**System Opacity and Student Agency in the New Media Landscape**

**Introduction**

Facebook's unchangeable monochromatic blue color scheme is perhaps the most overt, if innocuous, instance of our aesthetic experience of the Internet being impoverished by the vision of those creating the virtual spaces we inhabit. Selected by Facebook creator Mark Zuckerberg because of his red-green color-blindness (Vargas, 2010), this scheme is applied uniformly to all Facebook member pages. If our visual experience, and palette for visual expression, on the Internet's most populous social network is limited by a literal, mechanical limit of the creator's vision, what other dimensions of our experience are atrophied or precluded by less overt "limits of vision" – the biases, the hasty design decisions, the fealty to advertisers, etc. – on the part of the individuals coding and shaping the contemporary web?

Users' lack of control over the code-based substrate of contemporary culture is particularly problematic because the digital has become the delivery system for most other media forms. McLuhan (1964) noted that at its advent, each new medium takes as its content the media that preceded it, and because of the versatile multimodality of new media (Jenkins et al., 2006, Peppler, 2010) the medium of code now contains or delivers print, television, film, radio, etc. (or more specifically, translations of those media into the digital). The digital has become the matrix in which all other media are suspended. The term 'matrix' being evocative of the gelatinous substrate in which the organelles of a cell hang, the computer data structure of an ordered grid containing values, and of course the b-grade Hollywood "Gnostic nightmare" film in which mankind finds itself inhabiting a synthetic world over which it has no control, the laws of which are dictated

by millions of lines of indecipherable, invisible computer code roiling just beneath its surface.

The relation between users and producers of digital media is largely asymmetric, and even with the increased appearance of web culture as participatory, users are still largely subject to a landscape of "one-to-many media" (Rushkoff, 2010, p. 13) in which they are the recipients of, or participants *within*, artifacts and edifices crafted by a relatively small elite who have full fluency in the underlying language of the contemporary mediascape (Rushkoff, 2010). The development of highly participatory Web 2.0 tools, while they appear to have lowered the bar of entry for involvement in digital culture, have also restricted that involvement to particular channels, which contain the biases of the private interests that created them, and which shape participation and expression in ways more subtle than more transparently "one-way" media of the past. As programmer and media theorist Jaron Lanier (2010) observed:

> Something like missionary reductionism has happened to the Internet with the rise of Web2.0. The strangeness is being leached away by the mush-making process. Individual web pages as they first appeared in the 1990s had the flavor of personhood. MySpace preserved some of that flavor, though a process of regularized formatting had begun. Facebook went further, organizing people into multiple-choice identities, while Wikipedia seeks to erase point of view entirely. If a church or government were doing these things, it would feel authoritarian, but when technologists are the culprits, we seem hip, fresh, and inventive. People will accept ideas presented in technological form that would be abhorrent in any other form (p. 46).

Art education has a duty to provide students with meaningful and critical engagements with contemporary visual culture (Freedman & Stuhr, 2004). However, art educators have been traditionally reluctant to incorporate new media artmaking and literacies into their teaching (Lu, 2005, Örtegren, 2010). In what ways can art education provide students with agency in the contemporary digital mediascape, and in what ways can art educators, including those with little familiarity or experience with new media, incorporate new media artmaking into their pedagogy?

**The Problem of 'Pre-Formatted Thinking'**

In *Releasing the Imagination: Essays on Education, the Arts and Social Change*, Maxine Greene (1995) posed an opposition between the provision of critical engagement with arts and culture by educators and cultural creep of the kind of banal tyranny discussed by Hannah Arendt:

> If, however, we are to provide occasions for significant encounters with works of art, we have to combat both standardization and what Hannah Arendt called 'thoughtlessness'… Provoked by the spectacle of the Nazi Adolf Eichmann, Arendt broached the same theme in a warning against 'cliches, stock phrases, [and] adherence to conventional, standardized codes of expression and conduct' (Greene, 1995, p. 126).

In the context of new media, Jaron Lanier (2010) similarly warned against such adherence to standardized codes. While he acknowledged the tendency for artists to love the media and tools in which they work, he encouraged a skepticism toward pre-packaged software tools for creativity. "These designs came together very recently, and there's a haphazard, accidental quality to them. Resist the easy grooves they guide you into. If you

love a medium made of software, there's a danger that you will become entrapped in someone else's recent careless thoughts. Struggle against that!" (Lanier, 2010, p .22).

However, the opacity of these tools and platforms for expression tend to mask the human thought or motivations behind their design, and limit the level of agency and engagement students and other artists have with respect to them. Douglass Rushkoff (2010) characterized the typical interaction with contemporary digital interfaces as "a Hail Mary pass into the datasphere, requesting something from an opaque black box" (Rushkoff, 2010, p. 17). Jenkins, Clinton, Purushtoma, Robison, and Weigel (2006) of the Comparative Media Studies Program at MIT identified "transparency" (p. 14) as one of three core problems facing educators and students as they try to cultivate new media literacies. They noted the practice of using invisible algorithms to shape search engine listings according to commercial interests, and how "[i]ncreasingly, opportunities to participate online are branded such that even when young people produce and share their own media, they do so under terms set by commercial interests" (Jenkins et al., p. 16).

