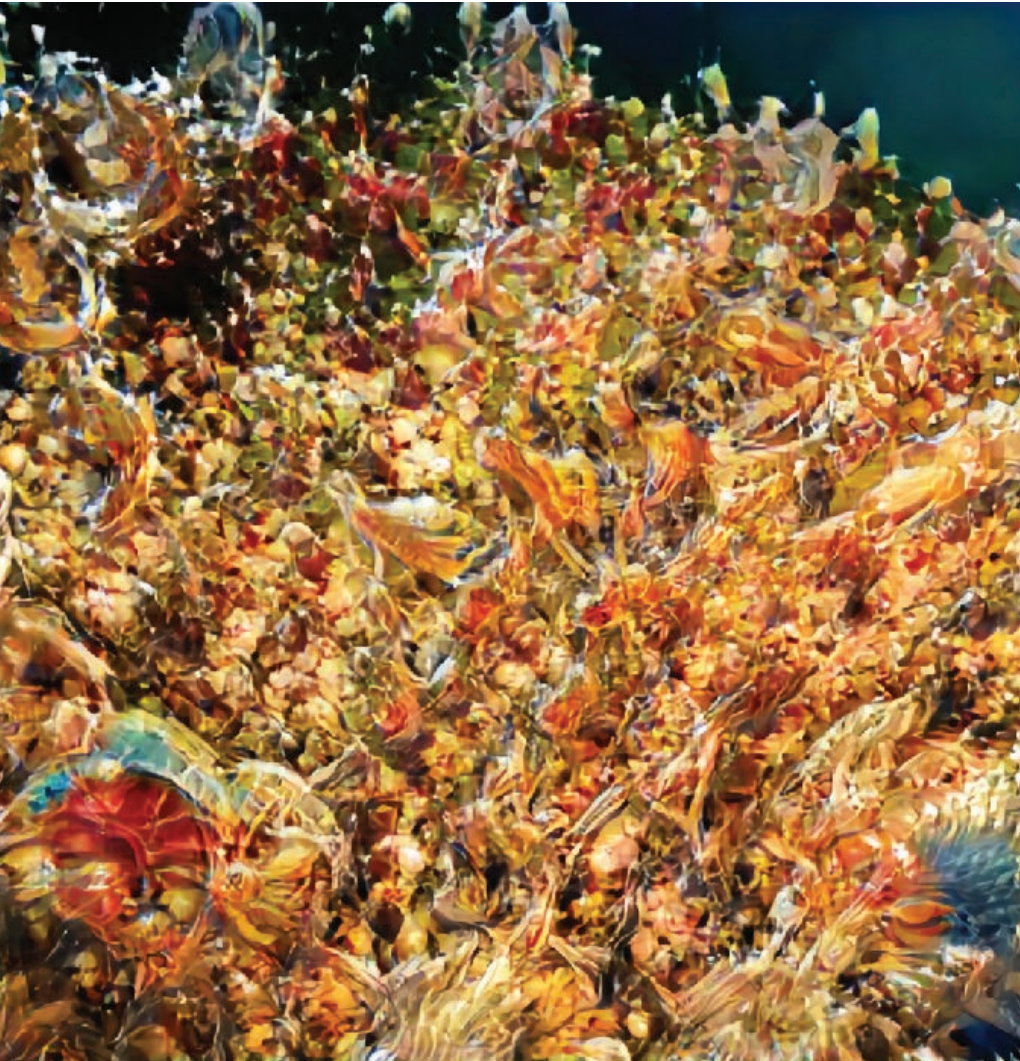


ART Entanglement Art Education: Factoring Artificial Intelligence and Nonhumans Into Future Art Curricula

Nicholas Leonard



Despite the massive advances in artificial intelligence (AI) alongside the saturation of digital technologies in society, the domain of art education has experienced little change to account for the fact that humans are not the only content creators. Recent movements in art education—including but not limited to visual culture, choice-based art, and social justice-oriented curricula—generally assume an anthropocentric perspective. This means that the content being experienced is assumed to have been created by other humans and does not provide a clear way to engage with nonhuman content. However, this stance is losing validity as our daily lives increasingly include computer-generated content (Figure 1), which is curated by algorithms.

