



## Glitching Form: Subverting Digital Systems That Capture the Physical World

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# Glitching Form:

## Subverting Digital Systems That Capture the Physical World

Luke A. Meeken and Aaron D. Knochel

**D**igital 3D modeling and scanning software is increasingly used to capture, represent, and reshape the physical world. Such uses range from museums' 3D-scanned archives (e.g., Smithsonian Institution, n.d.) to clothing designers digitally capturing body measurements to custom-tailored attire (e.g., Peleg, 2018), to architectural firms creating laser-scanned models of spaces for renovation and building (e.g., Zeiba, 2019). Despite the myriad ways digital and physical materials interact, teachers (Potter & McDougall, 2017) and arts specialists tend to perpetuate a "myth of immateriality" (Paul, 2007, p. 251), failing to address how digital systems shape the material and political realities of creative production.

One vein of art practice instructors may draw on to make digital systems less opaque is glitch practice. For more than 40 years, glitch artists have experimented with and intentionally broken the technological systems that undergird many cultural artifacts (Betancourt, 2016). By breaking the rules and structures of these systems, glitch artists can make these rules and structures visible and utilize artistic play to transgress these boundaries. The digital systems that shape contemporary life, and with which students interact regularly as a matter of course (e.g., social media apps, search engines, remote learning environments, video games, digital grade books, artmaking software), regularly reinforce oppressive racial, gendered, and colonizing norms (Buolamwini & Gebru, 2018; Mills & Godley, 2018; Noble, 2018; Russell, 2020). By engaging students in glitch practices, art educators can help students better understand, critique, and address the ways digital systems often fail us, both functionally and ethically (Sweeny, 2020; Wolfgang et al., 2017).

The translation of physical forms into digital data affords artists distinct opportunities for experimenting with form in the glitch art tradition. What follows is an instructional resource introducing artists who glitch digitally captured real-world forms using three strategies: glitching at the point of capture, glitching using software

tools, and glitching the data that make up digital objects. We recommend challenging students to develop their projects using one or more of these glitching practices and to generate a final project that elicits meaning through thoughtful interference in digital systems used to capture and contain models of physical objects. This resource is designed flexibly and can be deployed using free software tools or may capitalize on hardware tools such as 3D scanners or 3D printers. The authors have worked with these concepts and materials in a variety of settings with varied resources and varied student ages. Essential questions posed through this resource include:

- What new or distinctive ways of transforming, mutating, or reconfiguring forms are made possible by digitizing them?
- What particular ideas, meanings, or feelings can be explored or elicited by digitally glitching, distorting, or mutating familiar forms?
- What ethical considerations are there to making artwork about distorted or glitched human bodies? How might this relate to ableist cultural attitudes toward disability and bodily variance? How might artists explore these practices thoughtfully and sensitively?



Figure 1. Examples of point-of-capture glitches made by author Meeken. These include moving while being scanned by an Xbox Kinect camera (top), or scanning reflective and transparent materials using a free photogrammetry app (bottom).

## Point-of-Capture Glitch

Artists often generate glitched digital models and images by deliberately misusing and experimenting with the devices used to capture form. Rather than introduce glitches to data after the fact, these artists experiment with capture processes to create glitched files from the start. Point-of-capture glitch can be accomplished using a variety of methods (Figure 1).

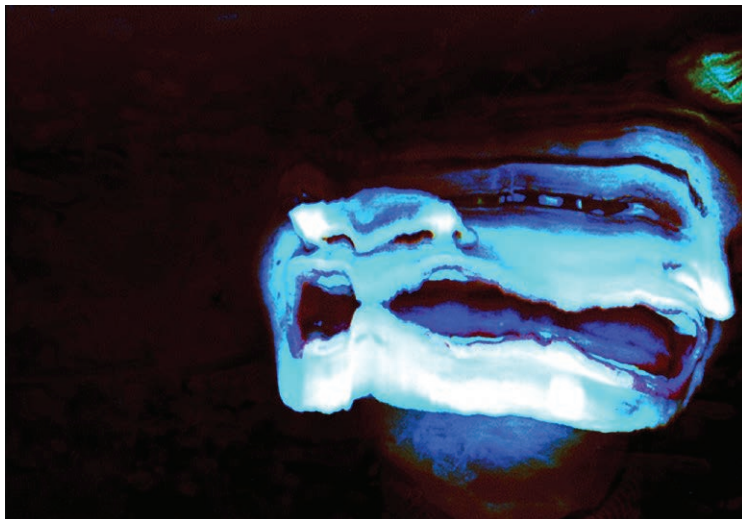


Figure 2. Kara Zona, *Ziplock*, 2015.

