# Developing a Critical Perspective of Creative Agency in Digital Environments

**Chapter** · December 2018

DOI: 10.15340/97860588873123



**1 author:**

Nicholas Leonard
Northern Illinois University
**8** PUBLICATIONS **34** CITATIONS

SEE PROFILE

# Developing a Critical Perspective of Creative Agency in Digital Environments

**Nicholas Leonard**

## Introduction

Digital technologies have come to saturate many aspects of modern society. These digital tools can be used to complete daily tasks such as checking the weather, obtaining travel directions, and communicating with others. While digital tools offer the luxury of convenience for such tasks, how the design of these virtual programs influence the intentions and creativity of the user is still unclear. This should be a point of concern since participation in the current culture requires both the consumption of media and the ability to produce media in response. Thus, how individuals communicate their intentions through creatively constructing digital media matters greatly. It is in these human-computer interactions that the creative agency of the user must be translated in a way that can be processed by the code written by developers. By placing user intent within a digital environment itself begins to develop agency through the restrictions of the coding and suggestions from algorithms. It then becomes the job of the individual using digital tools to critically review the digital environments to assess if the environment is serving the user, or if the user is serving the environment. If the users of digital tools want to support their creative behaviors, then the ability to critically question digital environments for creative agency must take place to preserve the user's creative agency.

Dr. Nicholas Leonard
Art + Design, Northern Illinois University, USA
email: ngleonard23@gmail.com

## Creativity

If the topic of creativity is to be discussed, there must be a clarification of what creativity is and how it is understood. Presently, there are two general perspectives on creativity. One of these perspectives argues that it is inherent within the individual. This Platonic (Yunis, 2011) understanding of creativity can clearly be seen influencing the popular art educator Victor Lowenfeld (1947). The other perspective locates creativity outside the individual, placing creative agency within the environment. This second understanding of creativity was made popular by the social psychologist, Csikszentmihalyi (1996). These two conceptual frameworks clash as to where creative agency is placed, preventing a cohesive statement regarding techniques to develop and support creative behaviors. In order to rectify this situation, a critical questioning of creativity assumptions must be made to identify a foundation for proposing ways to support creative behaviors. One field of study that has a well documented history of research for promoting creative behaviors is art and design education. By reflecting on how art education has come to address supporting creative behaviors through the environment, a critical lens can then be transitioned onto digital tools and environments.

## Creativity in the Individual

Arguably, the first landmark publication on creative development in art and design education was Viktor Lowenfeld's 1957 publication of "Creative and Mental Growth". Lowenfeld addresses creativity as a dispositional quality of an individual, believing that individuals are born with a creative capability and that it can be measured and transferable stating, "If children develop without any interference from the outside world, no special stimulation for their creative work would be necessary. Every child would use his deeply rooted creative impulse without inhibition, confident in his own kind of expression" (1957, p. 53). This quantitative research used methods to measure observable traits in children's drawings.

The findings from Lowenfeld's (1957) study on creativity and mental growth resulted in the development of artistic development stages.

These stages suggest that all children, regardless of context, have similar artistic developments. This encouraged those seeking to promote youth creative behaviors to stay away from influencing the inherently creative youth and plainly provide materials allowing children to flourish on their own accord. Due to these stakeholders, such as art educators, having little influence over student creativity, research was then directed at discovering how to operationalize and measure creativity to identify creative individuals.

Much like the popular standardized intelligence quotient tests (commonly referred to as I.Q. tests) provided a score for an individual's intelligence so, it was believed, that a measurement tool could be designed to measure an individual's level of creativity. Torrance (1966, 1990) developed the Torrance Test for Creative Thinking (TTCT) as a standardized tool to measure creativity. In the figural test, participants were asked to complete three activities (picture construction, picture completion, and repeated figures of lines or circles) each taking 10 minutes. The test focused on four aspects of creativity: fluency, flexibility, originality, and elaboration. Each of these four variables were then measured to produce a final score for an individual's creativity. The TTCT was widely adopted as a measurement tool for identifying creative individuals. The hope from this line of research was that creativity can be operationalized and the traits of those deemed creative could be identified so other non-creative people could imitate these traits and become creative themselves.

The understanding of the creative process resulting from this period consisted of five stages: Preparation, Incubation, Insight, Evaluation, and Elaboration (Csikszentmihalyi, 1996). Preparation is the process of becoming curious and immersed in a problem or issue. The second stage, incubation, is when ideas are processed in an individual's subconscious where unlikely connections are made. In the third stage, insight, the ah-ha moment occurs and all the parts come together to form an enlightening discovery. After insight, an individual goes through evaluation where a judgment is made on if the idea is truly valuable and worth pursuing. Finally, the last stage of elaboration occurs where hard work is invested to turn a glimpse of a valuable idea into a finalized contribution.

The findings from these studies have made an impact in how art program curricula were constructed and creativity was to be understood.

The essence of this understanding was that creativity was a dispositional trait that individuals were born with an inherent potential. The identified characteristics of creative individuals helped influence the domain of art education focus on the student, where creativity was innate, over the environment. It would not be until the 1990s that a more critical eye peering through a social psychology lens would usher in a new wave of creativity research.

