10 CHEESEMAKING EMANCIPATION: A CRITICAL THEORY OF CULTURAL MAKING

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The explosive growth of the maker movement and fab labs in education might appear sudden, but the pillars upon which these movements rest—constructivism, constructionism, project-based learning, critical pedagogy—have been slowly engendered for decades. Critical pedagogy theorists emphasized learners' empowerment, emancipation, and culture (D'Ambrosio, 1986; Freire, 2000). Constructionism brought visibility to the role of media, tools, "objects to think with" and powerful ideas. As a much-cited Papert quote states:

> Construction that takes place "in the head" often happens especially felicitously when it is supported by construction of a more public sort "in the world"—a sand castle, a Lego house, a computer program ... Part of what I mean by "in the world" is that the product can be shown, discussed, examined, probed, and admired. (Papert, 1991, p. 142)

Edith Ackermann, creatively combining Piaget and Papert, contributed with the idea of a cognitive dance—"diving in," or being immersed in the activity and being one with the medium, and then "stepping out," or emerging from the embeddedness. She reminds us that the attention to "hands-on" learning is just half of the story, and that the full cycle of building and reflecting, closeness and distance is what makes constructionist-inspired learning so powerful (Ackermann, 2001). Finally, Turkle and Papert completed the puzzle by reminding us that this process could take many forms and shapes and that children might want to program a computer or build robots in ways that might violate the canonical rules of professional coding and engineering—productively and creatively going against the grain of well-established practices in these technical fields (epistemological pluralism, Turkle & Papert, 1991).

Even though this primordial soup has been around for decades, it was not until the advent of the suitable social and technological infrastructure that the maker movement was able to take flight in schools at scale. It was a perfect storm: in the early 2000s, these theories and early experiences were met with cheaper and better technology (e.g., low-cost microcontroller boards, 3D printers), social acceptance of the tenets of progressive education (the rise of "twenty-first-century skills"), abundant funding for STEM education, user-friendly software (block-based programming, web-based software), and a critical mass of like-minded researchers and practitioners (Blikstein, 2018). Unfortunately, instead of celebrating and honoring the intellectual roots of maker education, many of its advocates are reinventing the same ideas and repackaging them into discourses that embrace the agendas of corporations and national bureaucracies, leaving youth empowerment and agency as an afterthought.

But the worldwide growth of the maker movement has been so fast—compared to the customary pace of educational reform—that we have not been able to reflect on fundamental questions about making in education. *Chief among those questions is how to think about equity, culture, power, and context.* In the Logo days, this question was somewhat less explicit since computers were new and unfamiliar, so there were no "indigenous" or familiar ways to deal with programming. But making is a more general type of practice, enacted on basic or advanced materials, with no or high technology: we have been programming for just a few decades, but people have been "making" for millennia. The fact that the term "making" can encompass such a wide range of activities makes its relationship with learners' culture and previous knowledge more intricate.

This poses a challenge that critical theorists and historians of science have already struggled with when considering the relationship between Western science and the local knowledge of indigenous peoples about nature and biology (Morrow, 2008). This scholarship, more recently framed in the context of Decoloniality (Quijano, 2000), has increasingly influenced science and mathematics education research (Carter, 2004). But we are still in the midst of this turbulent debate between cultural totality, respect for others and their epistemologies (Carter, 2004), and romanticization of the *beau-sauvage* (Semali & Kincheloe, 1999).

WHO ARE WE TO IMPOSE OUR PRACTICES AND EPISTEMOLOGIES ONTO OTHERS?