## Kara Zona

Atlanta-based artist Kara Zona focuses on scanning technologies to capture movement (Zona, 2014). According to Zona, the distorted image that results when the scanned subject moves during a scan tells a story of an event taking place, the same way a video might.

Zona's work with 2D scanners (Figure 2) also explores how scanners can remap space. Drawing on the work of mid-20th-century Cubist painters, Zona has explored how, for example, rolling a face across the scanner captures multiple angles in a single image, forming an image containing time. In this way, artistic play with or misuse of scanning technologies explores expressive, subjective themes through performative gestures, capturing facets of the material world that traditional capture technologies were not designed to see. Zona (2014) argued that scanning "takes these real life objects and makes them unreal" (para. 3). Per Zona, unlike a photo or video, a glitched scan does not pretend to be "real" and, as a result, might tell us more about performing bodies and relationships to time.

## Sophie Kahn

Sophie Kahn (n.d.) is an Australian artist whose work often takes the form of fractured sculptures of women's bodies 3D printed from incomplete 3D scans. Kahn deliberately misuses 3D scanning technology to produce incomplete and fractured 3D forms, which she then 3D prints.



Figure 3. A sculpture from Kahn's 2018 *Machines for Suffering* series.

Kahn uses her glitching of human bodies to explore various themes, including history, health, death, and gender. For example, in her recent series *Machines for Suffering*, Kahn (2019) scanned the bodies of dancers recreating poses from 19th-century medical photos of women institutionalized for hysteria (Figure 3), a diagnosis that no longer exists, and which contemporary scholars largely agree was a patriarchal construction to exert control over women's bodies (Devereux, 2014). In these works, the glitched "failures" of the scanning process reflect what Kahn (2019) called "the folly of using the technology of photography to attempt to capture and codify madness" (para. 2).

### Reflection Questions

- Zona's artistic play with scanners captures a body's movement in a way that is visible, even in a still image of her work. What are other ways artists capture movement or time in their artwork?
- Zona and Kahn disrupt the scanning process by moving the entity being scanned (usually a human head or body) during scanning. How else might you disrupt or glitch scanning tools during the scanning process? Have you discovered any consistent sources of disruption (reflective surfaces, hidden angles) in your scanning experiments that you could make use of intentionally?
- Both Zona and Kahn use the failures of scans of bodies as a glitch to comment on how digital systems often fail to produce a complete picture of things and people. What other themes or feelings might the image of a fractured or incomplete human body convey?
- Considering Kahn's exploration of gender, are there other types of embodied identities that 3D glitching might engage?

### Glitching in Software

Several artists generate glitched models through the use (and misuse) of 3D modeling software. Some artists try to recreate common glitch effects by intentionally manipulating the modeling software, while others use the software in experimental or unconventional ways to create unexpected effects. One accessible software tool teachers and students might use in this way is the free, browser-based modeling environment SculptGL (Figure 4).

#### Lee Griggs

Madrid-based artist Lee Griggs is an in-house artist at Autodesk, the company responsible for 3D modeling tools such as Maya and Tinkercad (Griggs, n.d.). He uses 3D modeling software to alter the underlying geometry of 3D scans of human heads in much of his work. For example, in his *Deformations* series (Figure 5) he applies mathematical transformations to the meshes,<sup>1</sup> resulting in fleshy forms with sometimes harsh or angular extensions and contractions (Griggs, 2015).

In his *Rolling Shutter Experiments* series (Figure 6), he hacks the virtual camera of the modeling software to scan across the models as they are rotated, resulting in forms that contain the twists and contortions of their movements. Griggs (2016) is interested in the concept of pareidolia—the tendency for humans to see faces in various shapes. His work experiments with how far scanned faces can be pushed before they no longer read as faces and how nonfacial forms may be manipulated to read as human faces.