## Creativity in the Environment

Csikszentmihalyi, a social psychologist, published a book entitled *Creativity the Psychology of Discovery and Invention* in 1996 that helped draw momentum back into creativity research. The new approach to understanding creativity was the result of critically reviewing how creative works are identified. Csikszentmihalyi opens his publication clearly stating his intentions of diverging from the previously common assumption that creativity is inherent within the individual, stating:

> For one thing, as I will try to show, an idea or product that deserves the label "creative" arises from the synergy of many sources and not only from the mind of a single person. It is easier to enhance creativity by changing condition in the environment than by trying to make people think more creatively (1996, p.1)

By denouncing the previous understandings of creativity being inherent in the individual, Csikszentmihalyi's work brought a new perspective and theoretical framework to those seeking to promote creative behaviors. Equipped with a social psychology understanding of creativity, creative stakeholders could alter their environment to support creative behaviors. In placing creativity in the environment, Csikszentmihalyi (1996, p. 6) identifies three requirements for creativity: culture with symbolic rules, a person who brings novelty, and experts in the field who recognize and validate the idea's novelty and value. In each of these three aspects the environment can either be constructed in a way that supports creative behaviors or stifles them.

The first acknowledged requirement for creativity is a culture with symbolic rules (Csikszentmihalyi, 1996, p. 8). This can be understood as a community that has an established system of knowledge such as

the visuals arts, computer science, engineering, etc. These domains of knowledge become increasingly specialized as more discoveries within the field are made. A creative environment allows for an individual to gain mastery of a domain of knowledge through a surplus of attention. If a person is focusing on survival or other life demands, then they will not have the needed attention to master the symbolic rules of the domain. Other factors of the environment that can support this endeavor include clarity of the domain, centrality within the culture, and accessibility to the domain (p. 38). These aspects can be used to help explain why there are frequently hubs of activity during revolutions such as the Enlightenment where domains of knowledge saturated the culture making areas of high accessibility, support, and development.

The second acknowledged requirement for creativity is a person who brings novelty (p. 8). A person's ability to produce novelty in a symbolic system of rules stems from the intersection of domains and cultures, crossing boundaries and combining ideas (p. 9). This means that the individual has learned the symbolic rules of domain, knows how to select criteria for answering a question, and the preferences of the field (p.47). The individual then addresses the same question from a new perspective, drawing from knowledge in another domain. This view of creativity has been expressed by multiple artists such as Stephen King (2010)

> ...good story ideas seem to come quite literally from nowhere, sailing at you right out of the empty sky: two previously unrelated ideas come together and make something new under the sun (p. 15).

In this example, King recognizes that creative ideas are formed when two domains of knowledge combine to produce something that is both new and valuable. Following this logic a person who deeply experiences their domain while experiencing other domain's perspectives can be said to be in a creative environment. This also produces a complex individual who can adjust themselves to perform in a variety of symbolic rules and cultures, and is not rooted in one way of being (Csikszentmihalyi, 1996 p. 89). Once the novel idea is created, judgment must be passed by experts in the field for it to be identified as creative.

The final requirement for creativity identified by Csikszentmihalyi (1996) is that experts in the domain recognize and validate the novel idea as valuable (p. 6). This means that if an individual does not have any access to a domain, the experts will never come across the novel idea, and it can not be claimed as creative. If an individual does have access to a domain, they can begin to understanding how a field operates for allowing for better understanding of what discoveries can constitute being called creative (p. 45). Fields can support creative discoveries by being proactive and attempting to stimulate novel thinking within the domain (p. 43) or have conservative tendencies rarely allowing new ideas to enter the domain (p. 44). Finally, the domain where a novel idea is accepted needs recognition from the greater social system to channel continued support (p. 44).

Understanding creativity from a social psychology perspective connects all creative ideas back to the social environment. An individual does not simply know a domain. Their knowledge is shaped by access to a domain and contributes to their future interests and pursuits. Experts in each field have helped develop specialized knowledge allowing for mastery and understanding norms in a domain. When an individual has developed a novel answer to a previously unsolved questions in a domain, the inspiration can be sourced back to the application of another domain's perspective to the issue. Once the novel idea is elaborated and presented to the experts in the field, they then act as gatekeepers allowing for new knowledge to be included into the domain's symbolic rules and then described as creative.

## Creative Categories and Agency

In describing creativity, Csikszentmihalyi (1996) noted that creativity is socially constructed and, in turn, opening future research to organize creative discoveries into levels based on social influence. The influence of a creative idea is the degree that a community has acknowledged an idea as creative. Here Kaufman and Beghetto (2009) developed four categories of creativity: mini-c, little-c, Pro-c, and Big-C. These levels were constructed in order to support more precise identifications and measurements of creativity without overlooking creative discoveries that did not appropriately fall into the dichotomy of little-c/Big-C creativity.

The first mentioned category of creativity, mini-c, was developed to support accurate measurement of inherent creative and meaningful insights that occur when learning new subject matter. Mini-c is described as the novel and personally meaningful interpretation of experiences, actions, and events (Beghetto & Kaufman, 2007) and is accredited to the concepts of personal creativity by Runco (1996, 2004) and individual creativity by Niu and Sternberg (2006). The identification of mini-c creativity constitutes a level of creativity that is mentally constructed and has, most likely, not been expressed in a tangible way (Kaufman & Beghetto, 2009). Using this understanding, creative agency for mini-c discoveries can be viewed as the knowledge expressed in an environment where a new idea is learned, and the actions of an individual to embody that domain knowledge.

The next category of creativity is little-c. At this level, creativity is emphasized as an important aspect of everyday life (Richards, 2007) where an individual has a personal discovery that they have made tangible but it is not new to the domain, such as learning an established art-making technique. This distinction from a mental constructed creative idea to a creative expression is the defining feature of the little-c category. Since both mini-c and little-c creativity constitute the individual as both the judge of an idea's novelty and value, a conceptual link can be loosely formed to the more traditional Platonic view of creativity. The remaining two levels of creativity rely on greater social influence for the accreditation of a creative idea, attributing creative agency further within the environment.

