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Making, Creative Learning, Technocentrism, and Hope

Much of the work in this book comes down to supporting the creativity that is too often institutionally bled out of students. We have focused on how to provide spaces and opportunities for students to express themselves through their learning in ways that are benefited by positive perspectives on data. In the end, learning is about affording students agency by giving them the space and teaching them the tools to express themselves. In the past 10 or so years, a *maker movement* has sprung up to enable kids to create with code, where they can try out 3D printing, electrical engineering, mechanical engineering, and more. In some ways, the maker movement has, by and large, afforded that agency to those children who are and have been otherwise supported in these domains by their parents, teachers, and community. Making can be technically difficult—even dispiriting—for adults. For every example of kids with resources simply getting more resources, there is an example of a school makerspace, or a library makerspace, or a community center with a creative lab for making video games that is designed to explicitly support minoritized youth. In particular, the work of Kafai and Peppler (2014) has been crucial for seeing that making is not a boys-only activity focused on creating killer robots (though it

certainly can be that) and that technological or technical creativity is not restricted to classically masculine-coded pursuits.

As much as we see the possibilities in these broad spectra, we also recognize that there are a lot of making practices that are not perceived as *making*. In this sense, there is a degree to which some technical pursuits are given different names based on how administrators perceive them. For example, hip-hop production is an extremely technical pursuit, but it is primarily structured to appeal to young men and boys. Similarly, textiles and weaving are forms of making that are coded as being for young women or girls, regardless of their technical (or aesthetic) interests. As a result, the framing of these as maker-included pursuits is often ignored. This is not a question of marketing or branding; it is a question of equity. Who is considered a *real maker*? The prevalent stereotype that only the “boy stuff” is technical enough limits social considerations of intellect, ability, and the possibilities of transformative schools for social, civic, and financial purposes.

What Is Making?

There is robust scholarship examining the intersections of learning and hip-hop (e.g., Adjapong & Emdin, 2015), but the politics of the intersection still plague the boundaries. Is it *only* racism that means “Hip-Hop Ed” is not typically thought of as maker education? Would it diminish the incredible work of the Hip-Hop Ed community (e.g., Ladson-Billings, 2014) to lump that subject in with positivist glosses on traditional engineering education content? Alternatively, is maker education a diminished form of Hip-Hop Ed, in the sense that it can be making with some cultural relevance stripped out?

As we dig deeper into the speculative and justice-driven possibilities of making and creative technology, we want to recognize two underlying tensions: the missing scholarship that should be a part of the historic work in this field *and* the overly-endorsed assumptions

that digital tools, even if they are meant to harness young people's creativity, are not the long-term solution to nondigital inequities that plague school systems and society writ large.

When we look at unique forms of making that young people encounter, engage in, and “geek out” about (Ito, 2013), we find that the kinds of activities that might be considered making are as unique as the kids involved in them. It is feasible to consider choosing toppings at a fast casual restaurant as a making activity.

However, if nearly *anything* could be considered a kind of making activity, how can we find a way to foreground making that will support or enable new perspectives? Is reading a book on the impact of anti-Blackness in the US and subsequently tweeting about it a form of making? It certainly has the possibility to foster new perspectives. In contrast, is learning how to optimize your C code a form of making if it doesn't change your perspective at all? Is an architect's drafting of the specifications to construct a bridge a form of making?

Such questions are semantic (at best). The bounds of the term do not matter so much as a recognition that the term carries different meanings for different people. We will not resolve a definition in this chapter, but instead will focus the question more tightly: Can (and, if so, how do) data support creative, technical, expressive work that enables new, just perspectives?