Helplessness in the face of such opacity forces students into the position of passive consumers of digital media and platforms, ensuring "that their entire orientation to computing will be from the perspective of users" (Rushkoff, 2010, p. 129). And this passivity in the face of culture could metastasize to students' expectations from other cultural spheres, such as educational institutions, leading to post-secondary students who "conceive of themselves as consumers who conveniently make a down payment on education and with next to no effort (like shopping) graduate into the good life" (Scholz, 2004, para. 21). Scholz (2004) asserted that such a "consumer approach to education"

(para. 23) in incoming new media students manifests such tendencies as demanding exclusively vocational training, and contempt for discussion and debate in studio classes.

In a contemporary mediascape where the retention of knowledge has less relevance than the ability to navigate, parse, curate, and find patterns in a surfeit of knowledge, the rhetoric of education understandably emphasizes the cultivation of "literacy" rather than "knowledge." The two-way nature of literacy across all media, however, is not always acknowledged. Alan Kay (1989) noted that "[t]he ability to 'read' a medium means you can access materials and tools created by others. The ability to 'write' in a medium means you can generate materials and tools for others. You must have both to be literate" (p. 191). Casey Reas and Ben Fry (2006), developers of the art programming language Processing, emphasized the importance of such literacy with respect to digital media: "Software is the medium that controls this flow of bits traversing the air and surface of our planet. Understanding software and its impact on culture is a basis for understanding and contributing to contemporary society" (p. 526).

The equitable distribution of this new media literacy is another challenge faced by educators. While the discourse on equity with respect to digital media has emphasized addressing the material poverty of certain communities and school systems, placing computer labs in public libraries and schools, it has failed to address the *conceptual* poverty endemic to the ways students are asked to participate with those computers. "Discussions surrounding digital equity today have expanded beyond physical access to computers and the Internet at home and schools. Today, digital equity means that all students have adequate access to information and communications technologies and actively engaging curriculum" (Peppler, 2010, p. 2149). Jenkins et al. (2006) describe a

"participation gap," wherein "[i]ncreasingly, children and young people are divided into those for whom the Internet is an increasingly rich, diverse, engaging and stimulating resource of growing importance in their lives and those for whom it remains a narrow, unengaging, if occasionally useful, resource of rather less significance" (Jenkins et al., 2006, p. 13). Pinkett (2001) cited data that even within the same level of income, minority households were less likely to own a computer than white households, indicating that factors beyond simple material equity were hampering some populations' access to and engagement with digital visual culture. However, Jenkins et al. (2006) found that urban youth were statistically more likely to be media creators than suburban youth, and found "no significant differences in participation by race-ethnicity" (p.6), making it unclear whether this "participation gap" falls along traditional lines of class or race.

The lack of *productive* new media literacy (e.g. "writing," the creation of new media artifacts) can also have an adverse affect on students' *receptive* new media literacy (e.g. "reading," the consumption of new media artifacts). The creation of simulations, interfaces, or games helps students to understand the design choices made in those systems, and provides them with the insight to engage critically when interacting with such systems (Jenkins et al., 2006). However, at present, even when educators incorporate games or other new media into lessons, students, conditioned toward consumption, tend to uncritically accept the models demonstrated by the game, and the information those models present (Jenkins et al., 2006). Case studies of such experiments showed that students learned "how to read information from and through games, but they were not yet learning how to read games as texts, constructed with their own aesthetic

norms, genre conventions, ideological biases, and codes of representation" (Jenkins et al., 2006, p. 15).

The opacity digital systems hold for students who have no experience creating or scrutinizing them inculcates an inability to recognize the created nature of digital systems, and the role of the human hand (and human biases) in their construction. "Instead of marveling at a person or group who have gained the ability to communicate in a new way, we tend to marvel at the tools through which all this is happening" (Rushkoff, 2010. p. 14). Jaron Lanier (2010) calls this the "oracle illusion" (p. 47) and likens the tendency to uncritically accept the 'authoritative' voice of a source like Wikipedia, which is in fact the product of countless anonymous authors, with past cultural tendencies to uncritically accept as the inerrant word of God biblical texts which were likewise the product of countless anonymous authors.

Jorgenson (2010) described a phenomenon analogous to this "oracle illusion" in the tendency of media educators to see the evolution of digital technology as a driving force for cultural change, rather than a product of culture. "[T]he digital is not driving history, it is not producing a different mode of economic or even socio-cultural production. Digital technologies are instead reproducing social, cultural and economic forms that preceded it. The digital is a metaphor for change rather than the change itself, and it is on this metaphoric level that universities must mount a critical intervention" (para. 3). As an example, he cited architect Zaha Hadid, who is characterized as a 'digital architect,' emblematic of a 'digital era' of design despite her aesthetics preceding her use of digital tools. "Why not," he supposed, "call this new era of design *Hadidesque*?" (para 4).