Pro-c creativity involves an individual who has mastered a domain of knowledge, such as painting, and that field recognizes their ideas as having novelty and value. As Pro-c creativity is defined, many professional can obtain a Pro-c label since it is made to also identify accomplished creative individuals (Kaufman & Beghetto, 2009). The experts of a field are contingent on the field being discussed. A high school art student may perceive the creative gatekeeper experts as their art teachers or a visual culture online community (VCLC) (Karpati, Freedman, Castro, Kallio-Tavin, & Heijnen, 2017). Since Pro-c creativity requires the field's experts to identify a creative idea, this level has clear and direct alignments with Csikszentmihalyi's (1996) understanding of social creativity, where the environment and experts have agency in the creative process.

The final creativity category is Big-C. Big-C creativity is not commonly obtained and, even when it is obtained, it is not commonly recognized during the individual's lifetime due to the magnitude of the requirements (Kaufman & Beghetto, 2009). Big-C creative discoveries are so impactful that they either replace a domains current paradigm or they create a new domain and line of study entirely. An example of this could be a medical discovery that produces an entirely new line of research and treatment. Since Big-C creativity marks such a radical change to the domain and the rate at which domains change can vary, Big-C creative discoveries may not be recognized for its creative value until long after the creative individual has passed away. The social recognition and influence of Big-C creative discoveries position the creative agency largely within the environment.

According to these categories, creative discoveries form a spectrum from creative recognition within an individual to the recognition of world-wide experts in a field. What remains constant in this spectrum is the individuals exposure and immersion to domain knowledge to begin producing novel ideas. This contingency on the environment calls for a critical review of power dynamics between the individual and their environment in order to identify environmental qualities that support creative behaviors.

## The Environment

Since a critical review of creativity from a social psychology perspective places creative agency within the environment, those seeking to promote creative behaviors must work to cultivate a supportive environment. Furthermore, since creativity is a social construct, the ability of communication becomes paramount to both learn a domain's knowledge and preferences, as well as allow experts to have access to ideas for judgment. While some may be able to physically move to a new city to reconstruct their living situation and social circles in the hopes of enhancing the potential for creative behaviors, this option is largely impractical for most. On the other hand, digital environments can be radically altered at little to no cost. The introduction of the Internet has launched modern society into a highly interactive digital environment influencing how we learn (Rosenberg & Foshay, 2002) and how we

communicate (Wood & Smith, 2004). The web browsers we use, the sites we visit, the programs we use all construct our digital environment. These tools can then be intentionally selected and altered to cultivate a digital environment that better aligns with Csikszentmihalyi's (1996) social psychology suggestions to promote creativity. To accomplish such a task requires critical questioning on how one interacts with their digital tools.

It is important to note that digital tools do not all operate under the same conditions as traditional media. Traditional mediums in this case refers to tools and processes that do not function according to binary coding. This distinction of traditional mediums would include: pen or pencil drawings, printmaking, ceramics, painting, and weaving just to name a few. These tools do not perform a function until the user takes action to manipulate them to perform their function. The brush does not paint unless it is held and animated through the artist to produce marks on a canvas. This understanding of how tools work is known as the Instrumental Theory of Technology (Heidegger, 1954). The influence and description of the Instrumental Theory is summarized by Feenberg (1991) stating:

> The Instrument Theory offers the most widely accepted view of technology. It is based on the common sense idea that technologies are "tools" standing ready to serve the purposes of the users (p.5)

Since this understanding of technology was commonly applied as normal science previous research, it predetermines our understanding of digital technologies in creative pursuits. In order to address how the tools in our environments influence creative behaviors there must be a re-evaluation of how digital tools influence this process.

Digital tools can be understood as the mediums that utilize binary code to operate. This description includes both software (ex: Adobe Photoshop, Phone apps, and Blender) and hardware (ex: Drones, 3D printers, and Microcomputers like the Raspberry Pi). These digital tools do not require the same interaction as traditional mediums. Minimal human interaction with these tools holds the potential for complex algorithms to run, producing content well after human agency has ceased. The algorithms that are executed can be viewedWWW

The first code category constitutes programs that have pre-programed

responses that do not develop to produce new outcomes. An example of this could be using an image filter on the social media platform Instagram. Filters allow a user to take a previously captured image and then alter aspects from color saturation to the appearance of a lens flare and many more. The layperson using these program features does not know exactly how the filter will alter their image until the option is selected and a preview is shown. The code used to produce these results is the same code each time, pending app updates. What makes this pre-programed code mysterious, a black box, to the layperson is the code complexity. The complexity of some code in programs can be so advanced that it would be simply unrealistic for a single human to be able to comprehend exactly what the outcome would be when the program is run. Since a human interaction with a digital tool causes moments of great uncertainty for the outcome, we can critically view these programs as having agency. While the effects of digital tool agency initially seem small, the second category of code advances the impact of digital tool agency many times over.

The second category of code involved is artificial intelligence (AI). Artificial intelligence is the process of code that can adjust its own variables from received data to produce new outcomes. Other terms such as deep learning and machine learning are also used to describe this secondary category of code. While the code is initially created by humans, the program is designed to evolve in order to increase its chances of completing its goal. Some of the digital tools that utilize machine learning are well advertised and as a result are clearly identifiable. Google Maps uses AI to collect data from cellular phones to help predict traffic on the roads and create alternative routes to avoid large delays. If Google Maps were to operate via non-AI code, they would repeatedly perform the same task and consistently direct drivers into high traffic areas. Some AI tools are less visible and possibly surprising to the layperson. In 2015, the New York Times published an article that artificial intelligence has largely been adopted in aviation, requiring the average Boeing plane flight to only require an average of seven minutes of human-steering (Markoff, 2015) In some cases artificial intelligence is completely disguised from the layperson or even a mystery to the party responsible for developing the code in the first place!

