

ended, daring, and risky (Barnett, 2007). So how do we teach, learn, and assess results in these new digital worlds?

Digital Culture

Players participate and immerse themselves in the new digital worlds through building digital culture. *Digital* implies electronic technology and its major components. Jenkins (2004) includes behaviors such as “play performance, simulation, appropriation, multitasking, distribution, cognition, judgment, transmedia navigation, networking, and negotiation” (pp. 3-4). Intellectual practices range from collaborative problem-solving to computational literacy, and even informal scientific reasoning (Steinkuehler, 2009) that involves several diverse types of digital media. These range from serious video games (Parks, 2008) and digital animation (Davenport & Gunn, 2009) to virtual worlds (Stokrocki & Andrews, 2011), to name a few. These media enable students to form various virtual communities that are linked with Web 2.0 tools. Digital media are emerging into new complex pedagogical learning sites that are products of informal visual culture influences that support equal, collaborative efforts from group members (Wilson, 2008). Contemporary culture can be viewed as “the collective heritage of a group, that is, as a catalog of ideas and practices that shape both the collective and individual lives and thoughts of all members,” as well as something that “only exists in the act of being performed, and it can never stand still or repeat itself without changing its meaning” (Bauman, 2004, Note 1, p. 21). Such digital culture immersion requires use of new literacy forms.

Media Literacies

Traditionally, art education literacy usually involved reading and writing to obtain knowledge, even including vocabulary involving video game terminology. New forms of graphic literacy now are emerging that are referred to as digital or media literacy (Snyder & Bulfin, 2007). Media literacy can be integrated with text-based forms to participate in a new global society that is currently emerging (Delacruz, 2009). Duncum (2004) argues for multiliteracies, “the making of meaning through the interaction of different communicative modes,” including music, gesture and motion, sounds, and pictures (p. 253). Virtual worlds, including video games, require operational, cultural, and technological literacies (Guzzetti, Elliott, & Welsch, 2010). For example, operational literacies include translating tutorials, procedures, and

applications using Photoshop; cultural literacies involve understanding meanings within a given context, such as a video game in leisure activities; technological literacies contain visual and print texts, rules, and play maneuvers as found in digital storytelling. Such practical understanding entails soliciting peer cooperation and collaboration to try out new games, critiquing them, offering suggestions, giving advice about character and thematic building, and soliciting contributions from peer audiences.

“So HOW do we teach, learn, and assess results in these new digital worlds?”

Using SL as an example, art educator Lu (2010) offered practical learning principles for designing digital events for students in virtual worlds. Those principles include learning by exploring, developing a sense of self through avatar identity, collaborating with others, collecting or uploading individual artworks, creating personal rooms and sculptures, and expressing and recording adventures through snapshots and writing reflections. Other art educators also have presented virtual-world learning experiences for students; Liao (2008) focused on avatar identity, and Carpenter (2009) designed a classroom where students could be observed continuously without the teacher interfering in their individual learning modes.

Digital world users communicate through chat and instant message functions, discover new sites, design new spaces, share services, and exchange goods (Wilbur, 2008). They also learn to communicate in a form of hybrid sentence structure that contains abbreviations, facial expressions pictorially represented by punctuation and letters, shortened words, and specific vocabulary with spelling errors (Black & Steinkuehler, 2006). Similar to video games, virtual worlds do not substitute for literacy activities, but rather produce new ones collaboratively (Gee, 2007).

New Communication Arenas and Visual Literacy

With literacy forms and functions rapidly changing in today’s postmodern world, multimedia fluidity in different communication arenas have expanded into multi-literacies that include video, pictures, music and dance, computer languages, Internet casual speech, and games, as well as in print (Thomas, 2007). Most of the May 2009 issue of *Educational Researcher* involved discussions over how to expand on these new literacies that “include new skills,

strategies, dispositions, and social practices that are required by new technologies for information and communication” (Burns, 2006). Such new literacies are multifaceted, multi-dimensional, and include multiple points of view.

