

Local X Change: Curriculum Development Tactics for Expanding Technological Literacy

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Introduction

Indiana University of Pennsylvania (IUP) is a rural, public institution located in Northern Appalachia, approximately 60 miles east of Pittsburgh. One third of the institution's 7,044 undergraduates are Pell-eligible, and 27% of our students are first-generation college students (FGCS). Affordability is one of the major factors influencing our students' matriculation choices. With the increased popularity of maker spaces in K-12 education, many students from high income areas are exposed to digital fabrication processes from a young age while students from rural and lower-income families are under-exposed [1]. While many scholars have documented the general value of the engaged learning that occurs in makerspaces, few have focused directly on the impact these educational methods have on women, FGCS and lower SES students studying at a rural PUI. Our curriculum development efforts have led to the creation of *Local X Change*, which are introductory learning modules that embrace maker culture and attract and welcome all college students including those in their earliest semesters of study and those who lack digital and computer literacy. *Local X Change* exposes learners to research, technology and professional opportunities as a strategy for improving student success and career preparedness [2]. These learning modules are consistent with the CUREs model which suggest an acceleration in students' acquisition of content knowledge and technical skills through public presentations of student research but are unique in the implementation of faculty/student collaboration, tactical absurdity, and civic engagement to further the digital literacy of FGCS and lower SES students [3].

Local X Change

Local X Change curriculum combines the content typically found in introductory engineering, art, and science courses with project-based assignments that engage students and provide them with both tangible technical skills and the ability to innovate, problem-solve, and collaborate. Civic engagement in introductory courses better prepares students to engage in professional activities such as internships, research projects and conference presentations as they progress into their upper-level course work [4]. Hands-on, or experiential learning engages students who may otherwise fail to thrive in a traditional lecture-style classroom environment. Perhaps more importantly, learning through making engages students' problem-solving abilities and creativity, skills that are sought after in the workplace [5] [6].

Critical making, a phrase popularized by Matt Ratto, underscores the "reconnection of two modes of engagement with the world that are typically held separate: critical thinking, traditionally understood as conceptually and linguistically based, and physical 'making', goal-based material work [7]." Maker culture meets the changing needs of today's students and includes digital fabrication, computational skills, coding, innovation, collaboration, and design thinking, all of which are 21st century skills that improve the digital literacy of users [8]. Additionally, learning by doing using digital technologies is a hallmark of maker culture, and "has the potential to help us reach institutional and policy goals for STEM learning for a range of students" [9] [6]. In our experience some students are better equipped and more comfortable utilizing a makerspace in their coursework. We are investigating the benefits of using tactics rooted in contemporary art practice to address this disparity, and promote greater equity in learning through making.

Sample *Local X Change* learning modules include *Common Goods*, which introduces creative methods of conceptualizing physical problems by asking students to design original paper packaging for items that cannot be purchased, such as happiness, empathy or rainbows. Students translate their paper prototypes into precisely scaled drawings that are then digitized in Rhino 3D software and cut using a large format laser cutter. Students develop proficiencies in basic hand skills, material understanding, and analog design which supports their introduction to 3D modeling software and use of a large format laser cutter. Laser cut multiples of their designs are installed in pop-up stores in vacant storefronts and proceeds are donated to a local cause. For another module, *The Hallmark Prize*, students use oil-based clay to model a medal for a design competition. The chosen design is 3D scanned and 3D printed, and the students use the 3D print to sand cast a medal in pewter. They present their medals to a community member worthy of recognition and document the process for an archived book. More digital skills are introduced, including 3D scanning and 3D printing, and students interact with a community member of their choice. In another learning module students use Rhino 3D and Fusion Slicer software to design hanging light fixtures. Each student uses the large format laser cutter to create a prototype in coroplast. These designs are presented to a panel of judges during *Design Stars of IUP*, a mock television show, presented in the style of a reality-tv design competition. In a

2022 version of the project, selected designs were laser cut in acrylic, dyed and permanently installed on campus.

Tactical Absurdity

As educators, we see a lack of digital literacy in our incoming students who are mostly from rural Western Pennsylvania and attend IUP for its relative affordability. These students are at a disadvantage to their more affluent peers who have earlier access to digital design and fabrication, and this gap is hard to overcome [10]. We also see a divide between creativity and technology, where many users of tech are merely reproducing existing designs, rather than gaining skills in ideation and design.

Local X Change learning modules seek to demystify the acquisition of new technological skills by situating technical instruction within a multi-layered collaborative project that is rigorously executed yet seemingly absurd in outcome. Creating unlikely or absurd scenarios, such as a storefront selling empty packages or a traffic island transformed into an oasis is way to invite students to consider solutions to problems that they have never encountered. Because these situations are absurd, there are no defined right or wrong answers, only innovation solutions. Rooted in Ratto's notion of Critical Making, *Local X Change* projects offer learners experiences with technology situated within activities that stimulate critical thinking and promote a form of making based in personal expression rather than a rational drive to solve a problem or maximize profit. Familiar materials, and/or presentation formats are used to make the acquisition of digital skills attainable for learners that may not self-identify as being technologically savvy. In *Common Goods*

students are introduced to Rhino 3D modeling software and learn to operate a large-format laser cutter to design and produce physical packages capable of holding feelings and experiences that cannot be bought. These impeccably crafted forms are produced in multiples and offered for sale in an off-campus pop-up store. Proceeds generated from the sale of student projects are donated to a variety of causes selected by the students. The success of *Common Goods* can largely be attributed to the diversity of tasks nested within a single project, and the way assignments remix various traits of consumerism and upend common understandings of value. We have found that this gap between expectation and experience disarms the technological divide separating more technological savvy learners from students that simply have not been exposed to technological resources or have previously had negative experiences with technology.

Conclusion

In an effort to preliminarily assess the significance of our ideas we have piloted *Local X Change* learning modules during the 2020/21 and 2021/2022 academic years. These new learning modules, *Traffic Island Oasis*, *Intergalactic Petrochemculture Aredome*, *Common Goods*, *The Hallmark Prize*, and *Design Stars at IUP* were overwhelmingly successful resulting in significantly higher quality work in

comparison to past projects using similar materials that were presented in a closed class critique.

Many larger universities have developed courses using similar constructionist teaching methods and demonstrated the positive impact these courses have on the education and retention of URM students [9]. We are working to expand this scholarship by developing curriculum and multidisciplinary collaborative strategies that are adapted for implementation at smaller, rural PUIs with fewer resources and a greater number of first-generation college students (FGCS). The efficiency of sharing entry-level digital fabrication curriculum across multiple disciplines significantly enhances the chances that a resource limited college/university can develop and consistently offer new courses. While additional assessment work is required, our pilot efforts suggest that promoting faculty/student collaboration, tactical absurdity, and civic-engaged learning can serve as a tactic to minimize the impact of the technological divide facing many FGCS and lower SES learners.

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