

TEACHING CREATIVE CRITICAL ACTION BEYOND
ECONOMY INTO “the ART of TECHNO-ECOLOGY”:
Approaches in integrating technology ethics with STEM Art
education

Jane Crayton University of New Mexico, Art Education, ARTSLab
jcrayton@unm.edu

Creative critical action with STEM-A (Science, Technology, Engineering and Math through Art) is a philosophy which integrates exploration of STEM subjects through project- based art inquiry. This approach to STEM education creates space for the instructor to include ethical, radical and inventive approaches to educating students.

Innovation is the most prized human dexterity, and STEM education is a critical component of societies to produce innovative products. However as global economies emerge, and human impacted climate change becomes inevitable, it is critical that we radically change the face of our education system and eventually our economies, to include a broader scope of STEM innovation. Art and diversity need to be included in STEM education to foster a sustainable community of ethical technologists who create solutions for humans beyond industry.

“However, STEM education without the arts simply encourages an education gap in the students’ ability to innovate, because they lack creative skills for innovation which are obtained with practice and inquiry through the arts process.” (Crayton, STEM art education movement: A creative approach to education in innovation for the 21st Century, 2011) Even more disturbing is their ability to navigate these new technologies discriminately.

We need to make sure our students know how to use and consume technology wisely. “What does it mean to be connected, connected electronically; to consume, consume indiscriminately, to multitask,

multitask neurotically; to exist and find purpose solely within the parameters of technologically mediated culture? What is the saturation point, the point at which the body is overwhelmed and anesthetized by technological efficiency; the point of unrelenting pleasure at the expense of criticality; at what point should the sublime ideology of technology be held in check?" (Sweeny, 2010)

"We believe that a primary goal for science education is to help students develop the knowledge, skills, and epistemologies necessary for dealing with 21st century, real world scientific issues." (Barab & Dede, 2007) Additionally, project-based learning with real world applications also gives students an opportunity for civic participation and critical inquiry. "Dewey (2008), in his 1939 essay "Creative Democracy—The Task Before Us," recognized political participation as an inventive and creative activity. Dewey conceptualized democracy as a way of life, with education being a source of effective participation." (Blandy, 2008)

However effective participation also has to do with motivation, specifically intrinsic motivation, and flow theory. It is important to consider these aspects when developing curriculum which may foster civic and critically engaging participation. Mihaly Csikszentmihalyi explains, "Flow is being completely involved in an activity for its own sake." (Csikszentmihalyi, 1990) Often children immersed in video game play, is used as an example of flow. Where the child is so engrossed in the activity, they lose track of the world around them, and become immersed in the virtual activity. "While in flow state, the learner is completely motivated to push their skills to the limit." (Bizzocchi & Paras, 2005)

As an educator, I am interested in finding ways to tap into flow, and help my students develop intrinsic motivation in their project-based learning. Finding ways for students to engage

in productive flow inquiry and learning has the potential to create

life-long passions in learning. Digital game based learning is an area which may support the flow theory, by providing an example of educational flow. According to Bizzocchi and Paras, “Games foster play, which produces a state of flow, which increases motivation, which supports the learning process.” (Bizzocchi & Paras, 2005)

How does immersive STEM education through art, defy formal education? It challenges its students to become engaged learners; who choose to participate in focused learning. With immersive STEM education, students play and create with project-based art inquiry, which motivates and ultimately stimulates students flow. Several of the classes I have developed incorporate techniques used to stimulate student interest, motivation and flow.

For example, in my beekeeping classes Secrets of the Hive 1 & 2 students engage in games, art practice and participate in hands on beekeeping, creating a unique immersive experience for students learning about bees. They are not just reading a book, or watching a film, they are exploring a live colony of bees, creating candles, lip balm and soaps. Students are guided in the dissection of flowers, participate in a honey taste test, and extract honey from the hive, giving them an immersive experience from nectar of the flower to capped honey combs in the hive. Students become engrossed in the games, art and exploration of the hive that they forget they are learning. Additionally, the games help me evaluate student understanding of STEM concepts covered in the lessons, without them enduring a test.

Additionally, this is a good moment for me to discuss impacts of colony collapse disorder and ultimately human impacts on the environment and the honey bees. A discussion about environmental conservation and ultimately technology ethics can surface as we discuss the future of the honey bee and its relationship to humans.

STEM art practice in my classroom has also influenced my own art practice, for example in one of my beekeeping classes, my students became extremely concerned about colony collapse disorder, so we began an investigation. We found that not only honey bees, but native bees and other pollinators were in danger too. The inquiry inspired me to research native bee habitat and conducted a research project on honey bees and colony collapse disorder.

From my research I found other artisans creating bee walls to support these micro pollinators. The project eventually inspired me to create a native bee wall from recycled and resourced items providing alternative urban habitat for native stingless bees. The functional art piece was exhibited at the Biennial of the Americas 2010 Artist Footprints show at Redline Gallery in Denver, and several of my students attended the event.