Students also must be visually literate to navigate the real world, which includes decoding, understanding, and analyzing the meanings and values communicated by images. “Just as readers of text draw inferences and construct meaning from written representations of language, viewers of images also draw meaning” (Burns, 2006, p. 2). Art teaching and learning contexts are the primary place in today’s schools where art students discuss the elements and grammar of images, composition and camera perspectives, symbols, props, clothing, color, light, text, and similar concepts. They learn to read digital instructions as well, and create their own Web pages and digital journals (Thomas, 2007), all of which require diverse forms of learning. Higher education art educators are in the process of inspiring schools to adopt some of these ever-expanding educational forms in a variety of ways for students to explore and experiment by promoting imagination and immersion in cultures otherwise inaccessible, and to integrate their art learning with other technologies and disciplines (Salman, 2009).

New Forms of Visual Art Learning

Learning involves processing new knowledge, behaviors, skills, values, or preferences in different ways. The formation of learning based on the written word is changing, as images dominate text and as screens overtake paper as the most frequent means of distributing information (Kress, 2003). Since digital worlds can be game-like, Gee (2007) presents three kinds of current modes of learning in which art education plays a major role: situated cognition (that is, contextual learning including material, social, and cultural forms); new literacy study that involves economic, historical, and political

concerns; and connectivism that stresses human powers of pattern recognition. This call for networks of people, tools, and technologies, as well as school programs to build better modes of learning through media literacy, matches well with future goals set for contemporary art education theory and practice.

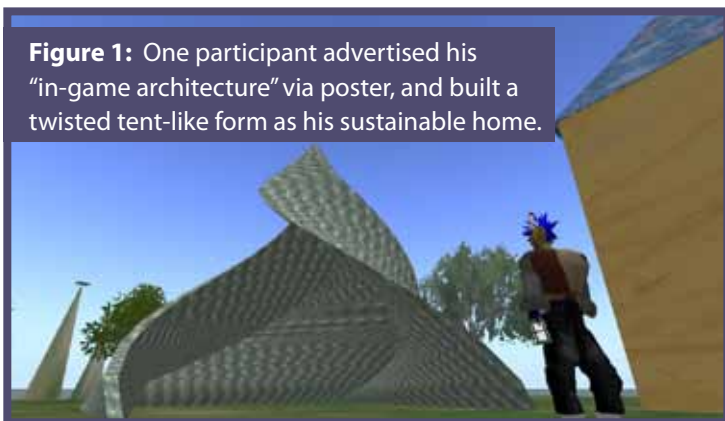
A number of questions arise about art education’s role in this new digital culture environment.

How do art teachers and school systems find a workable balance between digital learning and real-life fact/process learning? Digital learning can supplement real-life teaching since it offers unique art instruction skills for diverse audiences. These new technologies enable average people to archive, add comments to, and alter content. Innovative and pervasive networking forms, personified by weblogs, have blossomed from the bottom up, and participation requires that art teachers and art students mutually learn together (Kellner & Share, 2005). There now is a remix of old and new media constructed to respond to demands of novel ways of communication through combination of recycled pieces of information and materials.

For example, when art educators Stokrocki and Andrews (2011) mentored disenfranchised youth to use SL to develop their future art careers, the educators provided steps to achieve discrete goals: learn basic communication skills, acquire computer and digital literacy competence, develop life skills, imagine a place for dreams, envision a home, and build a business. One participant advertised his “in-game architecture” via poster, and built a twisted tent-like form as his sustainable home. (See Figure 1.)

How can art education help teachers with instructional assessment? U.S. education is dominated by standardized curricula, instructional systems, and assessment procedures. Due to the complex and rapidly evolving technologies, standardized assessments have overlooked the richness and unpredictable nature of inquiry that includes experiential and uniform reactions alike (Dewey, 1938). Learning evidence need not be only standardized, it can be holistic, multi-methodological, and qualitative, full of experiential evidence. That experience encompasses the visual, audio, verbal, and now kinesthetic, as virtual worlds enable art teachers to view their students’ three-dimensional accounts of learning.

Figure 1: One participant advertised his “in-game architecture” via poster, and built a twisted tent-like form as his sustainable home.



“Students also must be **VISUALLY LITERATE** to navigate the real world, which includes decoding, understanding, and analyzing the meanings and values communicated by images.”