This question, which has concerned Freire, D'Ambrosio, and many other scholars (emancipatory postfoundationalism, Morrow, 2008) for decades, is as vivid and timely now as it was then: who are we to impose practices and epistemologies on others, de-historicize science and technology, and deem some types of knowledge as superior? Ethnomathematics (D'Ambrosio, 1986) was the first well-developed attempt to find curricular and theoretical combinations of so-called normative and alternative knowledge in the field of mathematics—but it has nevertheless been controversial. Some scholars condemn attempts to equalize Western and indigenous or local knowledge, claiming that such attempts overromanticize oppressed populations and uncritically accept their knowledge as intrinsically superior or unquestionable. On the other side of the spectrum, researchers claim that conventional science or mathematics, as well as its methods and goals, cannot be taken separately from the historical context that generated them. Therefore, claims to its superiority would also be biased toward the dominant culture—perpetuating existing oppressive schemes and historical injustices. Freire, a man of praxis who was often confronted with the challenge of bringing these ideas to real school systems, tried to find compromises:

> Low-income boys and girls have the right to know the same mathematics, the same physics, the same biology as affluent boys and girls, but we should not accept the teaching of any content that does not include a critical analysis of how society functions. (Freire, 2000, p. 44)

Freire's position makes it clear that even after decades of work on critical pedagogy and ethnomathematics, the devil is in the details: how exactly can we balance conventional and indigenous knowledge in real classrooms, in the complex balancing act between building cultural capital, fostering inclusive learning environments, and connecting students' lived experiences to their education? For mathematics, Adam, Alangui, & Barton (2003) hypothesized these possible scenarios: Ethnomathematics as (1) a full replacement for conventional mathematics, (2) a supplement so that students see mathematics as a response to human needs found in nearly every culture, (3) a springboard for academic mathematics, (4) a progression in which ethnomathematics is a stage in a process that starts from the mathematical world of the child and then moves into other cultures, (5) a support for preparing rich learning situations and activities, and (6) an approach that looks at the classroom itself as a situated cultural context and mathematical learning as part of this context.

Even after decades of work and debates on mathematics, there seems to be a vast space of possibilities, which points to the complexity of the challenge for the much younger field of maker education. But can these previous debates shed light into the role that culture might play in maker education? Could there be Ethnomaking? Would it be a mere transposition of the six categories?

ETHNOMAKING: CONVENTIONAL VERSUS LOCAL KNOWLEDGE IN MATHEMATICS, SCIENCE, AND MAKING

One difficulty in examining scientific versus local knowledge in mathematics and science is that in modern societies they have become vast, specialized professional practices, rarely performed by ordinary citizens. But making is intrinsically less of a specialized profession and more connected to everyday life, so the comparison between conventional and other types of making might be more apt. Second, everyday practices and devices across cultures, although diverse, have a lot of commonalities. Most societies need to farm, build houses, prepare food, shape materials, or automate or offload repetitive chores—which embed micro-tasks that relate to making. In that context, what would culturally aware making look like? To examine that question, we first need to establish the "maker equivalent" to conventional mathematics or science. The activities in most makerspaces in the United States and Europe revolve around working with robotics, electronics, and microcontrollers; programming computers; generating objects using 3D printers or laser cutters; and working with e-textiles and other enhanced craft materials. Ethnomaking, or cultural making, would then comprise activities, materials, practices, and themes that are attuned to a more specific group, culture, or region (such as basket making, pottery, electronics upcycling, woodworking, or costume making).

One way to envision the possibilities of cultural making is to hypothesize an analogy with ethnomathematics, thus as (1) a replacement for conventional making, in which indigenous or local making techniques would take the centerstage, (2) a supplement to conventional making classes so that students can appreciate human ingenuity, materials, and techniques in other cultures, (3) a springboard or motivation for learning about conventional making, (4) a progression in which ethnomaking is a stage in a process that starts from the maker world of the child and then moves into other cultures, (5) a support for preparing more rich and diverse learning activities in makerspaces, or (6) a framework to structure the maker classroom itself as a situated cultural context. Not all of these possible frameworks have been enacted in maker education, but there are three common designs. The first is to let children choose personally or community-meaningful projects to make. The second is to create materials and kits that connect existing cultural practices to emerging technologies (e.g., Buechley & Perner-Wilson, 2012), and the third is to choose themes or project prompts that align with students' cultures and lived experiences (e.g., Blikstein, 2008). Even though these have resulted in rich learning experiences and significant advances in how we think about maker education, it is clear that there is a wide space for new research and design in cultural making. But the main goal of this chapter is to take a step back and examine one possibly overlooked aspect: the fundamental rationales and justifications for maker education, and their own cultural bias.