This chapter treads a funny line: Matthew and Antero believe in the power of creative expression. Plenty of theoretical and empirical work exists that justifies that position, but there is a clear positionality question: is there a tendency to imagine that the things we *like* will generate a positive future? It is possible to argue that creative, technical work in education will be inherently technocentric from a Foucauldian perspective, and that working in sexist, racist, neoliberal traditions merely replicates those structures of power? Indeed, Apple (2004) argues that whenever the focus of an education is *production*, we should be wary because we are being groomed as the product of capital. That the trend in schools has been to add makerspaces, and that administrations

seem broadly amenable to the idea, might suggest that those administrations see things like job preparation (rather than, say, civic education) as the chief goal, even with students as young as grade school. (Rhetoric from computer science [CS] education, regardless of sociopolitical or theoretical orientation, cannot help but mention job preparation; based on personal experience, almost every student, parent, teacher, and administrator asks about it.)

One rebuttal hip-hop education puts forward is that maker education can be antiracist if you are explicit about making it antiracist. Eglash et al. (2021) have done some excellent work here, but it is not yet the mainstream push of the subfield. It is also relatively suspicious of data as a subfield. At last check, Google Scholar has only a page or less each for searches that include either “anti-racist” or “social justice”; some version of “maker education” or “constructionism”; and some version of “data science” or “learning analytics.” Some of those hits are from the authors of this book, and most of the rest are from people we have already cited by this point in this book (e.g., Eglash et al., 2021; Payne et al., 2021; Reynolds et al., 2019; Turakhia et al., 2022; Vakil & McKinney de Royston, 2022; Weintrop et al., 2020).

Can we take a broader data and justice perspective on making?

Data and Making

This is a good excuse to turn back to AnSpec to evaluate how, when, and where data is being used in creative endeavors. There is, perhaps, an assumption that a child’s hand turkey outline¹ is the last vestige of presurveillance. This may be why few scholars are looking to explore the space.

AH: Anonymous Individual Making

Graffiti makes a better example than a theoretical hand turkey. It is designed to be both anonymous and individualized: simultaneously personal, connected, and untraceable. People work hard to improve,

and they might occasionally work together, but if you are traceable, you can no longer work in the space. In some ways, graffiti is a hope for humanity. People engage in it to better themselves, create art, and spread their message without the promise of financial or personal gain and against the threat of legal consequences. Graffiti is therefore, to some extent, an example of learning for learning's sake.

It does not go without saying that graffiti is almost universally recognized as a point of resistance, whether positive or negative. Most movies, TV shows, news broadcasts, or video games that feature civil unrest take pains to show the “INVADERS GO HOME” or other graffiti messaging on the main square; shows about urban poverty linger on graffiti that signifies gang warfare; and it is almost impossible to see any representation of the New York City of the 1980s that does not include a subway car awash in color.

This chapter is not an argument to join a graffiti crew or tag the Austin MetroRail so much as an argument for the notion of annotation in making. Kalir and Garcia (2021) wrote an entire book on that argument, so we will not rehash it here, but the “data” take is clear: creating traces influences later interpretation. Those traces need not be identifiable (and, in the case of graffiti, probably should not be, for the tagger's own safety), and they are each a teachable moment of resistance (Avramidis & Drakopoulou, 2012; Eldridge, 2013).

IH: Identified Individual Making

Most making activities for education and learning might engage individuals in something like “coding” or electrical engineering or textiles. Textiles, code, and gadgets exist aplenty, so the point is *specifically* to experience the joy of making something that feels “more like you” than any pre-existing product. The aforementioned electronic textiles (Kafai & Peppler, 2014) are a good example of this. These textiles enable people to express themselves through creative activity that is distinctively individual and marked, and they are also quite personal. The technology is possible to “assess” in a classic mode, but it is quite clear how deeply that misses the point: it is unlikely

that students will wear even the most technologically sophisticated creation if it sacrifices significant aesthetic value. However, students are likely to work quite deeply and thoughtfully on clothes that they plan to wear. In practice, we have solid empirical and theoretical evidence that this is so (Peppler et al., 2016a, 2016b).