Many art educators are examining these newer literacy communication modes of engagement that can include accounts of individual technological experiences or personal learning environments in art (Castro, Danker, Delacruz, Fuglestad, Roland, & Stokrocki, in press). Art education is situated to be in the forefront of building practical arguments and new assessments for success and interdisciplinary connections (Salman, 2009). In her case study of three art teachers using technology in midwestern high schools, Lin (2009) noted that when making podcasts with Latino youth, the teachers learned with the students about art content and mastering digital media technology.

How does art education help students become more critical of digital culture? Art educators see the role of digital media not only as an expressive exchange, but also as embodying socio-cultural change (Garber, 2004; Keifer-Boyd, 2004; Stokrocki, 2007). Gude (2007) argued for “reconstructing social spaces by transforming [them] with images and texts and a space that stimulated wonder in the process of learning” (p. 13). Young people, however, as “digital natives may be skilled with social networking ...[but] they are not generally skilled with online information use, including locating and critically evaluating information” (Leu, O’Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009, p. 266). Critical digital literacy, advocated by Buckingham (2006), is a means for eliminating marginalized peoples, misinformation, commercial predators, and cyber-bullying. Sweeny (2004) critically examined the nature of privileged forms of visual culture, and explained that art educators who teach about these new social creations and critical forms should critique those aspects “that are exclusionary, biased, and retrograde” (p. 210) in order to build democratic art education theory and practice.

Whatever the future brings, digital worlds will be vibrant sites for investigating these new participatory multi-literacies in art education. Art educators Lily Lu (2008), creator of The Art Café, and Sandrine Han, founder of the International Art Education Association (InAEA) on SL, have designed their own meeting places to network with other art educators. These networks

transcend individual expression to incorporate collaborative design, exhibition spaces for uploaded artworks, three-dimensional constructions built by avatars, and virtual field trips to different sites for building career awareness in the arts. In the future, the potential range of digital worlds for art teaching is endless, as art educators enable their students to learn, plan, construct digitally, and transform their plans into real-world possibilities.

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Living in Actual and Digital Visual Worlds: One Big Goal for Art Education

Brent Wilson

“How aware are we of our VISUAL WORLDS?”

When we establish goals, we envision ideal futures. When The Consortium of National Arts Education Associations (1994) published the national standards for visual arts education, my first reaction was, “These standards are like the trees, but where is the forest?” There were literally dozens of objectives, many of them desirable; but missing was a larger vision that would bind the standards into a coherent whole. I set about writing my one big goal for visual arts education (Wilson, 1996). That goal, stated in four parts, placed visual artworks at its center. I posited that K-12 students should learn to (1) mindfully *create* their own artworks; (2) insightfully *interpret* artworks of others; (3) *draw meaningful relationships* among the artworks they have created and interpreted and many other cultural texts in the arts, humanities, and sciences; and (4) *write* all of these texts within the texts of their lives—during, and especially beyond, schooling. Implicit within this goal is the notion that artworks are the source of both knowledge and satisfaction. In other words, artworks expand our cognitive orientation, our worlds, our futures, and the values that guide our lives (Kreitler & Kreitler, 1972).

I still believe that my formulation is a good one. Nevertheless, the world has changed remarkably since I wrote my big goal; art education has turned its attention to visual culture (of which artworks are still a primary component), and the image-pervaded Internet has mushroomed. I now see a different forest. My revised goal for art education places at its center *teaching students to live in art and visual cultural worlds*—teaching them how to find fulfillment, joy, happiness, satisfaction, and aesthetic and intellectual rewards through living their lives in these worlds.

Why Should Living in Art and Visual Worlds Be the Primary Goal for Art Education?

We live in an enormous global visual culture; we exist in worlds filled with visual images. But how aware are we of our visual worlds? How well do we live in these worlds? How well do we use them to enrich our lives? Do we use these image-worlds to create knowledge? Do we use them as ways to know our values, our futures, and ourselves? Do they enrich our lives through joy and pleasure? If not, then what might art education do about it?

Artworks and other visual cultural artifacts always exist in larger social and cultural contexts. Most school programs could provide an opportunity for these complex visual cultural entities to be both studied and lived in. Students could be taught how to participate wisely and knowingly in a variety of art and visual cultural worlds. Indeed, our students already live in some of these worlds, but it is the task of art educators to broaden both students’ participation and their awareness of that participation. What are these art and visual cultural worlds like? What are their components, and how do they function? And most importantly, how does one learn to live fully and well within one or more of these worlds?