Even within progressive educators, the predominant rationales for making are dominated by European or US-centric perspectives, with little regard for international or nontraditional contexts. These rationales can be summarized as follows:

- *Making as a job market skill:* Helping children learn engineering and programming
- *Making as a tool for deconstruction of industrial products:* Repairing/reusing, and as resistance to mass standardization and industrialization
- *Making as a way to have control of what you eat/use:* Rejecting industrialized products and making your own food (e.g., to have control of the ingredients), furniture, lamps, or other products (e.g., to make sure they are sustainable)
- *Making as understanding technology around you:* Understanding how everyday technology works, such as social media, computers, cell phones, household appliances
- *Making as personal expression and creativity:* Creating artistic or creative inventions

Although some of these components might seem hard to argue against, they came about in the context of the richer parts of the globe. Perhaps progressive educators in developed countries are unaware that goals such as "rejecting industrialized products" or resisting against technology massification are concerns germane to the developed world. Thus, counterintuitively, despite seemingly harmless, some of these rationales might become obstacles for designing truly inclusive experiences, especially in the Global South and other developing areas. To further examine this issue, I will resort to two vignettes of observations collected as part of a series of interviews with artisans from different countries.

MAKERS AROUND THE WORLD?

Vignette 1: Fatma in the Bedouin Village

In a remote Bedouin village in the Middle East, Fatma shows a spherical and dense piece of goat cheese and talks about how much work it was to make it. She is a very special member of the village, being one of the few women who were interested in studying and getting a degree. In the village, Fatma says, women spend copious amounts of time making many of the products needed for daily life from scratch, such as food and clothes. I asked her if she felt proud of the cheese she made, and if it was different from buying it ready-made from the supermarket. She looked at me puzzled and replied that being able to go to a grocery store and buy ready-made goods was a true liberation. She liked her goat cheese, but there was nothing magical about it. For her, saving hours a day by going to the supermarket was empowering and useful since she was able to redirect her time to other endeavors, such as studying and reading.

Vignette 2: Somsak in the Rural Village

Somsak is an artisan who lives in a small rural village in Southeast Asia. He makes wooden horses that are sold as souvenirs for tourists. He uses a soft, easy-to-carve wood and a set of metal tools that he proudly claims to be the only carving instruments he has ever used. As I talk to Somsak, he keeps working, undisturbed, as if the sculpting was completely automatic. I was initially impressed: not only was he using native materials and tools, but he was being artistic and doing what he loved for a living. But in the course of the interview I realized that I was mistaken. I learned that Somsak makes many identical horses a day—sometimes twenty in just a few hours. He sells them for one US dollar each to a middleman, who also tells him the exact horse poses to make, based on what sells well. The horses are then taken to a different facility to be attached to a base and receive a coat of varnish. Somsak was just a small piece in a large distributed industrial complex.

I asked him if he ever thinks of doing his own designs and horse poses. He looked at me perplexed, and said, "No, why would I?" He had no say on the poses or even the animals to be sculpted, and he did not miss it. I then asked if he would feel differently about his craft if he had a machine to make the horses. He welcomed the idea wholeheartedly and said that he would not miss making horse sculptures, telling me that if I was to create such a machine, "I will be your first customer!" I also asked Somsak if he was proud of his horses, and if he had any at his home for decoration, to which he replied, "Why would I have such ugly things at home?"

FATMA AND SOMSAK: MAKING IN CONTEXT

Fatma's vignette shows that the idea of makers as deconstructors of industrial products and producers of their own "stuff" found no echo in her life, despite being a progressive, valuable goal in a developed country. For Fatma, it was empowering to be able to stop making some of her own food and instead buy it at the supermarket. Resisting against industrial foods or mass-produced household items made no sense and would not have improved her life.