Figure 1. Nicholas Leonard and ArtBreeder's generative adversarial networks, *Everything is Entanglement / Entanglement is Everything*, 2019.

Figure 2. Chelsea Cwiklik and Adobe Photoshop, Andrew Newell Erased, 2019.

Furthermore, many people do not know how to critically engage with the content produced by computers, creating an AI black box phenomenon, where the computer's functioning and decision-making process is unknown or unchecked (O'Neil, 2018). To begin addressing these issues, a difficult and serious audit of art education must take place to question how posthuman theories can, and should, help develop future art education curricula.

The intention of this article is to make discussion of posthuman concepts reasonable, approachable, and urgent for digital art educators. First, I offer a reflection on digital image editing programs and their developments over the decades to show how computers are breaking away from Heidegger's (1954/1977) concept of tools. Second, I share two narrative (Rosiek & Snyder, 2018) vignettes that ground the development of my posthuman digital art education philosophy. Third, I introduce the posthuman theory of agential realism by Karen Barad (2007) to highlight possible concepts that art educators can engage with to develop posthuman art education curricula. This overview of Barad's posthuman theory culminates in the concept of entanglement art education (EAE) as a discussion point for posthuman art education curricula and aesthetics to account for content created by humans, machines, and other nonhumans.

Digital Image Programs and Art Education

Digital image editing programs share an intertwined past with art education. In the 1980s, digital painting programs offered limited features, which attempted to replicate the physical act of painting. As the technology developed, common image editing programs such as the GNU Image Manipulation Program (GIMP) and Adobe Photoshop grew more complex and offered more features using interactive algorithms. Features such as GIMP's "Heal Selection" and Photoshop's "Content-Aware Fill" analyze the pixel data around a selected area of the image (such as a piece of garbage or the unwanted appearance of a friend jumping in the background) to seamlessly construct brand new content in the image that is indistinguishable to the human eye (Figure 2). While these are major developments in digital image programs, they indicate another phase of humanity's relation to technology rather than a culminating finish line.



Presently, designers of digital image editing programs are exploring new ways of interacting with the user to create artworks. The popular Google application called "Quick, Draw!" was an AI experiment that prompted human users to quickly draw a doodle of anything from a bus to a cat. Equipped with all of the collected user drawing data,¹ Google created AutoDraw. This online program predicts what the user is drawing and offers alternative, professionally drawn options.

Taking this concept even further, NVIDIA Research created GauGAN, a program that has the power to instantly create photorealistic images based on a user's colored doodle. This is made possible by something called a generative adversarial network (GAN), where one algorithm generates new content based on the qualities of a provided data set in an attempt to "fool" the other discriminator algorithm, which tries to identify the new image created in the data set. Programs such as AutoDraw and GauGAN are remarkable in their ability to work with human users in the quest for artistic production. These programs should have art educators questioning the adequacy of existing art curricula in terms of addressing these developments.

Furthermore, machine learning algorithms are already generating art separate from the human user. Researchers have created AICAN, a creative adversarial network (CAN) that works like an upgraded GAN. Here, AICAN can recognize art styles and deviate from one data set to another to produce new art. The computer-generated content by AICAN has already had multiple gallery showings, and other GAN artworks by the collective Obvious have been sold for nearly half a million dollars.