Olia Lialina (2012) noted a trend toward the "invisibility" of computers in everyday life, which far from indicating complete transparency, in fact represents a more thoroughgoing and problematic form of opacity where not only are the inner workings of a digital system invisible, but that system itself and the interface used to participate with it are likewise masked and evade scrutiny. She linked this trend with the increased antipathy toward the word *user* in the rhetoric of UI designers, in favor of the word *person*, noting that "Being a User is the last reminder that there is, whether visible or not, a computer, a programmed system you use" (para. 11). Lialina also noted that addressing *people* and not *users* "hides the existence of two classes of people – developers and users" (para. 14), a loss of distinction that may cost the user their agency to control their files, opt out of systems, or simply see the system they are using. The superficially humanistic rhetoric of casting users as simply "people" *nominally* erases a distinction in power without *actually* doing so, not unlike a political system where the prevailing rhetoric asserts that both the dictator and dictatee are 'comrades.'

This opacity in the relationship of users to digital media and tools has resulted in a "tools-first" mentality that has shaped not only the rhetoric with which digital media is discussed, but also the philosophy with which it has been taught.

**Digital Media Framed as a 'Tool' Rather than as a 'Medium' for Expression**

Red Burns, founder of Tisch's Interactive Telecommunications Program, said of tools for new media production: "It has never been about the tools. It has always been about the people – how people use technology, and how these technologies can help people communicate" (Burns, 2004, p. v).

While reducing new media literacy, or new media art education, to the simple development of technical skills with digital tools "would be a mistake on the order of confusing penmanship with composition" (Jenkins, 2006, p. 20), the provision of digital tools has tended to be the priority of education systems. As discussed above, material equity has been emphasized over media literacy in the push to "wire" classrooms across the country, and in digital media courses often "the focus [was] almost entirely on the production process. Little effort was made to give youth a context for thinking about these changes or to reflect on the new responsibilities and challenges they faced as participants in the digital culture" (Jenkins, 2006, p. 59).

Rushkoff (2010) expressed a concern that American students were falling behind their contemporaries in other countries with respect to new media literacy, because "Instead of teaching programming, most schools with computer literacy curriculums teach *programs*. Kids learn how to use popular spreadsheet, word processing, and browsing software…basic skills [that] may make them more employable for the entry-level cubicle jobs of today, but…will not help them adapt to the technologies of tomorrow" (p. 129). Teaching a piece of software *as the subject of study* creates a pedagogical space 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).

Hokanson and Hooper (2000) noted that "[m]edia such as computers are traditionally described and investigated as tools that help to complete specific, pre-ordained tasks such as the delivery or recording of information" (p. 548) and that this understanding of computers prevails in education. "Media in this light, present a

prepackaged, unalterable piece of instruction. A good example is the filmstrip. Content, pace, organization, and goals are programmed as in teacher proof textbooks." Per Hokanson and Hooper, when media are considered simply as tools, changing media – for instance, installing computers in a classroom – produces no meaningful impact, apart from perhaps efficiency. Hokanson and Hooper recommend a shift in perspective from seeing computers as a 'tool' to a 'medium':

> A broader conceptualization adopts a definition from biology; a medium is a condition that is conducive to growth. A "cognitive" medium is one that provides an environment for intellectual growth. Such a shift alters our perspective of how computers should be used in education, and focuses on their generative use. Conceptualizing 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. (Hokanson & Hooper, 2000)

This perspective characterizes Kylie Peppler's (2010) conception of new media art education, which goes "[b]eyond surface forays into technology (such as typing, word processing, and web surfing)…encouraging designing, creating, and critiquing genres that connect to youth culture" (p. 2119). Not being beholden to specific tools makes students "computationally flexible" (p. 2126), extending students' new media literacy into *fluency*, which Peppler describes as "knowing how and why existing tools do not meet current needs… [and] the ability to create the tools that one can otherwise only imagine." This type of productive new media literacy is, for Peppler, at the core of new media artistic practice, both in the classroom and in the art world.

While critical engagement with new media may be a core value in the practice of new media artists, new media curator and art historian Christiane Paul (2011) noted that contemporary art *institutions* often embody the same uncritical, instrumental bias with respect to digital technology as educational institutions appear to. She observed that while "art institutions and organizations now commonly use digital technologies in their infrastructure—'connecting' and distributing through their websites, Facebook pages, YouTube channels and Twitter tours—they still place emphasis on exhibiting more traditional art forms that reference technological culture rather than art that uses these technologies as a medium" (Paul, 2011, p. 102).

