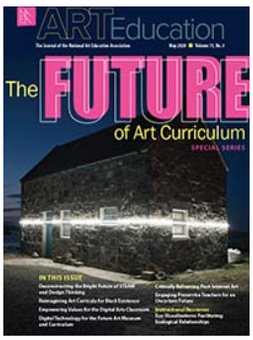

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SYSTEM ERROR:
Versatility and Facility as Empowering Values for the Digital Arts Classroom

Luke Meeken

During my four years (2014–2018) teaching digital artmaking in a public high school, a regular challenge was overcoming the ways that the software and hardware systems in the lab often failed to accommodate the learning needs of all my students. One such moment was a time when a student, who had three fingers on each hand, was unable to do a complex Photoshop shortcut that required pressing down four buttons simultaneously. This first led to a discussion of how, in Photoshop, there are multiple ways to execute any given command, which was useful for the whole class. But because that "solution" meant that the student in question had to use a much less efficient method to achieve the same aim without the shortcut, this unfairly slowed down his progress on the class project.

I introduced the student to AutoHotkey, an open-source tool used to remap, automate, and define custom keypresses on Windows computers. With this tool, the student was able to bind the complex shortcut to a much simpler key combination, and subsequently took the initiative to define several more time-saving custom shortcuts of his own. This tool piqued the interest of his neighbors in the class, which led me to start the next class period with a brief skill-sharing session to introduce the tool to the rest of the students. Several students used AutoHotkey to define custom shortcuts that suited their working style, and later in the year, when we were making experimental physical game controllers, being able to remap the inputs on the computer proved invaluable to several students' projects. What began as a way to address a single challenge that a single student was facing turned into a classwide exploration of an empowering new computing skill. The initially unaccommodated student was ultimately able to independently extend this skill to suit his own creative needs, as were his classmates.

When engaging with the problems presented by unaccommodating digital systems, I am often mindful of media theorist Olia Lialina's (2012) concept of the *General Purpose User.* Lialina described the General Purpose User as someone who "can write an article in their e-mail client, lay out their business card in Excel, and shave in front of a web cam.… [U]sers who have the ability to achieve their goals regardless of the primary purpose of an application or device" (para. 56–58). Lialina's General Purpose User is, significantly, "not a super user" who has exceptional disciplinary knowledge of computing (para. 58). In this article, I explore the concept of the General Purpose User as a model for the empowered and empowering digital art educator. Rather than a masterful knowledge of computer science, the General Purpose User (and the empowering art educator) is characterized by their *versatility* and *facility* with digital tools. I here define *versatility* as the capacity to envision varied applications of digital tools outside of their prescriptive use. And I define *facility* as comfort with digital tools—including comfort with their unfamiliarity—affording the ability to realize envisioned creative applications of technology. By cultivating in themselves, and in the students they teach, a sense of versatility and facility with digital systems and tools, art educators can step outside the often normative user experience grooves carved into digital systems by their designers. In so doing, they can find ways to creatively (mis)use[1] digital materials that are more empowering and accessible for *all* students.

Finding Facility: Identifying Sources of Discomfort With and Alienation From Technology

Just as the average art educator is not afraid to tape a paintbrush to a foam ball to make it more usable for students whose limbs are not accommodated by traditional tools (Coleman & Cramer, 2015), an art educator should feel comfortable and confident remapping the keyboard buttons on the computers in the lab or improvising an alternative keyboard with fewer buttons (Figure 1) to serve the same students in digital creative spaces.[2] However, a number of factors prevent art educators from feeling empowered to exert the same kind of creative problem solving with digital tools as they do with physical ones. Coleman and Cramer (2015), in their writing on adaptive technologies in art education, equate "low-tech" and "non-electronic" assistive devices with devices that