**WHAT IS CREATIVITY?
CAN A COMPUTER BE CREATIVE?
AND HOW CAN AESTHETICS BE UNDERSTOOD WHEN HUMANS
ARE NOT THE ONLY CREATORS?**

Perspectives of Photoshop in Publications

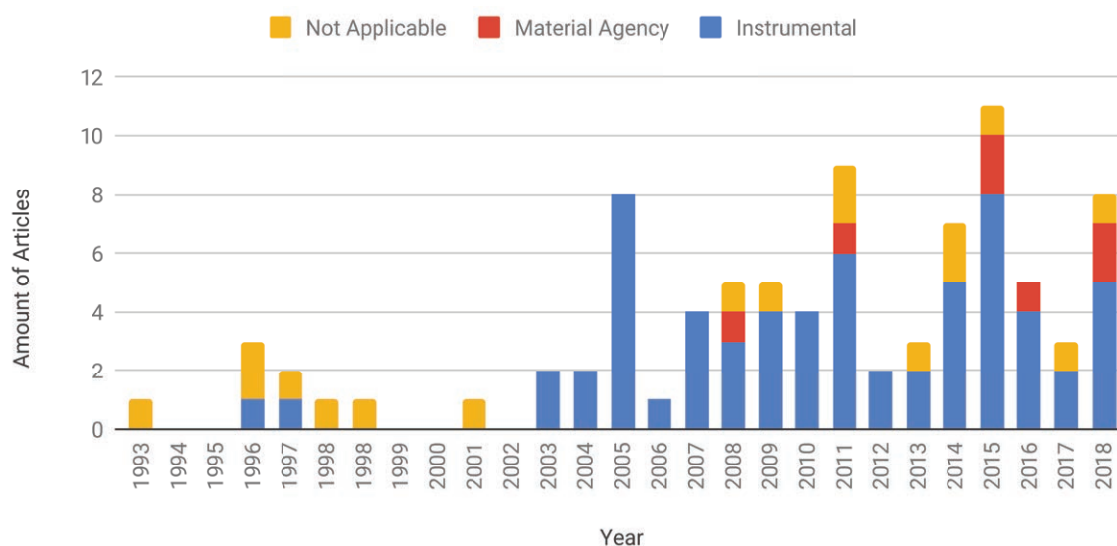


Figure 3. Frequency of perspectives by year of Adobe Photoshop in published articles from *Art Education, Studies in Art Education, The International Journal of Education Through Art, and Visual Arts Research* from 1993 to 2018.

These developments present questions about the visual arts that should be addressed by art educators, such as: What is creativity? Can a computer be creative? And how can aesthetics be understood when humans are not the only creators? If these questions seem ridiculous, then it is worth investigating what biases and values regarding the role of technology, creativity, and cognition are preventing these questions from being asked or taken seriously.

Digital “Tools”?

In the fall of 2018, I conducted a qualitative review of published articles since 1993 in *Art Education, Studies in Art Education, The International Journal of Education Through Art, and Visual Arts Research* to review the perspectives used to discuss Photoshop (Figure 3). The findings showed that only 8% ($n = 7$) of the articles reviewed included language in line with a posthuman perspective, where the program was given influential power or a position equal to that of human users. Textual cues rarely indicated a posthuman perspective of Photoshop where the program was equally significant and influential as humans in the creation process (Knochel, 2016). This means that a large majority of art education publications, either intentionally or unintentionally, apply the perspective of instrumental theory (Heidegger, 1954/1977). Here, digital tools are similar to a hammer. If a human is not actively using a hammer to hit a nail, the hammer remains still and without agency. This shows a humanist bias because the only transformative influence is coming from the human, and nothing else has transformative power until it is decided so by a human.

By viewing and treating digital technologies only as tools to be used by humans, art educators are ignoring new possibilities for future dynamics in artistic creation. This issue is concerning because research has already highlighted art educators as lacking creative approaches to technology usage (Gregory, 2009). Furthermore, art educators are calling for art classrooms to increase the use of digital

technologies for promoting creativity (Tillander, 2011) and designing curricula focused on creativity as well as emerging technologies (Rutland, 2009). To develop valid forms of art education curricula inclusive of nonhumans, new theories should be explored and tested that are reflective of the practices occurring in the art room with emerging digital technologies.