Lialina (2012), in her discussion of the changing attitude toward the "user" from the perspective of commercial interface designers, described the increasing, designed, alienation of users from their computers. Rhetorical movement from the term "user" to "person" entailed recasting users as busy people preoccupied with concerns outside the digital, whose "real jobs, feelings, thoughts, interests, talents — everything what matters — lie outside of their interaction with personal computers" (para. 24). Citing a 2007 ad for Adobe Dreamweaver wherein a designer opined that "I have more time to do what I like most — being creative," Lialina noted that "[t]he message from Adobe is clear. The less you think about source code, scripts, links and the web itself, the more creative you are as a web designer. What a lie" (para. 25). This rhetoric casts coding as mechanical, rather than expressive, "a working class skill like bricklaying, which may as well be outsourced to some poor nation" (Rushkoff, 2010, p. 131), and the line demarcating what is "creative" and what is "mechanical" is drawn by purveyors of digital tools – those discrete, opaque "apps" which purport to handle the unseemly technical business of

computing, affording users “freer” creativity. Consequently, the computer metamorphoses from an intentionally “stupid” (in the sense that it can not, and does not, make decisions on behalf of the user) multipurpose *medium* to a more “smart,” opaque, single-use *appliance* – or cupboard of such appliances (Lialina, 2012, para. 36).

Peppler’s (2010) above notion that fluency in new media arts involves the transition from using tools to creating new tools parallels the sentiment of New Media Artist John Simon, Jr (2004):

> “Why should an artist program? Are commercial software tools not sufficient? First, consider the models for popular programs. Word processors are based on typewriters and graphics programs mimic paper, pencils, and brushes. However, what program is inspired by a flowing stream? The obvious reason, therefore, for an artist or designer to program is to break the boundaries of commercial tools. Creative programming offers the possibility of activating your own models…”(Simon, 2004, p. 46).

The ability to program, or at least to understand the programming behind the tools and platforms one uses, can liberate the student or artist from the limiting design decisions s/he interacts with, decisions that may be hidebound and overly beholden to other media (“paper, pencils and brushes”) at the expense of capitalizing on the particular expressive potential(s) of new media. Typically, however, in both art and general education, there is a tendency to remain within those confines, and to use new media tools to teach traditional media skills.

**The Use of New Media to Teach (Exclusively or Primarily) Traditional Media Skills**

Imagine a new art educator in a public school, who has just completed a degree in painting, drawing, and printmaking, with a certification in art education. While s/he took a foundational ceramics course in school s/he has not done any ceramic work since, and has never personally operated a kiln. However, the school's art room has a kiln – an unfamiliar piece of technology – and the school's art curriculum mandates at least one ceramic project be completed each year. In meeting this requirement, the teacher has two options. One option is to move beyond her/his comfort zone, become acquainted with the practice and theory of ceramics, and to conceive a project which capitalizes on the unique properties of the sculptural medium. The other is to retreat to the familiar, to draw upon her/his prior experience, and roll out flat slabs of clay on which the students paint two-dimensional designs.

While the latter project could certainly be rewarding (and could draw upon art-historical antecedents like Persian tilework), if it were the students' *only* ceramics experience, or if all of their ceramics experiences were simply translations of drawing and painting experiences, their encounter with the medium would certainly be an impoverished one. However, an analogous approach seems to be prevalent in art education practice when it comes to utilizing digital media. A lack of familiarity with new media art prompts projects where students create simulacra of non-digital artforms (Lu, 2005, Örtegren, 2012) – paintings, photos, typographic layouts, and films, among others. Like the above slab project, such works can have value, and could be a component of a student's broader experience with the medium. But when such exercises, which don't fully explore the properties of new media, comprise students' entire encounter with the medium, that encounter is necessarily impoverished.

To extend the above analogy into the realm of fantasy, suppose, in this art-teacher's world, a relatively small oligarchy of clay-producing companies are producing ubiquitous adobe housing in which most people now live and do business, and imagine the advantages a student with a functional or refined knowledge of working and creating with clay might have in such a world. The new media landscape in which students, and everyone else, find themselves is shaped by a relatively small collection of private interests (one of which is, naturally, named "Adobe"), and providing students with critical and expressive new media literacies will help them to engage with, and shape, the mediascape in which they live.

*New media* is a flawed label, of which Paul (2011) noted "[a]fter approximately fifteen years of discussion, everyone seems to agree that the term itself is unfortunate, since it is not helpful in describing characteristics or aesthetics of the digital medium" (p. 103). Digital artwork that had been called computer art, multimedia art, or cyberart became *new media* toward the end of the twentieth century, adopting a term previously used for video, film, and sound art (Paul). Consequently, digital art labors under a term ambiguous enough to make distinctions between it and other media difficult, and loaded enough that to make such a distinction immediately casts other works as *old media* connoting a value judgment and imposing a kind of evolutionary narrative to the history of art. The term here is used as a convention, and in drawing the distinctions I do in this section, I don't mean to imply a hierarchy between 'traditional' and 'new' media.

Paul (2011) acknowledged the problematic nature of the term, but nonetheless asserted a clear definition for new media art as "computable art that is created, stored, and distributed via digital technologies and uses these technologies' features as a

medium. New media art is process-oriented, time-based, dynamic, and real-time; participatory, collaborative, and performative; modular, variable, generative, and customizable" (p. 103). In creating this kind of work, students use the computer as a transparent medium of expression, rather than an opaque tool.