#### Sondra Perry

American artist Sondra Perry's creative practice draws on digital video, 3D animation, and image manipulation to create multichannel video installations that interrogate the ways digital technologies impact Black lives, histories, and bodies (Baconsky, 2018). Perry's (2017) video installation *IT'S IN THE GAME '17 or Mirror Gag*



Figure 4. Examples of scanned forms, including a self-portrait captured by Kinect camera (left) and an equestrian model downloaded from the Smithsonian (right) manipulated by author Meeken using the free, web-based modeling program SculptGL.

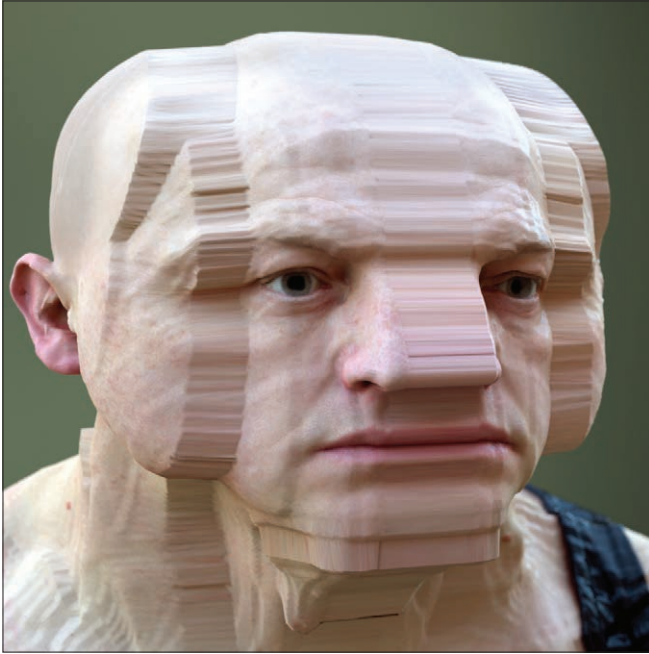


Figure 5. An image from Griggs's *Deformations* series.

for *Vitrine and Projection*, incorporates a variety of scanned forms, including 3D scans of non-European artifacts held in the collections of European museums and 3D scans of her twin brother, a former National Collegiate Athletic Association (NCAA) player whose likeness was used without compensation in several NCAA video games (Coon, 2016). Perry highlights how digital capture technologies are often used by those in power (capitalist video game companies and Western museums primarily run by White men) to extract value from people of color around the globe. The scanned artifacts have been altered with software, their texture and color replaced with the chroma-key blue used to render contexts invisible in special effects films and weather broadcasts. The scans of her brother are impossibly manipulated and distorted using animation software, emphasizing the lack of control over his stolen digital body (Greene, 2020).

### Antoine Delacharlery

French artist Antoine Delacharlery's film, *Ghost Cell*, uses 3D scans of daily life in Paris as the source of its imagery (Failes, 2016). Each scene in the film was captured using photogrammetry, stitching together 20 to 60 individual images to create a 3D-modeled urban space. Delacharlery intentionally looked for the errors that emerged in the stitched-together models and emphasized them as he developed the models into the final images for the film (Failes, 2016, para. 5). By emphasizing the messiness of the digital scans, Delacharlery wants to draw a connection between human urban movements and the movements of natural phenomena, such as the growth patterns of fungi (Failes, 2016). The glitches in the images also comment on how digital vision systems in urban spaces, such as the "eyes" of self-driving cars, capture an incomplete and often chaotic image of the world around them (Failes, 2016).

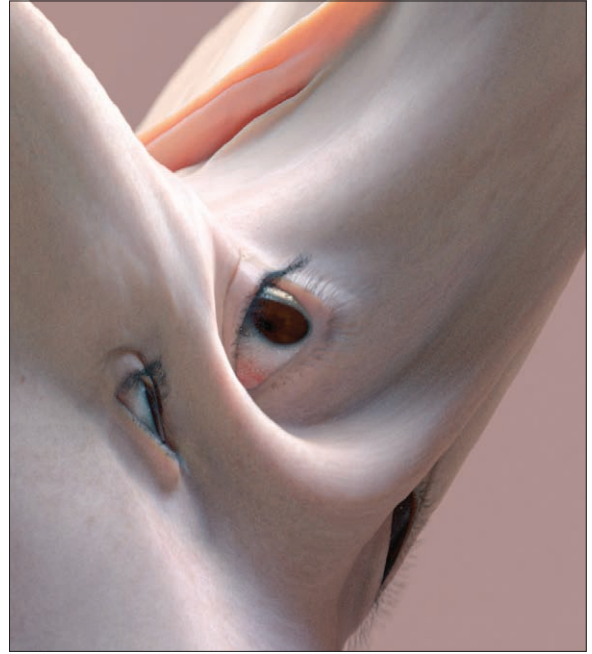


Figure 6. An image from Griggs's *Rolling Shutter Experiments* series.