Sociologist Howard Becker’s now classic *Art Worlds* (1982) acknowledges that the term “art world” is often used metaphorically to refer to an elite entity, for example, the “New York art world.” Nevertheless, he takes a considerably more egalitarian view, arguing that there are many art worlds. In discussing these art worlds, Becker analyzes relationships among players such as artists, art historians, curators, aestheticians, gallery workers, art supply and equipment manufacturers, and dealers—the participants who are every bit as much responsible for “making” artworks as are artists. But he might have given more attention to other art world participants, such as collectors, patrons, and the great number of different designers of art exhibitions, books, catalogues, and advertisements. And, of course, new art world roles continually emerge; in the 1980s, Becker could not have known of the proliferation of Web designers and Web-based digital artists today.

Just how many art worlds are there? Becker concludes that the question is unanswerable; it depends upon how those who study artworks slice and dice them. He argues that art worlds are fluid and dynamic, changing sometimes

gradually and at other times dramatically. “Art worlds, then, are born, grow, change, and die... Artistic work lasts when it has an organizational basis that preserves and protects it” (p. 350). It is this complex set of components—participants and the roles they play, their functions, and the institutions in which they work—to which I will return shortly.

Like Becker, philosopher Nelson Goodman posits a multiplicity of worlds in addition to the common everyday world in which naive realists think we live. Goodman begins his book *Worldmaking* (1978) with this phrase: “Countless worlds made from nothing by use of symbols” (p. 1). This is what Goodman has to say about the composition of worlds:

The many stuffs—matter, energy, waves, phenomena—that worlds are made of are made along with the worlds. But made from what? Not from nothing, after all, but *from other worlds*. Worldmaking as we know it always starts from worlds already at hand; the making is a remaking. (p. 6)

Goodman’s and Becker’s views of the multiplicity of worlds make it easy to include digital worlds within the growing realm of art and visual cultural worlds. Indeed, so far as art education is concerned, digital image worlds, especially those found on the World Wide Web, point to the future! Arguably they provide the best means for teaching students how to live in all other art and visual cultural worlds.

Polyvore: A Brief Case Study of a Digital Art World

Polyvore is a Web 2.0 site (O’Reilly, 2005) for creating and publishing fashion-related collages and digital artworks (Feldstein & Wilson, 2010; White, 2009). Polyvore users have literally created a digital art world that has all the components and functions found in the contemporary art world (Thornton, 2008). Here is an overview of Polyvore seen through the activities of a 15-year-old Swedish girl, whose user name is HellNoKitty. In late summer, 2010, she published a digital collage titled “Devil Released” (see Figure 1).

The work is composed of 24 separate images and fragments of text clipped from the Internet and reworked in the Polyvore editor. (The editor is similar to a Photoshop program that even a 2-year-old could manage.) To make her collage, she resized, rotated, positioned, cloned, flipped, flopped, and layered images and words—it is as if she has painted with them. Along with the collage, she published an eight-line original poem and a series of prose pieces about

things that make her happy and unhappy, references to YouTube videos and recently published works of adolescent literature, Swedish secondary school program options, popular culture preferences, and friends. It sounds like a mish-mash, but her writing (in English) is as sophisticated as her collage; together, they provide an interpretation of her visual image. Seventy-four Polyvorians have viewed her collage, and 47 indicated that they “liked it.” Among the viewers who favored HellNoKitty’s collages were her peers and manga fans, a PhD candidate in biophysics, teachers of various subjects, a painter with an MFA, a makeup artist, a gallery worker, a translator, and several designers—from at least 20 different countries.

HellNoKitty’s profile page informs us that her collages have been viewed more than 23,000 times and favored (liked) 8,000 times. She has 506 contacts that follow her work; her collages have won prizes in 38 user-organized contests; she has created eight collections (with names such as “blood, war, and cookie dough” and “in chaos we find safety”); and she publishes her collages in more than 30 different groups. She makes insightful comments about others’ collages, and sometimes models her works on their collages. Other Polyvorians use her works as models for their own—she is a



Figure 1: Electronic collage titled “Devil Released” published by HellNoKitty on Polyvore in late summer, 2010 (retrieved from www.polyvore.com/devil_released/set?id=21525559).

teacher. HellNoKitty is an active and skillful participant in a complex digital art world.