“Art has been a catalyst for transformative learning experiences that relate to students’ lived worlds. Frasca (2004) pointed out that games can encourage people to imagine change, and games for social change allow players to inhabit roles and situations otherwise inaccessible.” (Parks, 2008) Playing games and exploring art in Secrets of the Hive beekeeping classes has had a huge impact on learning for my students.

Another class I developed Immersive Landscapes, engages students in digital panoramic photography for the fulldome or digital planetarium. This course is primarily focused on technology; however the underlying concepts of this class focus on environmental issues, awareness and narrative. In this course students are introduced to basic panoramic photography concepts and techniques, while challenged in the lab with project-based computer science, as they manipulate their images to work geometrically in the fulldome.

In this class they are challenged to start seeing the world around them, to start noticing the immersive landscape about them at all

times. Students participate in field experiments where

they engage in photographic games which push them to explore perspectives and narratives. Discussions and observations of photographic challenges show the students how different the world is through each unique lens, specifically their own eyes. Teaching students about alternate frames of reference and perspective encourages student empathy, a skill they can use when faced with communication challenges in everyday life. This is an important lesson to consider when issues of social bullying may exist, because it provides students the tools to empathize and the voice to express their own feelings, fears and desires. The class also explores ethics of photography, and technology and students are asked to create digital narrative panoramas which show human impacts to the environment.

“Digital, media narratives allow students the opportunity to reflect and comment on social issues and develop empathy within a creative and constructive medium, expanding their voice, often encouraging additional participation.” (Crayton, STEM art education movement: A creative approach to education in innovation for the 21st Century, 2011) Additionally Amburgy advocates in her article, Diversity, Pedagogy, and Visual Culture that, “We should not just passively absorb this environment without thinking critically about the social functions of representations. In art education, it is important to reach students to think critically about all the visual representations that surround them, including art, and to see themselves as agents for social change.” (Particia, 2011)

By the end of the course, students have not only created technically difficult imagery for the fulldome and digital planetarium, they have also participated and been immersed in a playful form of exploring ethics and etiquette of the 21st Century. “New media is not just a tool but also a medium, a cultural interface connecting humans, technology and culture” (Manovich, 2001) Through the

exploration of electronic arts, media and sciences, students gain valuable skills for using and working with complex STEM concepts, while integrating ethical, and critical thinking skills. “In other words, the computer is not a technology that artists use to create art, but a cultural interface that contains human experiences.” (Laio, 2008)

In the Circuit Bending course I developed for youth 9-14, students explore culture jamming, hacking and re-use, re-appropriation and remixing of technology items. Students deconstruct “toys and discarded electronics which are hacked, modified, and ‘bent’ (act of random short-circuiting) into low-voltage battery powered electronic instruments.” (Crayton, circuit bent, 2009) Students are excited to deconstruct their abandoned childhood toys and reconstruct them into avant-garde electronic musical instruments, which empower students with new uses for their outdated and outgrown technology. In this lesson, students examine the impacts of cheap, single use technology, which creates e-waste hazards for the environment and humans. They practice re-use, re-appropriation and recycling with the production of their circuit bent instruments, giving them practical applications in STEM arts and technology ethics.

STEM acquired skills through artistic inquiry further the ability of users and creators to make educated decisions about innovative processes, products, or services; created or consumed. Additionally according to Mayo, “artists, educators, and cultural objects are significant contributors to our evolution, and their contributions should be cultivated in art education models that integrate arts-technology experimentation and create new spaces for self-directed interdisciplinary inquiry.” (Mayo, 2007) Educators need to start creating dynamic lessons for students in immersive STEM art (iSTEMart) education fostering project-based learning and self-directed inquiry methods to stimulate student motivation and ultimately student flow.

Through project-based art inquiry, educators have an opportunity to discuss several types of technology ethics or next generation ethics. “Teaching students to be innovative in STEM

subjects requires the ability to be creative, with process, technique and skill. It requires students to develop critical thinking, multi-modal, and scientific methodologies, applicable to tactile and tangible problem solving, in real-time, real world situations. Incorporating STEM and the arts allows the instructor to include multi-cultural discussions about society, culture, environment and ethics within a critically engaged activity which gives students practical skills in STEM subjects and concepts.” (Crayton, STEM art education movement: A creative approach to education in innovation for the 21st Century, 2011)

Some major themes in technology ethics exist and I have categorized them below to help educators include these topics in their lessons.

- The Internet: search engines, filtering, pornography, accessibility
- Databases: data mining, privacy, security
- Communication: e-mail, social networking, and monitoring, publishing, social and cyber bullying
- Gaming: regulation, violence, addiction, gender stereotyping, educational games
- IT Industry: intellectual property, e-waste, software piracy, hacking
- Innovation: e-waste, value vs. need, technology optimism
- User: consumption, saturation, multi-tasking Students involved in STEM art programs have opportunities to gain

valuable skills in construction of art, critical thinking, ethics, aesthetics, technique and style, which can lend its self to innovation. The STEM arts movement seeks to inspire youth with the multi-modal skills to inspire the next generation of innovators and global citizens, catalyzing a new era of radically urban sustainable technology exploration.

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