While the possibilities of a Skynet situation where machines take

over to control humanity can be a hot debate, the fact is that artificial intelligence tools are already greatly influencing human behavior. What makes this situation dangerous is that these algorithms are hidden and have no clear line of accountability. These highly influential algorithms are described by Cathy O'Niel (2016) as "weapons of math destruction" or "WMDs". WMDs have three defining elements: opacity, scale, and damage. Opacity does not just refer to the ability for an individual to recognize that there is an algorithm, it also refers to the awareness of the algorithm model of what and how things are being measured and calculated. Scale refers to an algorithms ability to grow. Small algorithms that were once used to assist humans have scaled to become part of the business world norm in industries such as banking, health, and human resources. The final element of a WMD, damage, describes an algorithm's fairness to the subject(s) involved in the model and the resulting ability to ruin or destroy quality of life. Examples of WDMs have been identified by O'Niel (2016) in education, online advertising, employment, and insurance just to name a few. In order to help bring back human agency and understanding to these algorithms, O'Niel makes suggestions for individuals to be able to protect their data, have access and be alerted to data being used, and to understand the functioning of these algorithms. While the changes needed to reassert democratic control over these algorithms requires multiple parties, initiatives can still be made by individuals. This can be done through thoughtful interactions with digital tools with a critical view to assess power dynamics between technology and the user.

Cathy O'Niel comments on the power dynamic between humans and algorithms stating: "Mathematical models should be our tools, not our masters (2016, p. 207)" While she is referring to big data algorithms, a similar critical perspective can be applied to the smaller scale digital technologies that individuals interact with on a near daily basis. The software programs and digital environments such as social media websites and phone apps are created by select developers. These developers are directly responsible for constructing a digital user experience. One program may allow for the capturing and editing of digital pictures through select filters while another program provides a comprehensive spectrum of refined editing capabilities. The constructed digital environment allowing for human-computer interaction,

known as the user interface (UI), may be designed in ways to make user decision-making options clearly accessible, or less apparent requiring multiple interactions. Since the way digital environments are constructed influences the decision-making process by the user, a critical perspective of the user must be utilized to address the concerns of user agency against program agency. This critical perspective regarding the computers algorithmic influence on the human creative process has been addressed by art educators since the early adoption and commodification of personal computers.

## Art Education, Creativity, and Digital Environments

As digital technologies became a popular and more financially obtainable item, personal computers began to make their way both into the hands of professional artists and school art classrooms. When viewing the computer as a new medium for making artwork, many questions arose such as identifying best teaching practices (Wohlwill & Wills, 1987) and questioning old assumptions regarding artistic terminology (Johnson, 1996). New frames of reference needed to be developed to grapple with this technology, so researchers set out on identifying how creative agency in digital environments compared to production with more traditional materials such as pencils, pastels, and paints.

While providing artistic instruction in digital environments, art educators were discovering aligning, divergent, and parallel concepts with traditional media. Previous artistic terminology for describing artworks such as the elements and principles of design created issues when applied to digital artworks (Johnson, 1996). Johnson suggested that some terms, such as color, can still hold a clear meaning while others become more ambiguous when existing in a virtual setting and new terms must be identified. To address this issue, Forehand (2005) created a revision of Bloom's Taxonomy for digital purposes titled *Bloom's Revised Taxonomy* and Churches (2009) created *Bloom's Digital Taxonomy*. As divisions between traditional and digital artworks arose, other art educators attempted to bridge this newly identified gap (Garvey, 1997). In developing curriculum rationales for computer generated artworks, there was still an emphasis on mastery of traditional media to then be applied to digital artworks. Observations of students using

technology noted how an initial focus was given to the computer and product then eventually transferred to the artwork concept (Freedman & Relan, 1992). This can align with experiences of creating artwork for the first time with traditional materials. As efforts were made about how to introduce and address the entire concept of digital art into art education curricula, focus was also directed to the interactions between the individual and the computer.

Narrowing the focus even further to the individual and the computer, attention shifted to how the software design influences artistic behaviors. While it was suggested that some divergent thinking behaviors are promoted with digital painting programs (Freedman, 1989), many critical aspects of computers were addressed in publications. Statements such as:

> End-user software resists inspiration. It must be learned step by step, tutorial by tutorial and even the experienced user must yield to the dictates of the latest version (Garvey, 1997, p. 31)

expressed the critical eye being applied to the agency of the digital environment and the role it played in artistic production. Freedman (1997) addresses this aspect by applying a visual culture approach to digital artworks to support art educators in asking questions about how and why digital artworks are created and viewed. Here, example questions are provided such as "What part do the software designers play?" (Freedman, 1997, p. 9). In 1988, Linda Ettinger predicted a future where art students would create digital artworks by creating their own software while questioning "does the student control the medium, or does the medium control the student? (p. 56)" Some researchers questioned whether computers are more conceptually restricting than other media (Squires, 1983) and that computers generally exert control over how the user thinks and acts (Bowers, 1988; Sloan, 1980). Questions like these are critical in nature, addressing the balance of power in creative agency when creating digital artworks.

More recent research regarding the interweaving of creative behaviors and software design has begun to help make suggestions for both practice and future research. Suggestions for teachers to not be seduced by the simplicity and ease of digital technologies and instead focus on the critical application of programs allowing for creative response became

more paramount (Sweeny, 2004). Publications began to encourage art educators to start mastering technology to subvert the original intentions of the program and "re-purpose technology" for artistic purposes (Ashburn & Floden, 2006). This idea to adjust and explore various technologies to identify constraints imposed by program agency and new possibilities is conducted by new media artists and should be supported in students for creative production (Tillander, 2008). Another study points out that there are differences in artwork quality and views of productivity between traditional and digital artworks with children three to five years old (Ackermann, 2017). In order to support creative behaviors while using technology, it is suggested by Ackermann that "we cannot simply provide these tools and expect children to utilize them for creative expression on their own, without intervention (2017, p.48)". As the process of creation is emphasized through the role of both being a producer and consumer of technology in society, researchers were called to explore societies' understanding of technology, pedagogy, and creativity (Tillander, 2011). One line of research addressing these issues was the influence of code determining the creation of a product (Lessing, 2009).