Responding to the issue of nonhumans in art education, Hellman and Lind (2017) argued for “perspectives [that] facilitate thinking differently about visual arts education and temporality of entangled assemblages where materiality also has agency” (p. 208). Following this perspective, assemblages are formed when students and digital technologies come together to create new ways of functioning, and materiality can be understood as the recognition that qualities of materials have influences as to how individuals and society use them. As a simple example, if a drawing app only allows for certain color palettes and line qualities, then certain forms of making and expression will be supported while others are suppressed (Leonard, 2018). It is important to note that assemblages assume there are individual entities that interact with other separate entities, and the agency of both combine to form new ways of functioning.

Vignettes of an Art Educator’s Becoming

My interactions with digital technologies have helped me recognize that I am materially embodied and embedded, with the ability to affect and be affected (Braidotti, 2019). As an important part of my educational philosophy, this realization emerged most notably through two separate events: analyzing high school students’ responses to a survey I designed, and instructing a preservice higher education digital technology art education course. In what follows, I offer vignettes (Rosiek & Snyder, 2018) of each event to describe how I became an art educator with an interest in posthuman concepts.

First Vignette

Entertaining new perspectives that facilitate thinking differently about relations in the digital art classroom, I conducted a research project in the spring of 2018 investigating creative assemblages involving secondary-level art students and digital technologies. The survey questionnaire was completed by participating students who had recently produced a creative artwork using digital technologies. Additionally, the survey examined student perspectives of creativity, artistic practices, classroom environment, and relation to digital technologies.

The study had 57 participating students ($N = 57$), who each completed the survey composed of 3 demographic questions, 6 short answer questions, and 16 rating scale questions. One short answer question addressed the students' perceived relations to computers and produced some particularly interesting insights. The short answer question (labeled as SA6 in the data set) asked, "Do you feel computer programs are tools that you use to make digital artworks, or are they more like partners that help you create an artwork? Why?" The students' handwritten responses were digitally transcribed and analyzed for themes.

The findings of the qualitative analysis for SA6 identified four themes: Tools, Partners, Situational, and Incomplete (Figure 4). The categories of Tools and Partners have straightforward responses where the student clearly states their position of computers as one or the other. In contrast, the Situational category consists of students who claim that a computer alternates between being a tool and a partner and is situationally dependent. The final category, Incomplete, addressed the few responses that failed to state a position clearly.²

The descriptive analysis of this survey item showed 42% ($n = 24$) of students recognize the computer as more than a tool, with Partner 28% ($n = 16$) and Situational 14% ($n = 8$). This was surprising to me because I frequently encounter art education resources and lessons that address digital programs through instrumental theory. However, despite this bias, students are developing their own counternarrative relations to digital technologies. While the study is small in scale and requires further

Perspectives of Technology from Data Set Item SA6

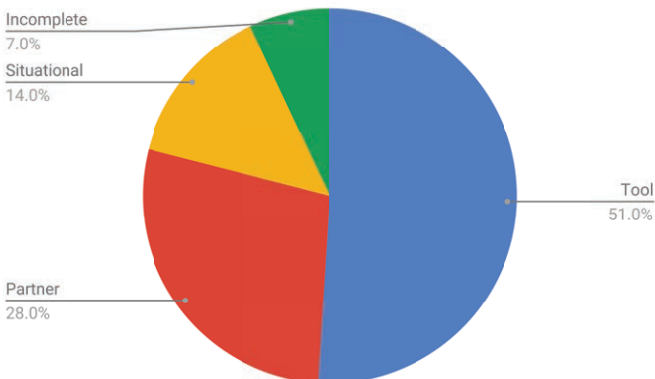


Figure 4. Frequency of themes for student perspectives of technology from data set item SA6.



Figure 5. Northern Illinois University's art education technology class trip to Tricia Fuglestad's classroom at Dryden Elementary School. Photo courtesy of Olivia Brus.

investigation, these findings made me question how to best engage high school students with digital devices and how theory is relating to practice. Specifically, how does my educational philosophy present and engage with human-computer relations to form my curriculum and influence the hidden curriculum (Jackson, 1968), what students learn that is not part of the overt curriculum, in my classroom?