### Caitlind R.C. Brown and Wayne Garrett

Canadian artists Caitlind R. C. Brown and Wayne Garrett's (2018) *Carbon Copy* (Figure 7) is a piece of public sculpture depicting a full-size 1988 Plymouth Caravelle distorted in a way inspired by the "rolling shutter" effect of shifting an image on a 2D scanner. While the final sculpture is built from an actual car that was sawed apart and had sculptural elements inserted, to construct the sculpture, the artists first took a 3D scan of the car and distorted its model digitally to use as a guide (Brown & Garrett, 2018).

Brown and Garrett (2018) stated, "Glitches and aberrations are sometimes re-absorbed, moving beyond their genesis to become something new, separate, and previously unimaginable—a broken mirror image of their origins" (para. 13). In creating this sculpture, they apply the transformative power of glitches to a physical object, inviting new ways of thinking about the physical world.

### Reflection Questions

- The above artists took inspiration from glitches in scanning technologies but used software modeling tools to intentionally recreate visual effects based on these glitches. How does meaning shift when a glitch effect is intentionally recreated, rather than when it emerges due to a technical shortcoming?
- Lee Griggs glitched scans of human faces to create 2D images. Antoine Delacharlery and Sondra Perry glitched captured forms to use in video pieces. Garrett and Brown glitched inanimate objects to create physical sculptures. How did the artists' choice of subject and medium affect the possible meanings and experiential impact of their



Figure 7. Caitlind R. C. Brown and Wayne Garrett, *Carbon Copy*, 2018.

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3 #begin vertices
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5 v 56.73015 -42.58119 -82.07118
6 v 56.59365 -44.81445 -83.12574
7 v 56.96368 -45.83326 -75.54311
8 v 56.03017 -47.76413 -85.66544
9 v 14.88495 -37.87129 -233.5932
10 v 15.66247 -42.56934 -231.7444
11 v 17.30944 -37.68595 -232.2053
12 v 17.90791 -42.50267 -230.8032
13 v 13.82038 -72.29708 -231.6838
14 v 13.32603 -76.57334 -232.6225
15 v 16.10836 -71.68658 -229.7468
16 v 14.30617 -78.01839 -232.2952
17 v 13.82003 -104.8329 -234.6992
18 v 12.29137 -104.7385 -234.4276
19 v 12.69085 -101.5538 -231.6642
20 v 10.95455 -102.8798 -232.718
21 v 11.1195 -97.75272 -237.4651
22 v 9.174654 -100.0479 -238.6341
23 v 9.811735 -102.4059 -239.9582
24 v 36.71179 -2.979168 -128.885
25 v 39.45882 -8.087551 -129.2493
26 v 40.15415 -11.64828 -130.3539
27 v 34.01983 -4.911104 -132.1662
28 v 32.67856 -29.91066 -137.1374
Normal text file length: 15,348,457 lines: 388,766 Ln: 1 Col: 1 Sel: 0|0

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Figure 8. A manipulation by author Meeken using databending to manipulate the underlying code of a 3D model in a text editor (left) to transform the source model (right).