Non-studio arts education has a similar tendency to couch old teaching methodologies in new mediated experiences. Typically, these pedagogical strategies fall short not only of the potential of the new medium, but are also inferior to the traditional practice being emulated. Hokanson and Hooper (2000) describe an activity where students observe a virtual art exhibition in lieu of traveling to a physical art museum. "The virtual experience is flat and electronic, only visual, two-dimensional and mediated. Students are removed from first-hand experience and miss the opportunity to see a painting with real paint or to experience art in the context of a gallery." (p. 538). They conclude that when "[u]sed to deliver the same instructional method, the potential of the computer to extend human cognitive capability remains unfulfilled" (p. 548).

Hokanson and Hooper (2000) observed a similar trend in American education across all subjects, characterizing it as the "application of existing instructional methods to the new technology with subsequent disappointing results" (p. 541), and connected it to the general development of media in society as outlined by McLuhan. As a new medium develops, prior media comprise its content – early films recreating stage plays without capitalizing on framing and editing, early television transcribing radio plays, and early video approximating film, etc. (McLuhan, 1964). "Only later does each medium develop its own language, its own grammar and syntax, and each has its own prejudices" (Hokanson & Hooper, 2000, p. 541).

Rushkoff (2010) framed this staggered media progression as a series of inequitable cultural stages, where the common people consistently have agency in media forms a stage behind an elite, who enjoy productive literacy in the most contemporary and powerful medium. For instance, “the printing press in the Renaissance led not to a society of writers but one of readers” (p. 13), as only an elite class could write and publish books.

> Finally, we have the tools to program. Yet we are content to seize only the capability of the last great media renaissance, that of writing. We feel proud to build a web page or finish our profile on a social networking site, as if this means we are now full-fledged participants in the cyber era. We remain unaware of the biases of the programs in which we are participating, as well as the ways they circumscribe our newfound authorship within their predetermined agendas” (Rushkoff, 2010, p. 139).

By teaching students to create content in “traditional media” forms to submit to and post on websites and platforms created by programmers who function as de facto gatekeepers and/or profiteers, educators prepare students, as producers of culture, to perpetuate this asymmetry.

One of the strengths of digital media is that it is multimodal and can contain and combine multiple prior media forms, including text, images, and video (Peppler, 2010). However, using new tools to create work that largely simulates other media forms does a disservice both to new media and to the form being synthesized. Lu (2005) noted in her study of pre-service art educators’ reactions to digital imagery that “participants saw any CGAI [computer generated art image] sample that resembled a traditional artwork as

'fake'…the CGAI painting was seen as lacking 'the sense of life or reality. Participants did not consider any other possible purpose for the creation of the CGAI painting, except to mimic or copy the original" (p. 94). The images did not succeed as paintings in the estimation of the participants, and their closeness to traditional paintings perpetuated in the pre-service art educators the notion that digital media primarily produce inferior facsimiles of works done in other media.

**'Inherent' Aspects of New Media that New Media Art Education Could Address**

If using the computer as a tool to simulate other media does not capitalize on all of the potential strengths computers have as a medium of expression, what *are* the strengths or aspects that can be explored primarily or exclusively in new media? A number of researchers and theorists in the field have addressed this, and together provide an array of conceptual and formal domains new media art education could explore. Reas and Fry (2006) identify software's "ability to produce dynamic form, process gestures, to produce behavior, simulate natural systems, and integrate various media including sound, image, and text" (p. 528). Paul (2012) identified several unique aspects of new media aesthetics that challenge art audiences, including procedural non-linearity, which requires recognition that the work is self-constructing and not an animation or video loop, its algorithmic nature, which requires a certain amount of programming literacy to parse, and its automation, which challenges traditional notions of authorship.

A key element of new media artwork is the ability to create *dynamic, procedural models and forms, including simulations* of real-world processes (Jenkins et al., 2006, Reas & Fry, 2006). New media artist and educator Golan Levin characterized software as a "brittle but determined little piece of mind that not only contains a model of one's point

of view, but actively works to impose that view on the surrounding environment. If writing is a medium of thought, then software is an agent of *will*" (Levin, 2004, p. 140). New media not only expresses or contains a thought, but can manifest that thought dynamically over time. And the creation of dynamic systems can make salient for students the "pieces of mind" present in the systems and simulations they encounter in culture, "develop[ing] a greater systemic understanding of the rules and procedures that shape our everyday experience" (Jenkins et al., 2006, p. 27). Procedural artwork exists over time, but does not typically have a predefined course or ending, presenting a challenge to artists and audiences accustomed to finite time-based media like video loops (Paul, 2012). Engaging with this non-linearity may require the cultivation of what Ng (2012) calls "branching literacy," which entails "good spatial orientation and the ability to create mental models, concept maps and other forms of abstract representations in hypermedial environments" (p. 1067).

Another prevalent aspect in new media artmaking is the *ease of appropriation, collage, and remix* (Jenkins et al., 2006, Ng, 2012). Jenkins et al. (2006) described appropriation as "a process by which students learn by taking culture apart and putting it back together…[T]his is not how we generally talk about creativity in schools …Our focus on autonomous, creative expression falsifies the actual process by which meaning is generated and new works produced" (p. 32). American youth already incorporate a great deal of appropriation in their independent media-making (e.g. remixes, mash-ups, supercuts, anime music videos), in part because digital media facilitate this form of creativity (Jenkins et al., 2006).