Second Vignette

As a current visiting lecturer at Northern Illinois University, I instruct an undergraduate- and graduate-level course titled Art and Technology in the K-12 Classroom (Figure 5). The focus of this course is the critical review and integration of emerging technologies in art classroom settings for both artistic practice and instruction. Every semester I have edited, added, or dropped projects to adjust for new technologies, philosophies, and student feedback. For example, to begin a deep and critical reflection of human-computer relations and to explore digital materiality, the nature of digital material to afford or constrain action (Leonardi, 2010), I developed projects involving erasure art, glitch art, and the open-source graphical programming language Processing. The course also visits and interviews local digital art educators to explore various classroom environments.

I FIND MYSELF IN AN INTERNAL CONVERSATION WITH MY COMPUTER EVERY TIME I WORK ON IT. IT IS A DEFINITE RELATIONSHIP. I WORK WITH ITS CAPABILITIES AND RUN ALONGSIDE ITS POWER.

These course adjustments were intended to form a curriculum that provides students with the experiences and lexicon to critically engage with human-computer interactions and posthuman materiality (Hood & Kraehe, 2017). Students addressed what it means to create with a computer, rather than being the user of a computer, and how this change in perspective influences artmaking and art instruction. Erasure art highlights the computer's role in generating content in an image through features like content-aware fill. Meanwhile, glitch art and Processing projects explore digital material for creative expression alongside critical computational thinking and making practices (Knochel & Patton, 2015).

By engaging with digital materiality and digital making to intentionally preserve new possibilities and potentialities, students began to refine their educational philosophies concerning digital artmaking. Students expressed their perspectives in both class discussions and written reflections. Commenting on her experiences, Andrea B. wrote:

I find myself in an internal conversation with my computer every time I work on it. It is a definite relationship. I work with its capabilities and run alongside its power.

Another student, Olivia B., commented: "This kind of symbiotic artmaking made me appreciate how much I needed to rely on the technology in order to create the glitch artwork." Drawing



Figure 6. Christopher Potter, Processing, and Mac computer, ©r3w_531fp0ttrait, 2019.

increased attention to the entangled nature of digital creation, Andrew E. stated, "The artwork is created almost naturally, without my control." Christopher P. (Figure 6) commented:

My experience working with glitch art has led me to explore these properties and embrace computers as cocreators of digital artwork. I no longer see computers, applications, and code as simple passive tools or a medium to manipulate. Relinquishing a portion of the creative process embraces the beauty in the anomalies and artifacts produced by the interference of man and machine.

By the end of the course, students were critically discussing the many intertwined factors that contribute to digital artmaking and their implications for art classroom settings. The overwhelming positive student response from this course was surprising and further encouraged me to break away from prior concepts and continue to engage with posthuman concepts with regard to digital artmaking.

A Posthuman Perspective

A posthuman perspective is one in which humans are placed among nonhumans rather than strictly above them, recognizing that humankind is not the measure of all other things (Barad, 2007, p. 136). While the term *posthuman* in the humanities domain of art education sounds illogical or detached, there is a historical lineage in the arts to suggest otherwise. The concept of materiality has a rich history in the arts, with artists claiming that the block of marble, paint, or other media "spoke" to them during the artmaking process. If the visual arts have a strong history of recognizing the influence of nonhuman mediums in the artmaking process, how can art educators reengage this perspective and simultaneously extend it to address the issue of engaging with content created by nonhumans, such as computers or AI technology?