Somsak's story shows the breakdown of another component of the conventional, US-centric definition of making. An external observer could see in Somsak the prototypical indigenous maker: a naïve artist in a remote rural village, using native materials to make beautiful wooden sculptures. He had the "maker mindset." He was using his hands. He was being artistic. But in reality, he was just a small peg in a geographically distributed system for the production of souvenirs, more a factory worker than an artist. Somsak's horses would be worth nothing if they were not "made by hand": no tourist would want to take home a sculpture made by machine. Somsak could look like a maker, but he was just a factory worker producing objects with no personal connection or meaning. Ironically, making by hand was a prison for him: because of the attribution of value that affluent tourists make to "hand made," any automation or improvement to the process would immediately annul the value of the product he had to offer.

IMPLICATIONS FOR DESIGN: HANDS-ON OPPRESSION AND CHEESEMAKING EMANCIPATION

The US-centric definitions of making that prevail in most makerspaces would be at odds with the lived experiences of Fatma and Somsak, for whom producing objects by hand was a symbol of oppression, alienation, and poverty. Sculpting wooden horses, or generating physical objects from organic materials, although romantic from the outside, was a proxy for repetitive and meaningless work. However, the exact same activity could well be a sign of liberation for an engineer in Palo Alto, United States, who might crave craft activities with organic materials, instead of dealing with computers. The process of making homemade cheese in the Bedouin tribe reminds Fatma of her long hours at home and of the college classes she could be taking instead. But cheesemaking might be emancipatory and life changing for a child of an affluent family in New York City, United States, who has never been to a farm or made his or her own food. Conversely, in Somsak's own words, a horse-making industrial machine would be liberating, and he would be happy to never touch his "maker" tools again. Fatma would rather just go to the supermarket and acquire her industrialized food.

In reality, for most of the world's population, not having to make your own food or furniture from scratch would hardly be considered a problem, and soapmaking, glass blowing, or woodcarving still represent exploitative practices or unhealthy work. As making celebrates the customized, the anti-industrial, the artistic, and the inefficiency of giving up industrial production, it often ignores that those might not make sense outside of affluent regions of the world. Glorifying the "handmade" is a profound demonstration of power.

But this does not mean that a *soapmaking epiphany* in Palo Alto is not real nor that we should not pay attention to *cheesemaking emancipation*. A misguided response would be to conclude that cheese and soapmaking are not worth studying or promoting and that technology only emancipates the less affluent. But it is of concern that most of the makerspaces, materials, curricula, machines, and theoretical frameworks are coming from prosperous nations and communities. What would Fatma's or Somsak's children think or feel when attending a maker workshop that celebrates practices that oppress their own parents? Definitions of making and makers such as "everyone is a maker" or "every child is a maker" reinforce the assumption that all forms of making "things" are voluntary and empowering. Perhaps some adults and children around the world would rather not make anything with their own hands?

CULTURAL MAKING

Researchers have responded to these challenges by creating new sets of materials or adapting themes of maker activities to different populations. But in Freirean pedagogy, the fundamental question is not only about respecting the local culture and context, but fundamentally about the compromise between what is already there—the culture, the practices, the materials—and the new elements that teachers or designers want to bring. And there lies perhaps the most important element of culturally aware making, since there are so many pre-existing making practices in any given community, as well as culturally specific values attached to those practices.

Whereas much of the academic debate in mathematics or science education is about epistemologies and bodies of knowledge often at odds with one another given the convergent nature of traditional science, *the divergent nature of engineering and making might offer opportunities for more creative, democratic, and inclusive combinations*. Conventional science seeks to find one single law to explain a wide range of phenomena, so different worldviews and epistemologies are not easily combined. But the divergent nature of engineering—per which multiple solutions to the same problem are accepted and encouraged—might offer a more fertile ground for different perspectives. For example, Cavallo's work in Thailand (Cavallo, 2000) identified deep local expertise in repurposing internal combustion engines for a variety of purposes, and my work in Brazil showed the same type of expertise in repurposing electronics (Blikstein, 2008). Both the Thai engines and the Brazilian repurposed tape decks are rich examples of spaces in which different epistemologies and knowledge systems co-exist productively, so the pre-existing and the new might not necessarily compete but complement one another. Internal combustion engines could be considered, for Western scholars, a symbol of economic exploitation, environmental damage, and pollution. But those same engines, in the context of rural Thai communities, became instruments of community development and emancipation, as self-taught local engineers managed to adapt engines for their boats, rice mills, and water pumps. Similarly, in the hands of the creative minds of Heliópolis, Brazil, consumer electronics were repurposed into all sorts of machines and contraptions that improved the livelihood of entire communities. These cases counter the "beau-sauvage" assumption, in which Thai farmers would only care about their traditional agricultural appliances, or that Heliópolis dwellers would not want to approach "foreign" technology.