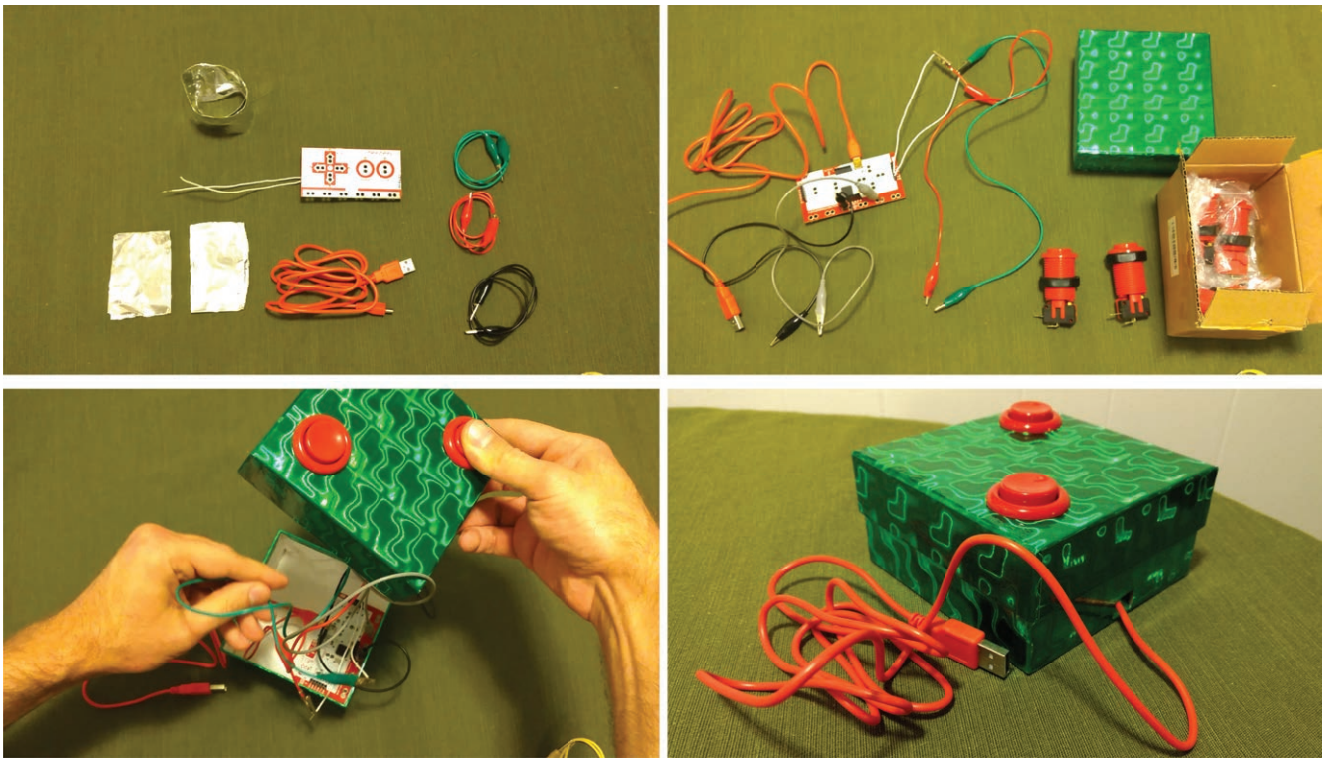

Figure 1. Facsimile of an input device made by a student to allow button presses with feet. The device was made using a MakeyMakey board, buttons, and a cardboard gift box. Photo by author.

Figure 2. Opening page of Universal Adaptor, a graphic narrative web resource developed by the author, with anecdotal classroom examples of technology failing to accommodate students and video tutorials of the solutions developed with the students.

are "easy to acquire" and "easy to make" (p. 7), and describe "high technology" devices as categorically expensive and challenging to implement. This categorization is more a consequence of perception by art education practitioners than an innate difference in cost and difficulty of facilitating material and digital accessibility.

One factor contributing to art educators not feeling empowered to (mis)use technology to achieve accessibility is the phenomenon of user self-blame. Lialina (2012) described how designers have increasingly made their systems transparent *experiences for people* rather than tangible *interfaces for users,* moving toward a frictionless model of computing that prevents the digital system from being seen as a salient human-made object that can be critiqued and corrected. You *use* a hammer, but you *experience* a sunset, and if there is a fault in the hammer's effectiveness, you can criticize the person who made the hammer as well as your own skill in wielding it. But if there is a fault in your experience of the sunset, there's no artisan to blame, and you will likely locate the fault solely in *your own* aesthetic or physical vision.

Designer Don Norman (2013) observed that, frequently, when people encounter failure in interactions with designed digital objects, they tend to blame themselves, falling into a cycle of learned helplessness. I have observed this phenomenon in both preservice art educators and secondary students in digital creative environments. For example, even in cases when software unexpectedly freezes or crashes and loses student work, a seemingly clear case of the program *failing,* students have blamed *themselves* for "breaking the computer" or even "making the computer mad." The phenomenon of self-blame can have even more dramatic ramifications when framed from a disability studies perspective.