## Creative Agency in Digital Environments

Critically addressing digital mediums for creative agency in artistic production introduces new biases, unrelatable to traditional mediums. The selection of watercolors compared to oil paints each lend themselves to certain processes, encouraging various techniques and artistic styles. When using traditional mediums, the environment of artistic production can vary greatly. A painter could be using a traditional large stretched canvas inside a private studio, a small box easel in plein air, or a a piece cardboard with gesso in a high school art classroom. These examples show that the tools and environment for traditional painting can be quite different. When evaluating digital mediums the process is always occurring through the use of a digital device such as a computer, tablet, phone, or virtual reality space. You could be sitting in a personal studio, outside with a scenic view, or in an art classroom making a digital artwork in a program, such as Adobe Photoshop, and the digital environment creates the same capabilities and restrictions for digital

production (Knochel, 2016). Since the virtual environment presented to the artist is consistent across locations, evaluating the relations users form to these digital environments alongside code created by the developers for potential biases is of utmost importance to understanding the creative agency unique to digital mediums.

In regards to the relations teens have formed to digital applications for creative production, Howard Gardner and Katie Davis (2013) recognized that there are two relationships that can form between human and machine: app-enabled and app-dependent. These two traits are described as:

> ...digital technologies afford enormous potential for individual or group breakthroughs-provided that the existing apps are treated as approaches to be build upon (allowing us to be app-enabled), rather than ones that constrict or constrain one's means and one's goals (causing us to become app-dependent) (Howard and Davis, 2013 p. 161)

In their research, Gardner and Davis identified that when using digital technologies the user can either limit themselves to the abilities afforded by the program (app-dependent) or use the program as a leap pad to achieve their own goals (app-enabled). This limiting of creative potential to the design of a program can also be understood as a power user, somebody who does not question the capabilities of a software program and instead models themselves to reflect the capabilities of the program. Critically reflecting on the balance of power in this situation, we see that the computer program is greatly leveraged and the user is left to the whims of the code. In this situation the agency of the creative process is strongly guided by the code.

Since programs are digital environments made of code, and code is written by humans, the perspective and knowledge of the developers greatly influence the users experience and capabilities. Interpreting creativity as defined by Csikszentmihalyi (1996), a creative idea is the result of combining content knowledge across domains. Thus, when operating in a digital environment for creative artistic production, the user is limited to the content knowledge presented by the developers through the code. It is for this reason, art educators (Knochel & Patton, 2015) suggest observing the code as a critical text outlining the

positionality of the developers. They introduce this concept building on the conceptual framework of Ian Bogost's (2006) unit operations methodology where code is "procedural rhetoric" (Bogost, 2007, p. 2) to be analyzed. Examples of app-dependent artistic creation practices can be seen in the many art directed programs and apps. Some programs may limit users to premade "drag and drop" images to create an artwork. Other art programs such as drawings apps are designed with various levels of detail control such as line size, texture and color selection. In these situations the developer bias, controlling what features to include to make an artwork, make the user dependent on the features in the digital environment. Critically reviewing software programs like these show a great creative agency imbalance, with power largely residing inside the program coding, causing the user to think within the program. This issue is also described by the "app-mentality" where the user is unwilling or unable to envision creations beyond the functionality of the software (Howard and Davis, 2013 p. 121). In order to combat an app-dependent, app-mentality that throttles user creative agency, a new way of relating to and selecting digital technologies must be explored.

Human-computer interactions that support the user's creative agency are defined by Howard and Davis as "app-enabling" (2013, p. 161). App-enabled users critically perceive software programs as one option in the greater process of obtaining their personal creative goal. App-enabled users may initially use a limiting program like a drag and drop drawing app to create an image. What separates this behavior from an app-dependent user is the app-enabled user continues their creative process for intentions greater than those offered by the drag and drop app alone. App-enabled users may produce multiple images using a drag and drop program to then import them into an animation app, transforming the collection of images into a GIF animation. This process of utilizing multiple software programs, with their own limited views of the creative process, to produce a user-desired final product is refereed to as "app smashing" (Brenner & Hauser, 2015, Kuloweic, 2013). Users of digital tools can also be app-enabled when utilizing a single digital tool that supports user creative agency.

Technologies that produce digital environments that support user creative agency can be identified for having minimal developer bias coded within the software design. To help recognize the constraints

a digital environment could impose, app-enabled users can utilize computational thinking. Computational thinking is the abstraction and translation of the human problem solving process into a form that can be "understood" by computers (Wing, 2006). The ability for computational thinking has been supported by art educators to develop critical perspectives on the digital tools students use daily for creative production (Knochel & Patton, 2015; Hsu & Lai, 2013). To progress computational thinking for visual artists, two app-enabling programs that have received great praise are Scratch and Processing.

Scratch was designed by the MIT Media Lab to be an app-enabling program for creative products. Emphasis on the user's creative agency is express by Maloney, Resnick, Rusk, Silverman and Eastmond in their description of the program:

> Scratch is a visual programming environment that allows users (primarily ages 8 to 16) to learn computer programming while working on personally meaningful projects such as animated stories and games. A key design goal of Scratch is to support self-directed learning through tinkering and collaboration with peers (2010, p.1).

One defining aspect of Scratch that makes it app-enabling is that the digital environment provides multiple modes of expression, allowing the user to access features required for their personal creative goal (Howard and Davis, 2013 p. 182). Using Scratch, users have created a wide range of projects including animated stories, games, online news shows, book reports, greeting cards, music videos, science projects, tutorials, simulations, and music projects (Maloney, Resnick, Rusk, Silverman and Eastmond, 2010, p.1). Since coding bias for dictating final products was actively considered by the Scratch development team, the final product allows for priorities to emerge from the user rather than the program.