These hybridizations should not be only about tools and materials but also about emancipation. Cultural making or ethnomaking should be about engaging with different populations, cultures, and contexts to identify and leverage the most emancipatory components of a given process, since we know that ultimately the mere existence of physical built artifacts—a wooden sculpture, blinking LEDs, or a 3D-printed keychain—is not an assurance of learner empowerment.

This goes against the common assumption that technology or science is necessarily oppressive for nondominant populations. In fact, it begs the question: who are we to impose our own academic views of what emancipation looks like to others, using stereotypical templates of what others want and need? What if local populations do not want to reject science or technology, but rather reshape and repurpose them to their own ways? The work of Paulo Freire is a good example—Freire did bring an element from the outside (normative written language) to disenfranchised populations but did so in a way that empowered individuals against an oppressive system.

Cultural making, thus, should go beyond specific materials, machines, themes, or spaces that exist in schools. It should be about finding mutual space for the enhancement and enrichment of old and new individual and social practices that could be at the same time locally relevant and intrinsically valuable. And even though the determination of what is "intrinsically valuable" could be controversial, I would like to suggest three possible criteria:

1. *The Principle of Emancipatory Making.* The first is the Freirean assumption that humans have an ontological vocation to change and improve one's own reality. Freire eloquently states that humans have the latent potential to go from the "consciousness of the real" to the "consciousness of the possible" by understanding "viable new alternatives." Thus, an intrinsically valuable goal of culturally aware maker education would be to take students from the acceptance of one's given reality to the possibility of changing it, *latu sensu*—which could apply to all cultures, countries, and contexts—even if "change," for many communities, might mean to resist external pressures to abandon their culture and habitat or, conversely, creatively appropriate external tools to enhance their own livelihood.
2. *The Principle of Powerful Expressiveness in Making.* A second intrinsically valuable goal for maker education derives from the first. To create new solutions, one needs exposure to diverse ways of connecting intention and implementation—it is the mediation of powerful tools and ideas. An idea that stays in the head and cannot be realized is not very useful. In many makerspaces, tools such as 3D printers and laser cutters are the ones that help students connect idea and realization and express themselves, but there could be many others (including traditional and indigenous tools and ways of making). Thus, maker education should be constantly concerned with the design of high *and* low technologies that ease the path between imagination and the world. In some contexts, laser cutters will the best tools to make this connection; in others, it might be a powerful technique for shaping clay. But there could be, also, many indigenous or high-technology tools that do not enable children to express their ideas—therefore, the value of tools and practices should be proportional to their expressive power rather than where they come from.
3. *The Principle of Learnability in Making.* A final intrinsically valuable element in culturally aware maker education is that there should be some measure of sophistication and complexity for products and processes so that *learning* can take place. Even within a given culture or context, there should be ways to determine if a given artifact is interesting, sophisticated, or clever. We should resist the all-too-Western custom of falling for the *beau-sauvage* fallacy: the fact that Somkat's horses were created locally with traditional tools does not mean that they are remarkable

artifacts. Hence, even within a given culture and context we should understand the criteria by which quality, sophistication, and complexity are judged—there should be such a thing as an uninteresting wooden horse or an unremarkable clay sculpture, in the same way that there could be a dull LEGO robot. Having culturally aware ways of assessing the quality of artifacts also guarantees the existence of a trajectory of learning—students should be able to get more skilled at expressing their ideas. In the absence of a learning pathway and rubrics of quality, maker education becomes merely "making."