Everyone CONTRIBUTES to the community, and everyone GAINS from the community.

Polyvore's Pedagogical Significance

HellNoKitty's Polyvore art world has all the components and functions of a complete art world. Participants perform multiple roles: they are creators, collectors, appreciators, interpreters, critics, art writers, documenters, connoisseurs, curators, designers, teachers, colleagues, collaborators—the list could go on. And even more importantly, Polyvore is an egalitarian art and visual cultural realm. Artists, designers, architects, and professors interact on equal footing with elementary and secondary school students, college students, PhD candidates, stay-at-home-moms, biologists, physicists, and opera singers—you name it, they are there. They bring with them their interests, knowledge, texts, and expertise. As a consequence, collages are juxtaposed with poems and short stories written by participants; users' creations are presented with selections from the worlds of music, literature, history, and philosophy; and users are continually informing one another about artists whose works they have discovered. Other participants write and illustrate the lives of the famous and the infamous. Popular and arcane images and bits of information flourish side by side. In short, visual texts are permitted to interact with virtually every other text imaginable. Everyone contributes to the community, and everyone gains from the community.

The situation I have just described fulfills my one big goal for art and visual cultural education—on Polyvore, within an art world context, participants are creating and interpreting visual texts and linking them to other texts. In doing so, they create new knowledge, connect it to their unfolding lives, and share it with others.

In my ideal art and visual culture classroom, students will learn to live in art and visual cultural worlds; they learn to perform multiple roles within these worlds. Complete and fully functioning art worlds such as Polyvore provide a marvelously efficient and comprehensive means for revealing the components, structure, content, functions,

roles, and rewards associated with all art worlds. I think that students in art classes should spend at least part of their time as explorers, creators, and participants in digital worlds such as Polyvore. And they should learn how these digital worlds relate to various other actual arts worlds in which they might live their lives while in school and beyond school. If I were in an art classroom today, I would add my students to my list of contacts—and await with eager anticipation their creations and interpretations. In this pedagogical third-site (Wilson, 2008), I would enter into my students' ongoing lives in art and visual culture—to the extent that they wish me to—while they are my students and more importantly, *beyond my classroom*. I want to know what my students are doing in art worlds, both now and for the remainder of their lives. The Internet makes it possible for me to remain my students' teacher—and for them to be my teachers for the rest of my life as well. What a marvelous future to contemplate!

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Envisioning a Future Techno-Infused Eco-Pedagogy

Karen Keifer-Boyd

“Artwork that embodies individual experience in relation to **SOCIETY** can **TEACH** viewers to discern injustice...”

The first decade of the 21st century has ushered in an era of global interaction with much disparity in access to water, food, shelter, healthcare, education, and communication characterized by war, poverty, illness, and global warming. Diverse social circumstances, access to education, and consequences of individual and social actions impact lives around the world. I speculate that high-quality arts education can prepare students—those entering pre-kindergarten today and graduating in 2025—for a future in which they promote a world that is democratic and sustainable.

The Self in Relation to the World

The arts are crucial to the “health of any democracy internally, and to the creation of a decent world culture capable of constructively addressing the world’s most pressing problems” (Nussbaum, 2010, p. 7). Artwork that embodies individual experience in relation to society can teach viewers to discern injustice, which is necessary for divergent thinking that re-visions and re-constructs a just world. Such a culturally responsive art practice **listens** to disenfranchised voices and complicated histories; **bears** witness to power structures that control people, cultural narratives, and worldviews of a society; **stops** traffic of harmful activities and products; and **envisions** global ecological well-being. These relational practices of contemporary artists are sources for exemplary aims, content, pedagogy, and outcomes in conceptualizing art education classrooms as experiential investigations of interrelationships of self and the world through sensory and increased interaction with the environment.

Culturally relevant arts education that prepares students for the future uses sensory experiences as touchstones for developing self-knowledge. In culturally responsive teaching,

cultural knowledge and experiences of diverse students are validated in learning environments where their differences are valued (Gay, 2000). Instead of a bell-curve view of learners, a multifaceted crystal is a more appropriate analogy for varied strengths and richness that teachers can mine from individual differences.