However, the typical school arts classroom doesn't welcome appropriated or repurposed content, emphasizing a mythical originality and retreating from the difficult ambiguity of ethics and creativity that appropriation entails. "[I]n doing so, they sacrifice the opportunity to help youth think more deeply about the ethical and legal implications of repurposing existing media content, and they often fail to provide the conceptual tools students need to analyze and interpret works produced in this appropriative process" (Jenkins et al., 2006, p. 33).

Peppler (2010) noted that in her experience "artists that begin with emulation become more critical and original in their work over time, indicating that emulation may just be one starting point for understanding new media" (p. 2142). Jenkins et al. (2006) also suggested that appropriation may provide scaffolding for beginning creators, and asserted that remixing involves the thoughtful and creative juxtaposition of materials from disparate domains of culture.

Another key feature of new media is its ability to make connections between *multiple modalities*, including images, sound and print (Peppler, 2010). "[S]tudents must learn to sort through a range of different possible modes of expression, determine which is most effective in reaching their audience and communicating their message, and to grasp which techniques work best in conveying information through this channel" (Jenkins et al., 2006, p. 47).

MIT's New Media Literacies developed an exercise which asks students to tell the same story across a range of different media, including conventional methods like drawings and video, as well as using tools like Powerpoint or instant messenger. "As they do so, they are encouraged to think about what each new tool contributes to their overall

experience of the story as well as what needs to remain the same for viewers to recognize the same characters and situations across these various media" (Jenkins et al., 2006, p. 49). Lialina (2012) asserted that "General Purpose Technology is the core of New Media" (para. 36), describing a "general purpose user" who

> can write an article in their e-mail client, layout their business card in Excel and shave in front of a web cam. They can also find a way to publish photos online without flickr, tweet without twitter, like without facebook, make a black frame around pictures without instagram, remove a black frame from an instagram picture and even wake up at 7:00 without a "wake up at 7:00" app…Such users will find a way to their aspiration without an app or utility programmed specifically for it. The universal user is not a super user, not half a hacker. It is not an exotic type of user. (para. 39).

The general purpose nature of digital media affords users the ability to flow between, to combine, and to *mis*use a variety of artistic media and digital tools, affording students the "computational flexibility" (Peppler, 2010, p. 2126) to engage critically with, and find new artistic uses for, digital media.

New media artmaking also allows for multiple levels of *interactivity*, including human-to-computer interactivity (Peppler, 2010). "As in the case of video games and other forms of interactive art projects, the viewer can have the unique experience of interacting with and changing the display or the activity in which they are involved. This involves a set of literacies and skills unique to this medium" (Peppler, 2010).

Jenkins et al. (2006) cited *distributed cognition* as a unique aspect of new media literacies, embracing the use of thinking machines to afford more complex cognition and

asserting that "it makes no sense to 'factor out' what the human brain is doing as the 'real' part of thinking, and to view what the technology is doing as a 'cheat' or 'crutch'" (Jenkins et al., 2006 p. 37). While artmaking doesn't (yet?) have its equivalent of a calculator which can produce a solution with the push of a button, Paul (2012) has identified the automation of new media art, and the ambiguity of authorship it presents, as a significant aesthetic challenge for audiences of new media art, and Lu (2005) noted that the idea that digital art is "created and controlled by machines, not humans" (p. 91) contributed to a bias against digital art in pre-service art educators. New media art education can explore and clarify the relationship between authorship and programming of a piece, and articulate the different types of work the artist and software accomplish in the execution of a new media artwork

Jenkins et al. also noted that "when calculation is 'off loaded' onto the calculator, the student is free to solve more complex problems" (p. 39). Students who use new media solutions to automate time-consuming, repetitive, or mechanical aspects of their practice afford themselves more time and mental and physical energy to produce more ambitious work. A more fine-grained understanding of the relation between authorship and programming can help students draw their own distinctions between the "mechanical" aspects of their practice and the "creative" ones, rather than allowing the tools they use to make those distinctions for them (Lialina, 2012).

Jenkins et al (2006) identified "*judgment* — the ability to evaluate the reliability and credibility of different information sources" (p.44) as a key new media literacy. While in and of itself, judgment is not an inherent aesthetic component of new media art, the type of critical engagement with media that new media artmaking fosters can

certainly incorporate and foster this kind of criticality. “[S]tudies find that children remain unaware of the motives behind the creation of websites, have difficulty separating commercial from noncommercial sites, and lack the background to identify the sources of authority behind claims made by website authors” (Jenkins et al., 2006, p. 45). In creating their own websites, new media tools, and platforms, students can become more intimately aware of the human motives and decisions that shape the various media channels and the information they present.

The New Medial Literacies project at MIT has developed a set of activities which help students question representation of “truth” and “fiction” in the contemporary mediascape. Such activities include an image manipulation task where students find a historic image, and alter it to change its meaning. “By manipulating images, students become familiar with the ways images may be altered to persuade and influence” (Jenkins et al., 2006, p. 46). While a fairly rudimentary activity, this could serve as the basis for a more complex exploration of how digital media shape truth and reality.