Thus, in dialogue with different populations we can understand what they want to achieve, if the tools and practices of making can help, and how to ascertain quality to students' productions. Even new or foreign procedures and technologies can give novel meaning to everyday routines and objects, improving them along community-relevant metrics: either more sustainable, aesthetically pleasing, elegant, or efficient. In this process we should focus on empowering people to change their world and on supporting social and cognitive processes that would enable this transformation (D'Ambrosio, personal communication, October 4, 2019).

We should not de-historicize science and technology nor uncritically accept local knowledge. We should also not make assumptions about what oppressed populations want based on armchair views of those populations, forcing US- and European-centric academic frameworks onto complex, historically constructed realities.

Cultural making should not be about romanticization of the *local* or simplistic incorporation of cultural elements into the production of objects. Cultural making should not be about uncritically importing academic agendas that do not fully understand learning and education, or ignoring that youth culture around the world does not always follow the calcified, same-old views of US-centric "revolutionary" researchers. It should be about powerfully engaging youth with the political, human, and social challenges of subverting and transforming one's reality through powerful tools and representations. No culture is good if it does not allow its children to rebel against the powers that be.

REFERENCES

Ackermann, E. (2001). *Piaget's Constructivism, Papert's Constructionism: What's the difference?* Paper presented at the Constructivism: Uses and Perspectives in Education, Geneva, Switzerland.

Adam, S., Alangui, W., & Barton, B. (2003). A Comment on: Rowlands & Carson "Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review." *Educational Studies in Mathematics, 52*(3), 327–335.

Blikstein, P. (2008). Travels in Troy with Freire: Technology as an agent for emancipation. In P. Noguera & C. A. Torres (Eds.), *Social justice education for teachers: Paulo Freire and the possible dream* (pp. 205–244). Rotterdam, The Netherlands: Sense.

Blikstein, P. (2018). Maker movement in education: History and prospects. In M. J. de Vries (Ed.), *Handbook of technology education* (pp. 419–437). Cham, Switzerland: Springer International Publishing.

Buechley, L., & Perner-Wilson, H. (2012). Crafting technology: Reimagining the processes, materials, and cultures of electronics. *ACM Transactions on Computer-Human Interaction (TOCHI), 19*(3), 21.

Carter, L. (2004). Thinking differently about cultural diversity: Using postcolonial theory to (re)read science education. *Science Education, 88*(6), 819–836. https://doi.org/10.1002/sce.20000

Cavallo, D. (2000). *Technological fluency and the art of motorcycle maintenance: Emergent design of learning environments* (Doctoral dissertation). Media Lab, Massachusetts Institute of Technology, Cambridge, MA.

D'Ambrosio, U. (1986). Socio-cultural bases for mathematical education. In M. Carss (Ed.), *Proceedings of the Fifth International Congress on Mathematical Education* (pp. 1–6). Boston, MA: Birkhäuser Boston.

Freire, P. (2000). *A educação na cidade (Education in the city)* (4th ed.). São Paulo, Brazil: Cortez.

Morrow, R. A. (2008). Paulo Freire, indigenous knowledge and Eurocentric critiques of development: Three perspectives. In P. Noguera & C. A. Torres (Eds.), *Social justice education for teachers: Paulo Freire and the possible dream* (pp. 81–100). Rotterdam, The Netherlands: Sense.

Papert, S. (1991). Situating constructionism. In S. Papert & I. Harel (Eds.), *Constructionism*. Cambridge, MA: MIT Press.

Quijano, A. (2000). Coloniality of power, knowledge, and Latin America. *Nepantla: Views from South, 1*(3).

Semali, L. M., & Kincheloe, J. L. (1999). Introduction: What is indigenous knowledge and why should we study it? In L. M. Semali & J. L. Kincheloe (Eds.), *What is indigenous knowledge?: Voices from the Academy* (pp. 3–58). New York, NY: Taylor & Francis.

Turkle, S., & Papert, S. (1991). Epistemological pluralism and revaluation of the concrete. In I. H. A. S. Papert (Ed.), *Constructionism* (pp. 161–192). Norwood, NJ: Ablex Publishing Co.