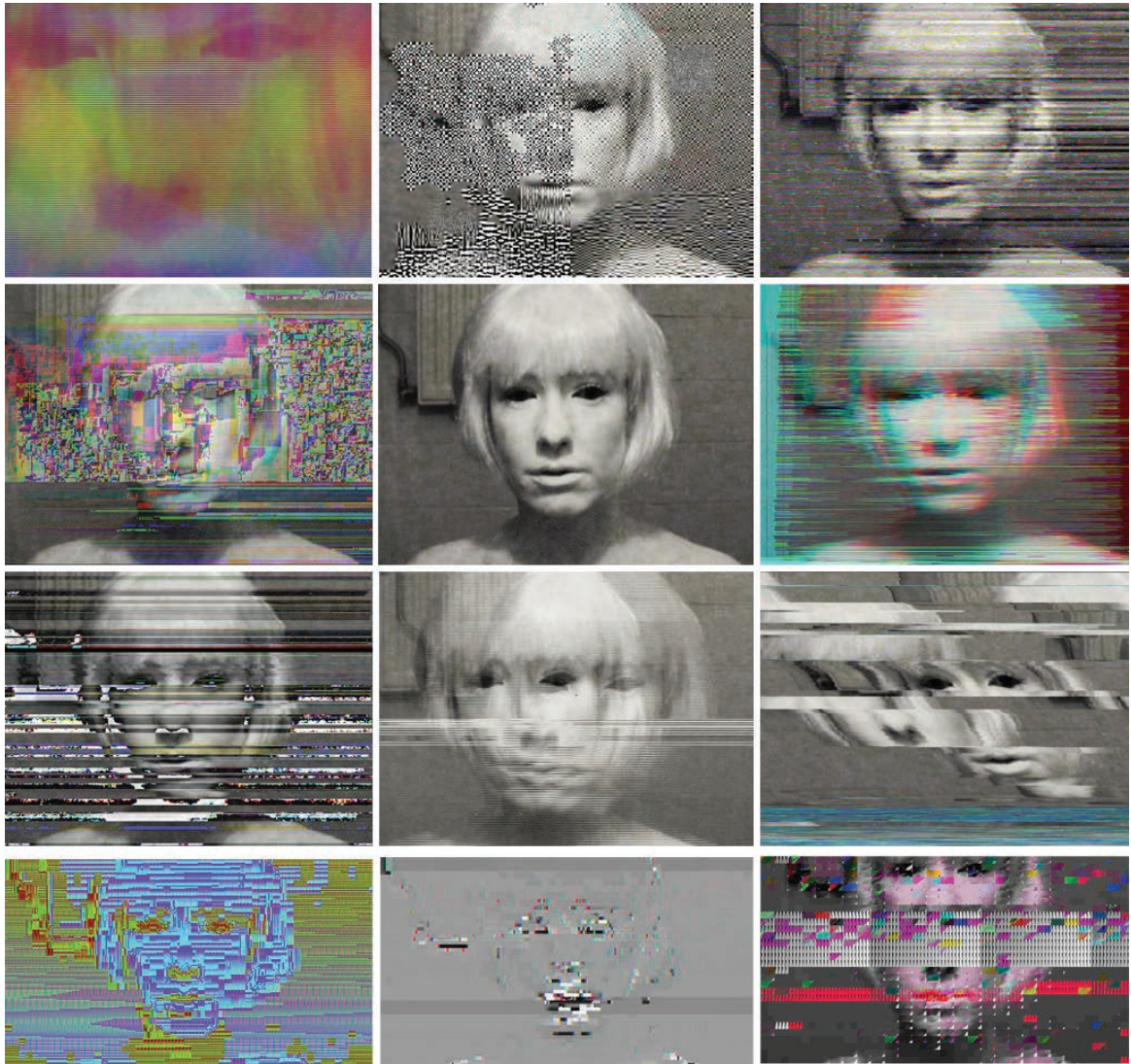


Figure 9. Rosa Menkman, *A Vernacular of File Formats*, 2010. Glitched images, generated by manipulating image data, compressed via different compression languages.

final artworks? What objects and media are you considering for your project, and how might those choices impact your approach to your project?

### Glitching Data: Databending

Many glitch artists work by manipulating the data and code inside digital files, generating unanticipated errors and breaks in them, a process called databending (jonCates, 2018; stAllio!, 2008). They highlight the structures of these file systems by manipulating them, sometimes creating new and unintended visual outcomes from common file types. Figure 8 shows an example of what the data inside a 3D model looks like, and one possible outcome of manipulating it.

#### Rosa Menkman

Rosa Menkman (n.d.) is a Dutch artist, author, and curator whose work focuses on the potential of glitch to produce new knowledge and experiences outside of the standardization of digital systems by manipulating the underlying data from which

digital materials are made. For example, she created a piece of software called *Monglot* that edits the compression-decompression (“codec”) data in video files to introduce visual glitches (Figure 9). *Monglot* is designed to help people learn about and research digital file formats by experimenting with them using glitch processes (Menkman, 2019).