One potential solution to this issue may be found in Karen Barad's (2007) theory of agential realism. This theory was founded in quantum physics and challenges many assumptions, some of which have been dragged along in this article until this point, for the sake of developing the argument. Previous calls for exploring assemblages between humans and nonhumans make assumptions that objects are preexisting with definable traits that then interact (Knochel, 2016). More specifically, there are separate human and computer entities with predefined traits that engage with each other while maintaining their independence from one another. Countering this understanding, Barad (2007) argued that all objects, including the human and computer, emerge through their intra-actions with each other, and their abilities emerge from

within the relationship of being entangled together. The term *intra-action* is used to recognize the ontological inseparability between entities as compared to *interaction* (Barad, 2007).

Barad is able to develop this theory of intra-actions in agential realism using the quantum mechanics concept of wave-particle duality. In wave-particle duality, a particle can be observed either as a wave or as matter. This is a paradox because matter cannot share the same space at one time while waves can share the same space and overlap each other. A quantum physics explanation for this paradox is that the tool used to measure the particle, also called an apparatus, plays an active role in constructing the particle. If one apparatus is used to measure the particle, it may create certain possibilities for the particle while eliminating others; thus, the particle behaves like matter. A second, different apparatus used to measure a particle may create an inverse situation, making the particle behave like a wave.

The example of wave-particle duality emphasizes that all matter is entangled with all other matter in the universe, creating a vast topology of matter that is iteratively reconfigured through each intra-action. Because all matter is mutually constituting one another through continuous intra-actions, there are no individual objects. Instead, something called an “agential separability” (Barad, 2007, p. 175) is made during an intra-action that creates the boundaries between entities. That is, the apparatus (e.g., the observer) enacts an agential cut through the intra-action with an entity (e.g., the subject), allowing for the creation of boundaries between the two as they emerge into being. Beginning to apply Karen Barad’s posthuman theory of agential realism and the entanglement of matter, new possibilities emerge for digital art educators.

Entanglement Art Education

All matter is entangled and continuously becoming through iterative intra-actions. Recent educational movements, such as visual culture, choice-based art, and social justice-oriented curricula approaches, apply a narrow anthropocentric focus to only explore aesthetic experiences with an empathetic lens to human-created content. What would it mean for art education to be inclusive to the creation of a computer-generated artwork? One possible path can be exploring art curricula with a conceptual framework that I term EAE.

In the proposed EAE concept, there is a posthuman emphasis on the entanglement of all matter and the new potentialities that occur through intra-actions. This understanding would dramatically reconfigure aesthetics to be inclusive of nonhuman-produced content. Recalling that the agential cut is created through the apparatus’s intra-action with an entity, aesthetics would be