For example, the Sculpture for Health-care: Interaction and Virtual Art in 3D (SHIVA) project (McLoughlin et al., 2016) was a design research project to develop 3D modeling software for use by students with severe physical and motor disabilities. When iterating and revising their software through testing with users, the SHIVA researchers specifically noted the phenomenon of those users feeling that they had personally failed when they encountered problems with the software, rather than seeing the situation as a technical bug or failure of design in the software itself (LivabilityUK, 2014).

The self-blame of the users in the SHIVA project illustrates how the tendency toward opacity (Rushkoff, 2010) in the design of digital systems perpetuates a deficit model of disability. Because digital systems often do not transparently present themselves as potentially flawed or biased human creations, when users are *misfitted*[3] by them, they are likely to perceive this as a deficit in themselves, rather than a deficit in the system that renders them disabled. Norman's (2013) call for designers of tools and systems to eliminate the concept of "human error" from their vocabulary in favor of "system error" (p. 66) in many respects mirrors the shift from a deficit model of disability to a *socially constructed model* of disability. In other words, this refers to a shift from a model where people and their bodies are seen as the source of the disability, to one where the designed systems and spaces that fail to accommodate bodies are recognized as the source of the problem.

Students have blamed themselves for "breaking the computer" or even "making the computer mad"

By embodying and encouraging the versatility and facility of Lialina's (2012) General Purpose User, art instructors can reframe their students' positions in relation to digital systems, affording them greater agency. This may entail the teacher hacking the system to create an accessible creative space, or the students themselves hacking the system to meet their own usability needs. Teachers can also rhetorically empower their students by situating the moments of failure outside of the students themselves. One anecdotal example of this rhetorical reframing from my own practice is when students encounter errors in coding projects. While students are quick to assume they have done something wrong, I remind them that the computer simply is not intelligent enough to infer their intent from what they have written. Consequently, they need to be much more careful and methodical in their coding. This need for extra care is not because they are not passing the computer's muster, but, on the contrary, because the computer needs them to explain their intent in clear, concise baby steps for it to understand.

Strategies for Cultivating Versatility and Facility With Digital Materials

In the following section, I articulate strategies for fostering the versatility and facility with digital materials necessary for cultivating an accessible and empowering new media learning classroom. These strategies include fostering *versatility* by seeing technology as a creative medium rather than a set of prescriptive tools or appliances and fostering *facility* by recognizing the potential of digital tools for flexibility and forgiveness.

Versatility: Seeing Digital Technology as a Medium and Not a Tool

Media theorist Douglas Rushkoff (2010) expressed concern that "[i]nstead of teaching programming, most schools with computer literacy curriculums teach *programs,*" inculcating a mindset where "[d]igital technology becomes the immutable thing, while the student is the movable part, conforming to the needs of the program in order to get a good grade on the test" (p. 129). Teaching students the prescribed uses of a particular piece of software (e.g., Microsoft Office or the Adobe Suite), rather than versatile and critical creative approaches they can apply in a variety of contexts, can contribute to the previously described phenomenon of learned helplessness in the face of technology (Norman, 2013). When digital materials are presented as closed

Why not, when possible, provide creative tools and skills for students to hack and correct the misfitting system?

systems, tinkering, retrofitting, and hacking those systems are less likely to be seen as possibilities, perpetuating a misfitting deficit model of disability where it is not the software or interface that needs to change, but the student (or their body) who is at fault.

Hokanson and Hooper (2000) noted how technology in school environments is typically used in prescriptive ways to more efficiently administer traditional models of education, a habit also observed more recently by Cuban (2013, 2018) and Shapley, Sheehan, Maloney, and Caranikas-Walker (2010). Hokanson and Hooper (2000) recommended framing new technology not as a pragmatic tool but as an expressive medium, arguing that "[c]onceptualizing computing as a medium rather than a tool changes our notions of how computers should be used in education. This approach shifts the focus from representative use (i.e., as a delivery system) to generative use for construction" (p. 548). Likewise, rather than seeing creative software as prescriptive tools for specific tasks, art educators can cultivate in themselves and their students a General Purpose User (Lialina, 2012) mindset that sees digital systems as mutable and expressive, presenting myriad nonprescriptive opportunities for agency and accessibility.