**Alienation of Teachers by New Media – Strategies for Engagement**

Of her role as Adjunct Curator of New Media Arts at the Whitney Museum of American Art, Christiane Paul (2012) said that “Myself and my colleagues at the Whitney are speaking different languages. It’s very challenging.” She (2011) noted that there persists a “continuing disconnect between new media art and the mainstream art world” (p. 105) on an institutional and audience level, rooted in the unique aesthetic challenges posed by new media art discussed above.

Art educators, typically educated in the traditional arts and operating from the context of this “mainstream art world” understandably are often alienated or intimidated

by new media art practice. Li-Fen Lilly Lu (2005) identified five common biases held by pre-service art educators. By highlighting and addressing these points of dissonance, perhaps art educators can be made more comfortable engaging with new media.

The first bias Lu described perceives digital art as being created and controlled by machines, not humans. This bias reflects a feeling that the computer exerts a degree of control over the creative process that inhibits the artist's free expression. The irony being that, with respect to the above discussion of opacity and pre-formatted thinking, that a reluctance to engage meaningfully with digital media tools leaves one *more* susceptible to such control. Lu also described a bias that categorizes digital artwork as "fake" and "artificial" (p. 94), that asserts that digital artwork primarily consists of degraded simulacra of other media. As discussed above, an emphasis on those aesthetic properties that are particular to new media can help educators and students to produce work that stands apart from work done in other media and which addresses its own aesthetic concerns. The third bias Lu described was that it is difficult to perceive expressiveness in digital artwork, and the fourth was that artists do not invest time in creating digital artwork. As with the first bias, digital media's ambiguity with respect to authorship, particularly in the case of procedurally-generated, programmatic, or machine-produced art, can make it hard to recognize the artist's hand in the work. By cultivating the same literacies, discussed above, that reduce the opacity of various commercial software systems, a similar transparency can be cultivated with respect to new media artwork that makes clear the role of the artist in the conception and execution of the piece. The fifth bias Lu identified was that artists create digital artwork to "show off" the capabilities of technology. Lu suggested this was the result of zealous instructors showing students

"how far artists can go" when working with computers (p.96). The treatment of digitally-created imagery in commercial and pop-cultural spheres like film and video games, where novelty, power of hardware, and verisimilitude of simulation are emphasized, likely influence this perception. Practice creating new media artwork can introduce artists and educators to different aesthetic ideals and definitions of success for digital artwork, and possibly even develop an appreciation for the craftsmanship that goes into those commercial digital images that *are* "showing off," to a degree.

Many of these biases are self-perpetuating, as an art instructor who brings these assumptions with them into the studio will allow those assumptions to shape their new media lessons, and induce those same biases in students. Rather than staking a position against "artificial," "inexpressive," "machine-made" digital art, asserting these biases actually makes one *complicit* in the continued production of art that exhibits those qualities.

Concern over an inherent generational disparity of skill and understanding with respect to digital media also affects teachers' attitudes toward technology. Rhetoric of "digital immigrants" and "digital natives" has created a false conception that educators simply have nothing to teach young people about new media (Ng, 2012). Educators, however, can "engage them in critical dialogues that help them to articulate more fully their intuitive understandings of these experiences. To say that children are not victims of media is not to say that they, any more than anyone else, have fully mastered what are, after all, complex and still emerging social practices" (Jenkins et al., 2006, p. 12). Particularly, if teachers are not operating under the model of digital media as a *tool* but a *medium*, students' prior familiarity with digital tools is of little consequence. A college

student who has been painting since preschool can still be taught to wring new images and types of beauty from paint, despite years of technical familiarity with the medium. Likewise a “digital native” can be taught to explore new avenues of expression with familiar digital media.

The incorporation of new subject matter into a school day or curriculum seemingly already “bursting at its seams” (Jenkins et al., 2006, p. 57) also presents a challenge to teachers of all subjects. Jenkins et al. noted that “[f]or that reason, we do not want to see media literacy treated as an add-on subject. Rather, we should view its introduction as a paradigm shift, one that, like multiculturalism or globalization, reshapes how we teach every existing subject” (Jenkins, 2006, p. 57). A fundamental change in thinking is in order. And while such a shift in thinking and practice in the classroom can be daunting, it can also be exhilarating. As John Maeda said, “Teaching can also be very tedious. To regurgitate the same ideas at the same hour on the same day of the week during the same period of the year for the rest of your life is a form of intellectual torture” (Maeda, 2004, p. 177).

In describing his early new media teaching at MIT, Maeda celebrated the role his uncertainty played in his development as a teacher: “My first class at MIT revealed my own ignorance about teaching., and I treasure that memory. I strive to achieve ignorance in my everyday life. Ignorance, of course, means that any discovery, whether large or small, will go unignored” (Maeda, 2004, p. 214). Engaging with new media artforms may entail immersion in ignorance, but if art educators can embrace that ignorance there’s a good chance they will make numerous discoveries about their teaching, their artmaking, and their students’ relationship to contemporary culture.