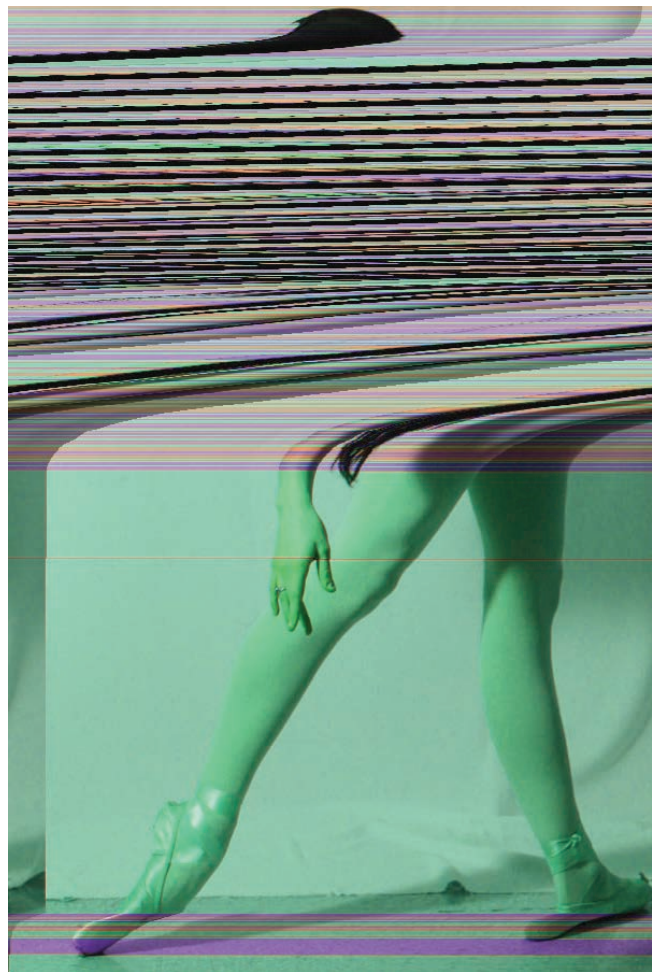


Figure 7. Olivia Brus and Mac computer, *Ballerina Glitch*, 2019.

re-understood as the fine-tuning of the apparatus for intra-actions in the world to recognize how differences and new possibilities occur. Thus, the direction of a posthuman art education, such as EAE, would deconstruct the well-established human-centered bias. This would be accomplished by critically reviewing ourselves as an apparatus that is consistently influencing, and being influenced by, the ongoing reconfiguration of the world (Figure 7).

Furthermore, EAE’s recognition of entanglement involving all matter imposes ethical concerns because the concept of the isolated individual is replaced by a mutually constituted existence (Braidotti, 2019). An art curriculum influenced by EAE would ask questions regarding the cartographies of how various materials came into being and continue to change. By emphasizing and supporting materially embedded differential perspectives, students go beyond computational thinking (Knochel & Patton, 2015) to explore how the digital materiality of algorithmic variables influence all other matter, from artworks to environmental and social justice issues (O’Neil, 2018).

HOW CAN ART EDUCATORS REENGAGE THIS PERSPECTIVE AND SIMULTANEOUSLY EXTEND IT TO ADDRESS THE ISSUE OF ENGAGING WITH CONTENT CREATED BY NONHUMANS, SUCH AS COMPUTERS OR AI TECHNOLOGY?

Implications and Conclusion

A posthuman-influenced art education curriculum that recognizes machines and other nonhumans as both creators and creative partners should have profound implications on the domain. Discussions of how digital programs can influence creative practices (Leonard, 2018) should be expanded through entanglements that support programs and features while simultaneously recognizing that digital technologies are also dynamic matter that is perpetually in the process of becoming. Unfortunately, applying a posthuman perspective to a humanities course such as the visual arts may carry a negative tone to those unwilling to acknowledge nonhuman creations. To address this issue, art educators may need both a reason for and clear ideas about engaging seriously in posthuman concepts.

This article intended to make a discussion of posthuman concepts to address digital technologies reasonable, approachable, and urgent for digital art educators. Because it has been warned that the humanities will prosper to the extent that they are willing to change and enter into unfamiliar territories (Braidotti, 2019), more widespread posthuman discussions must occur. Contributing to this effort, the posthuman theory of agential realism by Karen Barad (2007) was presented as a concept for art educators to engage with in an art education context. This discussion culminated in the proposal of EAE as a potential future for posthuman art education curricula and aesthetics to account for content created by humans, machines, and other nonhumans.

Art education pedagogy, like all matter, is dynamic and constantly changing and becoming anew. Because another dominant phase of art education has yet to clearly emerge through the entanglement and intra-actions of art educators, students, digital technologies, school systems, political leaders, and quite literally the rest of the universe, more discussions must occur. The proposal of EAE provides a non-post-something term for discussion in the field. It encourages conceptual engagement to explore the different possibilities that could emerge through such a framework to address machines and other nonhumans. If art educators want to address the content created by computers and other nonhumans without a human-centered bias, then posthuman concepts for digital technologies must be explored. EAE does not claim to be the replacement of the current art education paradigm, but instead it provides new matter for intra-action in the field, supporting the becoming of future art education curricula that factors in AI and other nonhumans. ■

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Endnotes

- ¹ Found at <https://quickdraw.withgoogle.com/data>
- ² To read all student responses, you may download the open-access data set and questionnaire at <https://commons.lib.niu.edu/handle/10843/20261>

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