Another defining aspect of Scratch is that it embodies an open community. Open in this situation refers to the sharing of code, creating complete transparency for the design of a program, allowing others to inspect and build upon it. Knochel and Patton express the importance of open code stating:

> Code's relation to openness sets up two significant dynamics: (1) open code encourages collaboration and remixing and (2) the debate of openness in code is a debate about political free speech (2015, p. 29).

When a project is made in Scratch, the file can be viewed by others from two perspectives: the final project, and the code. The final project, as identified earlier, can range from interactive games to songs, animations, or videos for viewing consumption. By allowing the code to be open for this large array of products, users can explore and adapt the code to make their own creations. It is this remixing potential of open code that supports creative behaviors while simultaneously combating censorship imposed by proprietary code and copyright.

The Scratch coding language uses block-coding, a highly visual method of coding that uses color-coded shaped boxes to create "lines" of code. It is because of this construct that block-coding becomes highly intuitive and approachable, allowing younger individuals to efficiently work within the digital environment. Researcher Kylie Peppler (2014) utilized Scratch in an out-of-school setting with teenagers to investigate creativity using digital technologies for this reason. By producing a coding language that is approachable, that can quickly grow in complexity, and allow for a wide range of results, younger people have the ability to explore computational thinking in the visual arts (Resnick, Maloney, Monroy-Hernández, Rusk, Eastmond, Brennan & Kafai, 2009).

Another open coding language used to support computational thinking within the visual arts is known as Processing. Processing is an open source program that uses a more traditional coding interface, displaying text in lines rather than colored blocks like Scratch. Processing can be understood as a digital sketchbook where lines of code correlate to visuals such as lines and shapes. These basic lines of code can grow exponentially in complexity, creating animations and interactivity features at an even more sophisticated degree then Scratch. Since the digital environment in Processing is less intuitive than Scratch, it can be considered as the maturing next step in computational thinking and coding for creative visuals. Processing can be used by students, professional artists, and researchers to explore the visual potentials

of open code and community (Knochel & Patton, 2015; Reas & Fry, 2006) to critically reflect on computational thinking, digital literacy, and creative agency.

While free coding programs such as Scratch and Processing have been praised for their features supporting their app-enabling user relationships, there are many more digital environments where creative production is being explored. A highly researched digital environment that involves a large degree of visual communication is the Internet. The Internet provides both digital tools and social environments for interactions, producing a completely virtual environment influencing all aspects of the social psychology creative process. To better understand how people consume, create, and respond on the Internet, a critical perspective of social creativity can be applied to these digital environments to identify creative agency.

## Digital Social Environments and Creative Agency

The Internet is a term that refers to the network of interconnected computers. The Internet has created a massive digital environment that is seeing a steep increased use by the layperson. In 2018, a Pew Research Center study showed that 77% of Americans go online on a daily basis, including the 26% who identify as being online "almost constently" (Perrin & Jiang, 2018). Online through various virtual environments, people are consuming content then creating their own content in a response to their experiences. This behavior of consumers also creating is described as a Read-Write (RW) culture (Lessing, 2008). RW culture can be observed across the Internet where the layperson, hobbyists, amateurs, and professionals are all communicating through the use of images, music, animations, videos, and/or three-dimensional (3D) virtual objects. One example of websites coded to encourage various forms of communication between users are social media websites.

Social media websites are digital environments constructed with various tools for communication, allowing users to interact. Some social media websites are designed for a very specific focus, such as a fan page for the progressive rock and roll group Coheed and Cambria called cobaltandcalcium.com. Other more popular and widely used social media websites do not cater to one interest group. Instead they

focus on the digital tools withing the virtual environment to allow for communication to occur. Examples of these larger social digital environments include Facebook, YouTube, Instagram, Twitter, and Pinterest.

Facebook, one of the most used social media platforms worldwide, produces very little of its own content. Part of what makes Facebook successful are the multiple options that it provides to its users for creating. On Facebook, one user can send a message using written text. That user could have just as easily included "stickers", emojis, pictures, GIF animations, videos, money, website links, or any other form of attached digital file. By allowing Facebook users access to these features, their website becomes populated with various media allotted by those tools. YouTube, another highly popular social media website, focuses their digital tools around the production of video content. As a result, the digital tools available on YouTube dictate video as the main medium of communication. The same relationship between available tools and forms of communication can be said of other sites: Instagram for pictures and videos, Pinterest for images with web links, and Twitter for short texts with media attachments. These social digital environments provide content for consumption by providing the means for user produced content progressing a RW culture.

Researchers have explored how these digital environments and their associated digital tools influence human behavior. Howard and Davis (2013) critically reviewed the user interface of digital programs and recognized that it was an integral part of how a user chooses to express him or her self stating:

> Though the range of self-expression is great online, it's not unrestricted. For instance, expression are limited to 140 characters on Twitter, whereas digitally manipulated photos are the coin of the realm on Instagram. The app identity, then, is multifaceted, highly personalized, outward-facing, and constrained by the programming decisions of the app developer (2013, p. 60)

Furthermore, the user interface of many social media websites utilize algorithms to dynamically alter the content being displayed. Websites utilize personal data collected from browsing history, recent purchases, and other online interactions to create a comprehensive description of

the user referred to as big data. The use of artificial intelligence to collect big data on a user can be startling to the layperson who may not be aware of the functioning complexity of digital environments. For example, Facebook's artificial intelligence was able to describe my profile picture with very high detail stating: "your Profile Photo, Image may contain: 2 people, including C...eonard, people smiling, people standing, wedding and outdoor". Here, advanced code was able to identify my wife by name and describe an outdoor wedding photo (See Figure 1). Since digital environments are able to collect highly specific big data on individuals, other algorithms then begin to predict user interest and desires, further altering the digital environment with the goal of increased convenience for the user. This means that the digital environment created by the combined influence of both the app developer and associated algorithms are influencing the way the user functions.