Knochel and Patton (2015) similarly framed digital code as artistic *material,* noting further that, unlike physical materials that are defined by concrete physical constraints, digital materials are defined more by *constructed* capabilities and constraints that define how they function. Physical art materials often have immutable qualities such as size, weight, or fragility, whereas properties of software, like the size and arrangement of on-screen elements, can often be altered and adapted. This is an empowering outlook from a disability theory standpoint, as the constructed and thus malleable nature of the constraints manifest in software systems may give them *more* potential for accessibility. The wholly constructed nature of digital systems and media means that, for a versatile user who recognizes that constructed nature, those systems can be reconfigured and adapted in empowering and accessible ways.

Concerning digital assistive technologies, Foley and Ferri (2012) identified what they called the "Speak & Spell effect" of dedicated, prescriptive assistive digital technologies (p. 198). In addition to being expensive, hard to repair, and of limited use, commercially available assistive technologies often aesthetically resemble children's toys, with rounded edges and thick plastic shells that can be stigmatizing or embarrassing for students to use. Foley and Ferri (2012) advocated for a shift from conspicuous, single-purpose "assistive" technology to more universally empowering "accessible" technologies (p. 193). Rather than buying expensive, commercially supplied assistive technology that ultimately marks misfitted students as *others* needing correction, why not, when possible, provide creative tools and skills for students to hack and correct the misfitting system? Treating these creative skills as part of the curriculum for all students, rather than as a specific tool for specific students, may also reduce feelings of stigma, as Quinlan, Bates, and Angell (2012) observed that students classified as having a disability describe accommodations that target and benefit all students as the least stigmatizing and most effective.

Facility: Recognizing and Incorporating Forgiveness in Digital Materials

Lialina (2018) noted that *forgiveness* has been a core design element in digital systems for over two decades, most evidently characterized by the ubiquity of the "undo" function (at least until the age of tablet computing). Despite the intimidation felt by novice users (Norman, 2013), including preservice art educators (Patton & Meeken, 2017), digital media lowered the stakes for error, puncturing some of the sacredness of the act of creation and fostering the possibility for play and experimentation (McCord & Malley, 2017). There is evidence (e.g., McEwen, Zbitnew, & Chatsick, 2016; Young, 2008) that thoughtful introduction of digital creative materials can lower the stakes for failure and encourage freer artistic experimentation for students characterized as having a physical or cognitive disability.

Art educators already know that failure can be productive. Teachers who foreground digital materials' potential for forgiveness can help encourage students' use of digital materials, even when those materials do not seem to be accessible or empowering in their design. Students can overcome alienation and discomfort, and find facility with new media tools when they realize that hours of work deleted by an errant keystroke can be restored with another keystroke, or that the error generated by their coding project is not a sign of failure but a signpost indicating where *the computer* failed to understand the command. Likewise, teachers and students who manipulate digital materials to create their own accessibility and utility solutions should be mindful of the design principle of forgiveness, and ensure that, say, the hands-free interface they develop affords easy access to the "undo" or "step backward" functionalities of their software. By recognizing digital technology's potential for forgiveness, art educators can help contribute to a more accessible and empowering learning space that is amenable to experimentation and risk-taking.

Versatility, Facility, and Critical Creative Outcomes

It is difficult to find exemplary student work illustrating the specific benefits of this approach to creative technologies, as this method of working aims to make *any* project more accessible. That the final Photoshop project of the student from the opening anecdote was *not* visibly distinctive from those of his peers and did not bear the marks of any special accommodation is itself a notable outcome. However, I *have* taught students who used the critical affordances of a versatility and facility approach to create work that explicitly hacked the relationship between technology and the varied bodies that use it. For example, a high school student, who was a dark-complected Black woman, responded to the bias