By composing images from our experiences, we frame or emphasize our sensations, memories, dreams, fears, and desires. Transformative artmaking occurs when we are aware of our frame of how we know the world, and begin to open our own borders through a process impacting and impacted by interconnected eco-political-social systems (Ellsworth, 2005; Grosz, 2008; Massumi, 2002). In this relational process, the body is a point of departure that is extended through art creation, making paramount the interdependency of a person and his or her relationship to the environment. Such embodied and relational art transforms what seems normal in our daily lives. Transformative learning involves exposing a discrepancy between actual experience and what a person has assumed to be true (Cranton, 2002). Art educators capitalize on these transformational qualities of art in their teaching so that students learn about the power of art in their lives and the lives of others.

In culturally response-able and sense-able art education, art teachers guide a reflective process in art practice in which a student’s life is related to larger socio-political systems, which “involves coming to understand oneself in relation to others” (Darling-Hammond, French, & Garcia-Lopez, 2002, p. 201). High-quality art education provides situations, processes, and environments to conceptualize one’s self in relation to the world, and to connect artmaking to issues that matter.

Empowerment emerges from a sense of self-worth, and opportunities to be heard and to choose (Buskins & Webb, 2009). Collaborative art creation is a reflective process that can be empowering and transformative. An example is a transcultural dialogue project that I facilitated while living in Uganda in 2010, connecting art students at Makerere University in Kampala, Uganda, with art education students at Penn State University in the United States. I designed a system for participation and collaborative artmaking that utilized social networking tools. The Ugandan participants selected websites that represented the visual culture of the United States, while the United States participants selected

websites that represented the visual culture of Uganda. The project participants looked at what was bookmarked to represent their country, read the rationales for the selected representations, and responded whether, how, and to what extent the representations related to their own lives. The participants, in negotiation with each other, created visual art that synthesized the topics and perspectives that arose in their text-based dialogue. An excerpt from the dialogue provides an example of how the dialogue itself functioned to make assumptions transparent and to question beliefs.

Ugandan participant: I always had two impressions of the USA. My first impression of the USA was a place dogged with violence, shootings, and intolerance towards minorities... the other side was an ideal place to live, where by everyone seemed well off... **Paradox** indeed. I have always tore myself between what impression to go by and which one to discard.

United States participant: I too find myself making certain assumptions of places I have never been. For some reason I always seem [to] put the United States above everyone else but I know this is wrong of me to do because I do not have the experiences to do so... I hope that some day I will be able to rid my views of other countries and get the chance to travel and experience a different culture.

Such relational artwork creates new insights, invites participation, and can evoke transformative learning when individuals discuss their perspectives with each other and create art together about their diverse perspectives.

Interdisciplinary Inquiry

Pedagogy concerns *the content and methods* of teaching and learning, and, more broadly, the nature of knowledge and learning. How can art education pedagogy prepare students for the future in which knowledge, like art, is inseparable from their values, beliefs, and sensitivities of how they know the world and themselves? I envision a future techno-infused eco-pedagogy in which knowledge, disciplines, and courses are not organized by discrete timeframes, and students are not grouped by age but rather by investigation of topics. Moreover, alphanumeric grades become obsolete; instead, evaluation based on criteria set by the student in dialogue with others in areas of student interest is presented to global teams of mentors via electronic multimedia portfolios that reflect student learning and thinking.

“Interdisciplinary inquiry is NECESSARY to solve COMPLEX problems.”

Current educational policies involving standardization, conformity, control, and narrow views of idea construction and communication in art, language, science, and math systems are unharmonious with a future in which life is electronically interconnected. Educational preparation for interdisciplinary partnerships and collaborations is needed as a result of the increasing interdependence of resources and work environments (Zhang & Kramarae, 2008). There are exemplar artworks that do this, and serve as models for an art education in sync with future needs. For example, Cary Peppermint and Leila Christine Nadir’s 2009 artwork, *Eclipse*, is a participatory-driven Internet program that alters and corrupts photos of United States parks posted on Flickr,[®] a popular photo-sharing website. The artwork is programmed to obtain real-time pollution data from the nearest city to the park via an application developed by the U.S. government (airnow.gov). An image is then produced that is a corruption of the original photograph “through a set of programmed algorithms that affect color, saturation, and contrast and that impose intermittent mirroring, deletion, or cropping of the file’s data” indicating the level of pollution (Peppermint & Nadir, 2009, 2).