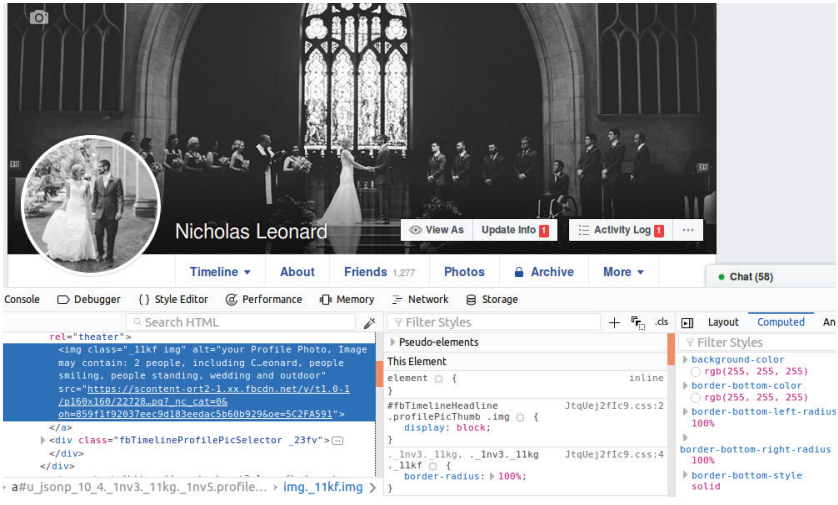


**Figure 1.** Facebook Profile Image Big Data

One take on this issue has been described as "the filter bubble", where users online are continually directed to similar content and perspectives (Pariser, 2011). This can create a great issue when looking to virtual environments and digital tools as mediums for increasing creative behaviors for the user. In order to creatively utilize the great abilities afforded by digital tools, a critical perspective must be applied

to recognize these digital environments for their creative agency against the intentions of the user.

## Conclusion

When utilizing digital tools to produce creative content, a critical lens must be used to support creative behaviors. A social psychology perspective of creativity emphasizes that the environment has agency in the creative process by influencing an individual's exposure to domains of knowledge and the experts of a field. When using digital tools, the user is operating within a virtual environment design by developers, projecting their domains of knowledge upon the user. Furthermore, the code used by developers to construct digital environments can utilize artificial intelligence, dynamically altering the user experience based on available big data. When critically viewing the power dynamics for decision making between the user and digital tools, a large potential for conflicting creative influences can be recognized. It is then the goal of the user to be able to address these potentialities to retain their creative agency when using digital tools.

In order for the users to maintain their creative agency when using digital tools, critical questions must be asked. Questions like: Who designed this digital environment? Why was this digital environment designed? What forms of knowledge are imposed or presented through the digital environment? Do the intentions of the digital environment support or suppress the intentions of the user? Can multiple digital tools be used in conjunction to liberate user creative agency in a way unattainable by committing to just one program? While these questions serve as a starting point for developing a critical perspective on creative agency in digital environments, they also hold the potential for developing new habits in regard to using digital tools. If the users of digital tools want to support their creative behaviors, then critically questioning digital environments for creative agency must take place to preserve the user's creative agency.

**Acknowledgements:** "Writing is a lonely job. Having someone who believes in you makes a lot of difference." - Stephen King. Thank you to my loving wife, Chelsey Leonard, for being my difference maker.

## References

Ackermann, S. (2017). To Swipe or Not to Swipe, That Is the Question: The iPad in a Preschool Setting. *Art Education, 70*(3), 43-49.

Ashburn, E. A., & Floden, R. E. (Eds.). (2006). *Meaningful learning using technology: What educators need to know and do*. Teachers College Press.

Beghetto, R. A., & Kaufman, J. C. (2007). Toward a broader conception of creativity: A case for mini-c creativity. Psychology of Aesthetics, Creativity, and the Arts, *1*, 73–79.

Bogost, I. (2006). Unit operations: An approach to videogame criticism. Cambridge, MA: MIT Press.

Bogost, I. (2007). Persuasive games: The expressive power of videogames. Cambridge, MA: MIT Press.

Bowers, C. A. (1988). *The cultural dimensions of educational computing: Understanding the non-neutrality of technology*. Teachers College Press.

Brenner, A. M., & Hauser, J. S. (2015). Creating Innovative, Student-Centered Projects with App Smashing. *International Association for Development of the Information Society*.

Churches, A. (2009). *Bloom's Digital Taxonomy*. Retrieved September 2009, from http://edorigami.wikispaces.com/Bloom%27s+Digital+Taxonomy

Csikszentmihalyi, Mihaly. 1996. *Creativity the psychology of discovery and invention*. New York, NY: First Harper Perennial. 978-0062283252.

Feenberg, A. (1991). *Critical theory of technology* (Vol. 5). New York: Oxford University Press.

Forehand, M. (2005). *Bloom's taxonomy: Original and revised.* In M. Orey (Ed), *Emerging perspectives on learning, teaching, and technology.* Retrieved September 2009, from http://epltt.coe.uga.edu/index.php?title=Bloom%27s_Taxonomy

Freedman, K., & Relan, A. (1992). Computer graphics, artistic production, and social processes. *Studies in Art Education*, *33*(2), 98-109.

Freedman, K. (1997). Visual art/virtual art: Teaching technology for meaning. *Art Education*, *50*(4), 6-12.

