation and book were created to popularize these origins and for use in the classroom. One outcome was that this research inspired architect Xavier Vilalta to create the Lideta Mercato shopping mall in Ethiopia.

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