IH work can itself be resistance to sexist technocentrism. For example, Buechley (2016) and Blikstein (2013) show that learning opportunities that are forms of personal expression can be quite powerful. That said, personal expression as data makes a tricky argument: what is data that shares few features in common? There is a natural temptation to reduce it to a lowest common denominator: the code that makes a shawl show a message, say. This is likely a misstep that reframes the personal and humane as a purely technical experience and assumes that what is valuable about the experience is the most technocentric subset of that experience. It rejects the values of the activity and substitutes others.

This highlights (perhaps late in the book) the value of IH data as *difficult* data. Often, IH data is something of which to be careful, but, in this case, it is data's very individuality and idiosyncrasy that make it hard to assess or process. A tweet might be just as personal, but it is encodable; a scarf that glows per the local weather forecast is very hard to compare to a backpack that recites lines from song lyrics. Matthew has done work (e.g., Berland et al., 2015) in which he evaluates the idiosyncrasy of student program code as a goal; his team used these data to help the teacher help students find potential partners. In this study, the IH data was used not as a means of grading or evaluation but as a tool to increase collaboration and help teachers with a minimally invasive classroom tool.

AG: Anonymous Grouped Creativity

In many anonymous creative group activities—such as people singing along at a concert or leaving locks on the love bridge—the point of the activity is to be part of a crowd and to leave something creative

behind in aggregate. Anonymous group creative work can make up some meaningful facet of life in a city; every day, city dwellers pass by any number of elements of art, music, or speech. These stimuli jumble together and become the noise of the city: horns honking a tune, marching bands, and street preachers. One could argue that these things are not anonymous at all—that it is possible to determine the identity of the people who make the buildings, the house decorations, and so on—and it may be the case that functional anonymity will disappear as technology improves. That said, you could walk up to a street preacher, and he may choose to tell you his name, but that is his choice and, without robbing him of his identification documents, there is no guarantee that the name that he does or does not give you has any relationship to his experience. The same is true of so many of the musical or lyrical or verbal components of walking around New York City, Boston, or London. What could be a more salient anonymous group creative activity than a spontaneous “second line” marching band parading through the heart of New Orleans? Anyone can join, anyone can play, players and marchers come and go, but the music carries through; it is not attributable but represents in a tangible way the culture of the city.

A labor union can be an example of data as action, on an aggregated spectrum that can range from fully anonymous to fully identified. Although the identity of individual union members can be determined, the values of the group are group values. Relative anonymity in the union is power; members can speak and act as thousands when interacting with those in power. The union itself can use data to find and leverage potential new members, donors, or political actions. However, the identifiability of potential organizers is a lever for an antagonistic boss; while it is technically illegal to fire someone for union organizing in the US, it is so easy to fire someone that it is wiser to use anonymity as a tool.

IG: Identified Group Making

Many public makerspaces serve as mini art galleries for the creative work that happens in them. There are dozens of examples of makerspaces that hang metal work, laser-cut art, or LED winking electronics from walls and the ceiling. They typically have some set of names attached, but we have yet to see one where everybody's individual contribution to the creation of some electronic gewgaw was spelled out explicitly. The objects are created, exhibited, made, and serve as an implicit assessment of the kind of work that is possible at that makerspace; they signal the kind of thing that you learn to do by spending time there. The possibility space is attributed to some combination of all the people, materials, and knowledge in the makerspace. In that sense, there is something beautiful about showing off the broken and half-finished—but still “cool”—projects. There is something freeing in a makerspace that does not simply exhibit the very best projects, but also the failures, sidetracks, and weird ideas. On a trip to a makerspace not long ago, there was an example basketball hoop made by a group of kids that displayed both how many baskets had been made and the average speed of the ball as it entered the basket. It really did not seem to work correctly, but it was both generative and welcoming to kids precisely because it looked like a mess. The kids exploring the space with me had many questions about it. It was very clearly made by kids, for kids, and you could (presumably) ask them questions if you emailed the addresses that were taped to the backboard. It was made visible in the space because many would-be creators might be tempted to try to make their own version. The project sent a clear message: things you are interested in are here, you can do them, and they don't have to be perfect. That is a fantastic use for data.