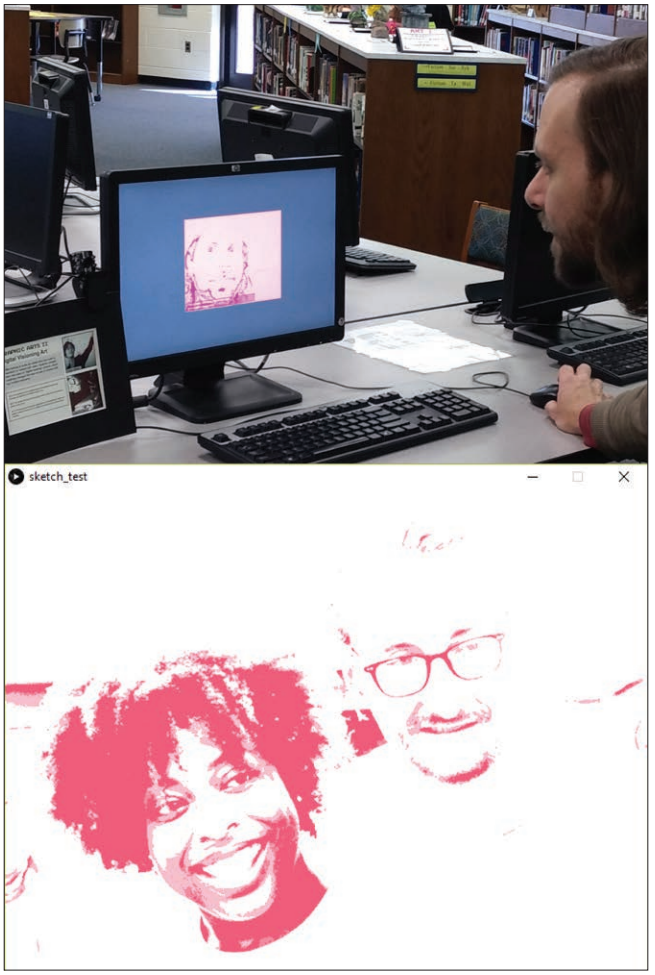

Figure 3. Student-coded webcam filter running live (above) and applied to a royalty-free photo from Rawpixel (below). Image used with permission of the artist.

toward light-complected faces in digital imaging technology. She coded her own Instagram-style webcam filter that rendered dark-complected faces with a full value range, while blowing out the faces of her White classmates and teacher (Figure 3). The resulting piece gave her White peers the rare (for them) experience of interacting with a digital system not made by and for people who looked like themselves.

Another student, an undergraduate preservice art educator, developed a piece that expressed her movement from alienation to facility with digital technology. She created an intentionally overwhelming and confusing physical and software interface (Figure 4), with unclear commands mapped to buttons that snaked up the walls and across the screen. The system, however, had an underlying consistency and could be learned with practice to win the chaotic "game" the software presented. The idea that, with a combination of persistence and creativity, one could achieve mastery over an intentionally alienating digital system had resonance in this class of preservice art educators who had started the semester expressing often-gendered feelings of intimidation and exclusion regarding digital tools and the cultures surrounding them.

Figure 4. Student-built custom interface artwork. Image used with permission of the artist.

Conclusion

The perceived immutability and infallibility of digital systems and the resultant tendencies of self-blame and lack of agency felt when those systems fail to accommodate all users potentially lead to the disabling and misfitting of students whose bodies are not considered in the design of those systems. As "disability is a broad category, and each student has particular needs for traditional art-making support, based on physical limitations and complexities" (McCord & Malley, 2017, p. 318), one-size-fits-all solutions are inadequate and individualized, single-purpose accessibility technologies can be expensive, limited, and stigmatizing (Foley & Ferri, 2012). Teachers who are General Purpose Users (Lialina,

Teachers who foreground digital materials' potential for forgiveness can help encourage students' use of digital materials, even when those materials do not seem to be accessible or empowering in their design.

2012), who foster students to become General Purpose Users, may help mitigate technology's disabling qualities and activate its potential for forgiving, empowering creative practice. By putting the values of versatility and facility with technology into practice, teachers will be equipped to provide as accessible a digital creative environment as possible, and students will be empowered to hack or remix the systems in place, at moments when the digital environment inevitably misfits them. ■

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Endnotes

[1] The formulation *(mis)use* here is employed to describe uses of digital materials that may not reflect their prescribed use. An openness to using digital materials in ways that seem technically or nominally *wrong* can instead reveal novel and sometimes liberatory uses for common digital tools.

[2] I have developed an online resource, *Universal Adaptor* (Figure 2), which uses graphic narratives and tutorial videos to demonstrate how to implement these specific solutions, as well as some others, in a digital arts learning environment. *Universal Adaptor* is accessible at http://gildedgreen.com/universaladaptor/

[3] *Misfitting* is a feminist disability concept articulated by Rosemarie Garland-Thomson (2011) that focuses on the relationship between a body and the designed environment. When a person experiences misfitting, the fault is not with their body, so much as with the space that has failed to accommodate, or *fit,* it.