**Teacher and Student-Friendly Media for Creative Digital Expression**

A wide variety of hardware and software tools, programming languages, and development environments for artists and students have been developed and many are freely available. Such tools include Processing, openFrameworks, Pure Data, VVVV, Scratch, Hackety Hack, and ActionScript, each of which was the subject of a presentation at the 2009 Art && Code Symposium, a conference series concerned with "programming environments for artists, young people, and the rest of us" (Levin, 2009). Any or all of these tools could be used in concert in the new media arts classroom, as "[r]ather than dealing with each technology in isolation, we would do better to take an ecological approach, thinking about the interrelationship among all of these different communication technologies, the cultural communities that grow up around them, and the activities they support" (Jenkins et al., 2006, p . 8). Some of these tools have seen more wide adoption than others, and a few have fairly extensive coverage and case studies in the literature.

*Scratch* is a media-rich programming environment designed to facilitate the learning of elementary programming skills in young designers (Peppler, 2010). While the platform does involve coding – reflecting John Maeda's (2004) assertion that coding is one of the fundamentals of media art – students in Peppler's (2010) computer clubhouse didn't identify their process as programming, instead framing their expression in terms of prior art experiences, experiences at home and at school. This may make Scratch an ideal tool for students or instructors who want to engage in the procedural aesthetics of new media but are intimidated by programming. The visual nature of Scratch's development

environment also lends itself to other key aesthetic components of new media, such as multimodality (Peppler).

Peppler (2010) described a notable Scratch project from the computer clubhouse:

> An example of work that can be found in this space is a piece of media art created by an 8-year-old special education student…This piece is particularly interesting because the designer is unable to read or write beyond an emergent level but has tied together several different modes of communication (images, sound, and animation) to create a personally meaningful and powerfully communicative project using a visual programming language (Peppler, 2010, p. 2120).

A slightly more traditional programming tool, *Processing* is a programming language and environment developed by Casey Reas and Ben Fry (2006) for the media arts communities. "It is created to teach fundamentals of computer programming within the media arts context and to serve as a software sketchbook. It is used by students, artists, designers, architects, and researchers for learning, prototyping, and production" (Reas & Fry, 2006, p. 526). Processing's design as a "software sketchbook" facilitates fast, iterative experimentation and exploration with simple visual and code ideas.

"Processing does not present a radical departure from the current culture of programming, but re-positions it in a way that is accessible to people who are interested in programming, but may be intimidated or not interested in the type of programming that takes place in computer science departments" (Reas & Fry, 2006, p. 530). Processing is used by students, as well as by exhibiting new media artists, and is an example of a free, entry-level tool that is also used at a professional level.

*openFrameworks* was developed by Theo Watson and Zach Lieberman of the Parsons School of Design to facilitate the teaching of visual programming concepts to artists and designers in Lieberman's classes (Noble, 2009). It is a programming framework that is similar to Processing in many respects, but has as its basis the language C++ rather than Java, which affords it several strengths and weaknesses that Processing does not possess (Noble). openFrameworks, for instance, is better equipped than Processing to produce three-dimensional graphics, however it is less readily able to display projects over the Internet (Noble). Processing projects are easier to run on a variety of platforms and computers, but openFrameworks projects can make use of powerful C++ graphics libraries such as Intel's OpenCV, affording additional functionality (Noble).

*Pure Data* is a visual programming environment created for use by sound and visual artists, and based upon the physical "patching" of sound synthesizers (Steiner, 2009). Just as electronic musicians connected, or "patched" discrete pieces of hardware to create and modulate tones, Pure Data users connect rectangular boxes containing numbers, variables, and simple blocks of code by drawing lines between them and constructing simple virtual machines that resemble flow charts visually. While it lends itself most readily to sound synthesis, Pure Data has also been used to make visual interactive projects, provide the code behind interactive robotic sculptures, and to procedurally generate soundtracks based on the movements in a physical performance (Steiner, 2009).

*VVVV*, like Pure Data, is a visual programming environment designed for artists that uses a "patching" interface to construct programs (Oschatz, 2009). VVVV is more

explicitly designed for video performance and installation work, and can be readily used for live processing and synthesis of audio and video (Oschatz). However, it can be used for more simple creation of procedural images, and the environment for developing programs allows the user to see the results of their program and any changes made to it in real-time (Oschatz).

**Conclusion**

For the most part, students, despite their high level of engagement with contemporary digital culture (Jenkins et al., 2006) are only partial participants in that culture, "hav[ing] access to the capabilities given to them by others, but not the power to determine the value-creating capabilities of these technologies for themselves (Rushkoff, 2010, p. 14). A thoughtful education of new media artmaking in schools, one that isn't hidebound by aesthetic or cultural biases imported from other traditions, one that thoughtfully examines the potential of new media artforms and allows students to fully explore that potential, and one that allows students to engage critically with a culture shaped by programmers and in turn shape culture with their own programs, could help provide students with the cultural agency they need to have a voice in contemporary visual culture.

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