Gardner, H., & Davis, K. (2013). *The app generation: How today's youth navigate identity, intimacy, and imagination in a digital world*. Yale University Press.

Garvey, G. P. (1997). Retrofitting fine art and design education in the age of computer technology. *ACM Siggraph Computer Graphics*, *31*(3), 29-32.

Heidegger, M. (1954). The question concerning technology. *Technology and values: Essential readings*, *99*, 113.

Hsu, W. T., & Lai, W. S. (2013). Why Should Computational Work and Aesthetics Be Taught in the Art Classroom?. *Visual Arts Research*, *39*(2), 1-12.

Johnson, M. (1996). A comparative study of terms used in art education and computer graphics to describe the visual properties of images. *Studies in Art Education*, 184-192.

Karpati, A., Freedman, K., Castro, J. C., Kallio-Tavin, M., & Heijnen, E. (2017). Collaboration in visual culture learning communities: Towards a synergy of individual and collective creative practice. *International Journal of Art & Design Education*, *36*(2), 164-175.

Kaufman, J. C., & Beghetto, R. A. (2009). Beyond big and little: The four c model of creativity. *Review of general psychology*, *13*(1), 1.

King, S. (2010). *On writing*. New York, NY: Scribner.

Knochel, A. D., & Patton, R. M. (2015). If art education then critical digital making: Computational thinking and creative code. *Studies in Art Education*, *57*(1), 21-38.

Knochel, A. D. (2016). Photoshop teaches with (out) you: Actant agencies and non-human pedagogy. *Visual Arts Research*, *42*(1), 71-87.

Knochel, A. D. (2016). Photoshop teaches with (out) you: Actant agencies and non-human pedagogy.*Visual Arts Research*, *42*(1), 71-87.

Kuloweic, G. (2013). App Smashing: Part One. The History 2.0 Classroom. Viewed 1 July 2018, http://kulowiectech.blogspot.com/2013/02/app-smashing-part-i.html

Lessig, L. (2008). *Remix: Making art and commerce thrive in the hybrid economy*. Penguin.

Lessig, L. (2009). *Code: And other laws of cyberspace*. ReadHowYouWant.Com.

Lowenfeld, V. (1957). *Creative and mental growth* (3rd ed.). Oxford, England: Macmillan.

Maloney, J., Resnick, M., Rusk, N., Silverman, B., & Eastmond, E. (2010). The scratch programming language and environment. *ACM Transactions on Computing Education (TOCE)*, *10*(4), 16.

Markoff, J. (2015, April 06). Planes Without Pilots. Retrieved from https://www.nytimes.com/2015/04/07/science/planes-without-pilots.html?_r=0

Niu, W., & Sternberg, R. J. (2006). The philosophical roots of western and eastern conceptions of creativity. Journal of Theoretical and Philosophical Psychology, 26, 18 –38.

O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. Broadway Books.

Pariser, E. (2011). *The filter bubble: What the Internet is hiding from you*. Penguin UK.

Peppler, K. A. (2014). *New creativity paradigms: Arts learning in the digital age*. Peter Lang.

Perrin, A., & Jiang, J. (2018, March 14). About a quarter of U.S. adults say they are 'almost constantly' online. Retrieved from http://www.pewresearch.org/fact-tank/2018/03/14/about-a-quarter-of-americans-report-going-online-almost-constantly/

Reas, C., & Fry, B. (2006). Processing: programming for the media arts. *AI & SOCIETY*, *20*(4), 526-538.

Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., & Kafai, Y. (2009). Scratch: programming for all. *Communications of the ACM*, *52*(11), 60-67.

Richards, R. (2007). Everyday creativity: Our hidden potential. In R. Richards (Ed.), Everyday creativity and new views of human nature (pp. 25–54). Washington, DC: American Psychological Association.

Rosenberg, M. J., & Foshay, R. (2002). E-learning: Strategies for delivering knowledge in the digital age. *Performance Improvement*, *41*(5), 50-51.

Runco, M. A. (1996). Personal creativity: Definition and developmental issues. New Directions for Child Development, *72*, 3–30.

Runco, M. A. (2004). Everyone has creative potential. In R. J. Sternberg, E. L. Grigorenko, & J. L. Singer (Eds.), Creativity: From potential to realization. (pp. 21–30). Washington, DC: American Psychological Association.

Sloan, D. (1984). *The Computer in Education in Critical Perspective*. Teachers College, Columbia University.

Squires, D. A. (1983). Effective Schools and Classrooms: A Research-Based Perspective. Retrieved from https://eric.ed.gov/?id=ED232972

Sweeny, R. W. (2004). Lines of sight in the "network society": Simulation, art education, and a digital visual culture. *Studies in Art Education*, *46*(1), 74-87.

Tillander, M. D. (2008). *Cultural interface as an approach to new media art education*. The Pennsylvania State University.

Tillander, M. (2011). Creativity, technology, art, and pedagogical practices. *Art Education*, *64*(1), 40-46.

Torrance, E. P. (1966). The Torrance Tests of Creative Thinking-Norms-Technical Manual Research Edition-Verbal Tests, Forms A and B-Figural Tests, Forms A and B. Princeton, NJ: Personnel Press.

Torrance, E. P. (1990). The Torrance tests of creative thinking norms—technical manual figural (streamlined) forms A&B . Bensenville, IL: Scholastic Testing Service, Inc.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *49*(3), 33-35.

Wohlwill, J. F., & Wills, S. D. (1987). A study of elementary school children's computer graphics. *Visual Arts Research*, 1-13.

Wood, A. F., & Smith, M. J. (2004). *Online communication: Linking technology, identity, & culture*. Routledge.

Yunis, H. (Ed.). (2011). *Plato: Phaedrus*. Cambridge University Press.