Interdisciplinary inquiry is necessary to solve complex problems. Contemporary art is a prime example of how artists currently draw upon diverse knowledge systems in novel and critical ways. By using the processes and practices of contemporary artists, visual art education introduces and provides practice in interdisciplinary thinking and inquiry. Artist and educator Suzi Gablik (2002) wrote about many contemporary artists whose art brings people into embodied relationships with their social and physical environments. In *The Reenchantment of Art*, she draws our attention to the power of art as interdisciplinary inquiry that transforms and connects self and world, “art, which speaks to the power of connectedness and establishes bonds, art that calls us into relationship” (2002, p. 114). For example, an art education student who worked on a collaborative site-specific artwork with artist Lynne Hull, and with other students in his class, commented: “Working with Lynne I realized... how little I pay attention to my own environment and how much it has an effect on me” (J. McCollister, personal communication,

January 2000). The sculptural artwork of a windmill and hitching posts created as nesting sites for migratory birds in a dry playa lake in the high desert of West Texas involved artist Lynne Hull working with playa lake specialists, biologists, and others in creating art literally *for the birds* (Keifer-Boyd, 2001).

Augmented Reality and 3D Printing

Visual arts education also involves creation with media and how visual artists use materials related to their time and place. In the next 20 years, augmented reality and 3D printing will change our relationship to knowledge, artmaking, and purposes of art education. Augmented reality involves culturally infused technological interfaces that superimpose sensory enhancements (visuals, sounds, touch, and smells) in the physical environment in real time. Augmented reality is everywhere already. For example, many people use iPhone and iPod touch-screen Web browsers or handheld language translators during cross-cultural conversations. The next generation of augmented-reality systems will be directed individually by complex body gestures to perform actions that project information (Bonsor, 2001). Quality art education in the future will enable all people to contribute to critiques and creations that, in turn, broaden and diversify viewing augmented by computer-generated sensory input. Without intervention in a social system that creates poverty, however, the disparity will become greater between those who produce and have access to such sensory enhancements and those who do not.

Some people have built their own 3D printers from discarded technology parts and have produced outcomes that are examples of augmented reality. In sculpture and engineering studies at Penn State University, there are classes that include use of rapid prototyping with 3D printers. A drawing of an idea for an object is placed in a printer along with the raw materials for the substance of the object, and the printer produces a 3D object translating the drawing into layers to “print” the object. Researchers at Penn State’s Applied Research Lab are using robotically guided lasers for large-scale 3D printing. Medical scientists are experimenting with bio printing of cells and organs. Artists are translating their drawings into sculptural objects. The cost for 3D printers has come down drastically since 2003; in 20 years, I expect that many people will have 3D printers in their homes and they will buy raw materials to make their material possessions such as shoes, chairs, and lamps. Most will purchase designs

and customize them with minor changes. The current practice of built-in obsolescence in manufacturing products will change to repair and recycling, since physical storage of products and parts will not be needed. Global capitalist ventures will likely focus on supplying the 3D printing machines, designs, and raw materials. Quality art education will prepare people to work directly with raw materials—e.g., clay, silicon embedded with circuitry, and banana fibers—to understand potentials and consequences of materials from social, health, and environmental perspectives. Art educators will be prepared for these new ventures by teaching students how to study potentials and limits of materials and, in the process, making visible their lives in relationship to other lives situated in intersecting social, political, and environmental systems around the world.

Augmented reality and 3D printers are two examples of future trajectories that bridge cyberspace and the physical world. New media artist and educator Elizabeth Ellsworth (2005) finds pedagogical value in transitional spaces in which “augment[ation] through invention” can allow one to “engage in political practice” (p. 127) and connect with environments both at home and around the world. Students in U.S. kindergartens today will experience cyber and fiber material as integrated media for creating art; as they grow into adults, they will live in the transitional space of augmented reality. High-quality art education programs that prepare students for the future can facilitate transformative embodied learning that will lead the way in creating just and democratic methods of teaching and learning.

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