Speculative Making, Data, and Justice

Perhaps because it does correspond to capitalist modes of production and progress, maker/arts education pops up in an overwhelming amount of speculative fiction. The act of creating speculative fiction is itself a technical and creative act; it is most prevalent as a simple reflection of its medium. That said, the contrast between “what counts as education/learning” and “what counts as child labor toward creative output” is curious and worth exploring. Disney’s *Big Hero 6* (Hall & Williams, 2014) imagines a school as a sort of technocentric, corporatist MIT Media Lab for children. The presumption is that this ragtag group of youth have some “genius” that enables them to do mechanical, electrical, and computer engineering extremely quickly and uniquely. This conceit springs from an extremely long line of similar themes, in which the superhero-protagonists are children who somehow invent something truly unique and immediately usable in practice. (One might argue that David’s remarkable anti-Goliath sling is an example.) Spider-Man (e.g., Watts, 2021) is a classic example of a teenager who can (in some stories) barely pass his high-school classes, but who is able to create an engineering masterpiece in his “web shooters.” Notably, this technology cannot be replicated by anyone else (they are a personal expression of his new powers) even though there is (typically) no point in the comics at which he learns the skills and knowledge to do this. In some versions of the Spider-Man mythos, he learns from Otto Octavius, at Empire State University, or from a friend, but in almost all scenarios it is a creative personal expression of who he has become. It is sometimes implied that it came from his parents who died (or went missing) when he was a baby; in so many cases, engineering education is more inherited in comics than it is taught.

The most recent *Space Jam* (Lee, 2021) suggests that the technical ability to express oneself by creating games may be similarly genetic.

The character who plays the son of LeBron James creates a video-game so powerful that it has the potential to imprison all human life on earth, but he could not be more excited to go to a basic game design camp where he will presumably learn . . . something? (Both of us have taught related material, but our students' games have only rarely ended all life on earth; it is not on any current syllabus.)

The metaphor of creativity being something inherent or innate rather than taught pervades almost all popular cultures' experience with it. Teachers, per Illich (1971), exist as foils to institutionalize creativity rather than support it. No matter whether it is in the past, future, or present, schools are typically represented by bored students munching on a pencil, listening to a lecture. Even in *Big Hero 6*, which presents situations in which people learn through experience, tinkering, and project-based learning, the protagonist learns only incidentally from anyone except for himself. He is given the resources to learn but no guidance that is not explicitly nefarious.

In *Big Hero 6*, as well as Spider-Man comics and movies, data on creative engineering design are neither collected nor shared. It is a trope that stealing the product of a student's design experience—e.g., webshooters—would unlock untold unfortunate possibilities. Those may be obvious McGuffins, but it remains true that most speculative fiction does not imagine a world in which so much as an engineering notebook is kept.

Star Wars is one notable exception, as everyone is learning to fix their constantly failing ships. Although there does not seem to be any school where one can learn to be a mechanic, everyone nevertheless learns how to create, modify, and adapt ship technologies (presumably at the risk of dying in the vacuum of space, though that happens remarkably rarely in this fictional universe). It is consistent with the *Star Wars* imperial dystopia that the purchase of ships is the purview of the elites and that everyone else must learn to work on technology. Small children are expected to be able to build their own droids without outside instruction, and, indeed, are not expected to

have any meaningful amount of instruction. Only the Jedi Academy and the Imperial Academy are mentioned, more or less, as schools, and they are both framed as propagandists. In an odd turnabout, the Imperial Academy is a purely voluntary device for (predominantly white, human) children to become imperial officers, and the Jedi Academy takes children from their parents permanently. In *Star Wars*, educational institutions are propaganda, but technical apprenticeship learning is crucial and good. Due perhaps to the lack of education, data are effectively freely accessible, often wrong, and subject to no security. Secrets are encoded, but always decodable; whether good or evil, the entire galaxy is sort of a “move fast, break things” hackers’ dreamspace.