#### Mark Klink

California-based artist, teacher, and programmer Mark Klink emphasizes experimentation in his glitch-based 3D modeling practice (Klink, 2016; Malatesta, 2018). He describes the development of his creative practice as “experimental and iterative,” rarely entering a project with a specific plan or concept and instead discovering themes as they occur in the artwork (Klink, 2016, para. 22).

Klink’s glitch practice involves opening 3D model files in unconventional software, such as text editors or spreadsheet programs, and manipulating the data directly (Figure 10). This way



Figure 10. A 3D scanned head, with forms distorted by databending. Artwork by Mark Klink.

of working lends itself to experimentation, as the artist cannot immediately see the outcome of their changes. However, Klink also notes that simply “play[ing] around” with new tools can result in work that only has a superficial novelty but does not invite extended or repeated engagement from the viewer (2016, para. 11). Consequently, Klink views thematic development from his experiments as a necessary part of the creative process that extends beyond happenstance (Klink, 2016; Malatesta, 2018).

### Reflection Questions

- Databending practices typically involve experimentation and discovery, rather than working with an intentional plan or goal. The results can be unpredictable, and you cannot immediately see the outcomes of your actions. What are the possible benefits and limitations of this process?
- Both of these artists create works that exist as digital forms—programs, video files, and image files. What challenges exist in creating physical versions of databent and glitched models through 3D printing? How could you overcome these challenges?
- Several of Mark Klink’s artworks use scanned sculptures as their source material. What ethical considerations does an artist have to consider when appropriating cultural artifacts? Can glitch be harmful? Should certain artifacts be “off-limits”? Why or why not?

### Equity and Implementation Considerations

When working with newer technologies, concerns about accessibility and cost of materials, and attendant critical concerns of educational equity, are inevitable. The authors have explored these concepts with a variety of students in different contexts with different amenities, including a public high school art computer lab, a remotely taught summer camp for middle school students, and a workshop for undergraduate students on a college campus. In all cases, free modeling software, such as SculptGL and Tinkercad, and free text editors, such as Notepad, TextEdit, texteditor.co, and Notepad++, were used. SculptGL, Tinkercad, and texteditor.co are also browser based, which made them useful and equitable in remote teaching settings, where some students were accessing the program from inexpensive Chromebook devices that cannot install software. While author Knochel had access to relatively costly 3D printers and scanners in his on-campus workshop, author Meeken has explored glitching digitized forms without 3D printing, relying either on free online repositories of scanned objects or by using a repurposed Kinect camera from an old Xbox game system as a 3D scanner (at the time of writing, the average price of a Kinect camera on eBay was \$20). While different settings may explore these concepts and processes in different ways, this resource has been informed by experiences in a variety of settings and is designed to afford students critical engagement with glitch practices in varied educational environments.

## Conclusion

As digital capture, distribution, and presentation of physical objects become more commonplace, it is increasingly important for students to have a critical awareness of the systems that perform this work. Glitch art practices are a form of inquiry that makes digital systems more visible and susceptible to critique; however, they are not often explored in 3D modeling or digital fabrication curricula. In the authors' experiences teaching with glitch practices, students have developed and explored new critical understandings of digital materials. For example, exploring databending with a group of middle schoolers in a summer camp program resulted in students developing a greater curiosity and confidence regarding the digital files they were using, resulting in heterodox experimentation beyond the system's prescribed file associations—opening MP3s in Photoshop and JPGs in Notepad. Glitch processes have helped make digital fabrication more accessible to youth in the maker workshops the authors have run. In particular, a workshop student whose vision afforded her legally blind status, and for whom computer screens were difficult to see, would likely have found the expectation to create a polished, commercial-grade 3D model exclusionary, but she enthusiastically

participated in the processes of scanning herself and glitching that scan in Tinkercad. The workshop's 3D printer also allowed her to create physical glitch works, rendering digital systems not just visible but *sensible* in a tactile way that was more accessible to her. This resource aims to provide an accessible way for art educators to explore these issues and practices in their own settings by fostering critical sensitivity to digital systems that capture physical forms using experimentation, play, and meaning-making. Additional free resources, including process tutorials and handouts, may be found on the MAKE 3D curriculum page.<sup>2</sup> ■

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## Endnotes

<sup>1</sup> The term *mesh* describes the collection of points, edges, and facets of which a 3D model is composed. The connected points that make up the surface of a model visually resemble a net or mesh.

<sup>2</sup> <https://sites.psu.edu/mobilemakerspace/make-with-us>