The Marvel and *Star Wars* universes assume the classically hierarchical position that one either has innate ability or will exhibit total incompetence. What is to be done about a future where people learn only on the job or in times of great need? Is institutional education inherently a counterpoint to engineering education?

Toward Just Futures: Creative Data

The good news is that much of what is so valuable about making practices and creativity is the ways it can emphasize tactility, systems thinking, and literally getting our hands and limbs *dirty* in the complexity in front of us. If some of the problems with democracy, safety, and individual expression are the limitations of the digital platforms and digital tools at hand right now, then the focus here on analog making feels like one pathway forward.

What are the frameworks in which creativity can be sold to formal or informal learning spaces as educational? What are the forms that feel “schoolish” enough to be treated as first-class citizens by schools? For instance, programming computers makes a lot of sense to school administrators as an academic subject; therefore,

programming games can fit in schools. However, programming, say, the hairstyles mentioned earlier (Eglash et al., 2021) is a harder sell, even if it is every bit as complicated and potentially more useful than programming yet another quiz game. Because of the formalist requirements of technological creativity, often the expressive element can get lost. In painting class, are students allowed to paint what feels meaningful to them, or do all students paint still-lives for the entire year?

This question perhaps points us back to Illich on one side with most of current educational research on the other side. Illich (1971), among many others, shows that the institutionalism of the school exists to legitimize itself. Because society is itself racist, sexist, and biased against the agency of children, and because schools must justify themselves to that society, only by explicitly rejecting institutionalism can we enable kids to create things that are meaningful to them. In other words, it would only be educational to enable kids to create if it didn't "feel" educational. Illich is effectively suggesting (at least in modern contexts) that the creation of expressive solutions to personal problems is an inherently good thing. Another critique (from, e.g., Warren et al., 2020) is that by focusing on creative technologies we are enabling a neoliberal, hyper-Western, technocentric perspective on what education means and is. Learning equitable community values is perhaps more important than personal expression; it may be, at least, a crucial prerequisite for responsible personal expression. Obviously, they can coexist, but they can also directly conflict. boyd (2014) shows how memes and media generated by young people can be clearly personal expressions of values while manifestly entrenched in reactionary models of power and truth (e.g., white supremacy, incel culture).

Perhaps ironically, this potential for technocentrism is often incompatible with (or at least not amenable to) surveillance capitalism. Despite generating reams of data (artifacts, physical tools, digital production) in almost every maker project, there is very little work

on using those data either for selling to corporations or for improving student experiences. One counterexample—GitHub Copilot (GitHub, 2022)—uses the data of the millions of source-code repositories to generate live “boilerplate code” for new projects. It is an unquestionably neat gimmick: someone could write a working program with clever seed words and a liberal use of the Tab key. Similarly, though research projects (including ones conducted by the authors) have used student-generated data of this type to help those students in live teaching contexts, it remains extremely uncommon to see a product that adopts this approach in public schools. It is surprising enough that it raises the question “why”? Potential answers vary: the data is too noisy; the outcomes vary too much; creative work is too hard to categorize. The problem likely results from a metaphor mismatch. If students are being asked to be “original” and “creative,” they may not like to think of their work as data, which can feel either anonymizing or institutionalizing.

Perhaps unsurprisingly, we are landing on the perspective that making and creative education have vast potential to disrupt potentially harmful modes of both pedagogy and data analysis while embracing explicitly antiracist and justice-oriented perspectives—though not without a passel of potential pitfalls. In the conclusion to this book, we will try to compress all of this into specific, actionable suggestions.

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The Left Hand of Data

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