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Article abstract

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Critical Making Takes a Holiday¹

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Abstract

“Making” is used to engage young people into ways of collaborative learning using materials, resources, and equipment in *makerspace* environments. In this paper we attempt to interrogate the popular maker movement’s “state-of-the-actual” in education with respect to its criticality. We begin by conceptually clarifying the movement with respect to its semantic disarray. Next, we situate maker and production pedagogies philosophically, and discuss how their thrust and emphasis create both hidden and overt curricula that can either cultivate or silence criticality. Finally, we problematize the effects of uncritical exuberance for educational making, and propose concrete strategies in which educators can nudge their own makerspaces into more state-of-the-art environments that promote criticality.

Keywords: makerspaces, maker movement, critical education, praxis, poesis, production pedagogies

¹ The ideas in this paper have been further developed from a presentation at the 2015 *Philosophy of Education Society* conference in Toronto, Ontario. Some of the descriptions of makerspaces and their activities are adapted from: Pinto, L. (2015). Putting the critical back into makerspaces. *CCPA Monitor* 22(1), pp. 34-39.

La fabrication critique prend des vacances

Résumé

La « fabrication » est utilisée pour engager les jeunes dans des moyens d'apprentissage collaboratif en utilisant des matériaux, des ressources et des équipements dans des environnements « Makerspace ». Dans cet article, nous tentons d'interroger « l'état du réel » du mouvement populaire dans l'éducation en ce qui concerne sa criticité. Nous commençons par clarifier conceptuellement le mouvement en ce qui concerne son désarroi sémantique. Ensuite, nous situons philosophiquement les pédagogies de fabrication et de production, et discutons de la façon dont leur orientation et leur accent créent des programmes cachés et déclarés qui peuvent cultiver ou faire taire la criticité. Enfin, nous éludons les effets de l'exubérance non critique pour la fabrication éducative et proposons des stratégies concrètes dans lesquelles les éducateurs peuvent pousser leurs propres makerspaces dans des environnements plus à la pointe de la technologie qui favorisent la criticité.

Mots-clés: makerspaces, mouvement maker, éducation critique, praxis, poesis, pédagogies de production

La creación crítica se toma unas vacaciones

Resumen

"Making" se utiliza para involucrar a los jóvenes en formas de aprendizaje colaborativo utilizando materiales, recursos y equipos en entornos "Makerspace". En este artículo intentamos interrogar el "estado de lo actual" del movimiento de los creadores populares en la educación con respecto a su visión crítica. Comenzamos por aclarar conceptualmente el movimiento con respecto a su desorden semántico. A continuación, situamos filosóficamente las pedagogías de creación y producción, y discutimos cómo su impulso y énfasis crean currículos tanto ocultos como abiertos que pueden cultivar o silenciar la visión crítica. Finalmente, problematizamos los efectos de la exuberancia acrítica para la creación educativa y proponemos estrategias concretas en las que los educadores pueden empujar sus propios espacios de creación hacia entornos más avanzados que promueven la visión crítica.

Palabras clave: makerspaces, movimiento de creadores, educación crítica, praxis, poesis, pedagogías de producción

Introduction

Arendt (1954) identified the existence of a perpetual crisis in (North) American education, a rhetorical theme since the middle of the 20th century that persists to this very day. One pervasive manifestation of the crisis currently making its rounds is a shortage of science, technology, engineering, and math (or STEM) graduates (Britton, 2014). As a response to this purported crisis, policy-makers and educators have demonstrated immense enthusiasm for *maker* or *production* pedagogies as a state-of-the-art solution (Thumlert et al., 2015).

The Maker Education Initiative describes making as “a strategy to engage youth in science, technology, engineering, math, arts, and learning as a whole” (Maker Education Initiative, n.d.). In this context, educational making is an attempt to engage students in subject-specific learning, though clear emphasis is placed on STEM. Maker initiatives have received government support, which demonstrates the political interest in averting this so-called STEM crisis. For instance, in 2016, U.S. Department of Education Career and Technology Education (CTE) funded a “Makeover Challenge,” which invited schools to compete for \$20,000 grants to build *makerspaces* (U.S. Department of Education, n.d.). Makerspaces are “an environment or facility that provides resources, materials, and equipment for students to conceive, create, collaborate, and learn through making” (U.S. Department of Education, n.d.). They have also been described as “places where participants may work together to create and co-create knowledge and physical or digital products” (Mersand, 2021, p. 175). *Fablabs* or *hackspaces* are sometimes also referred to as makerspaces (Mersand, 2021), however, distinctions exist, especially with respect to their resources, tools, and/or purpose. Fablabs are typically associated with 3D printers and other digital fabrication tools (de Boer, 2015; Gershenfeld, 2010; Massachusetts Institute of Technology, n.d.; Mersand, 2021), while hackerspaces are associated with computer programming, coding, and computing technologies (Mersand, 2021; Schrock, 2014). As interest in these spaces increases, schools—K-12 and post-secondary institutions alike—rush to establish makerspaces, fabrication labs, and hackerspaces; however, critical analysis of the phenomenon has lagged.

In this paper we interrogate the popular maker movement’s “state-of-the-actual” with respect to its criticality. We begin by conceptually clarifying the movement’s semantic disarray. We call attention to the departure from making’s roots as well as its effects on the identities of those who embrace and resist the maker moniker. Next, we situate maker and production pedagogies philosophically, and discuss how their thrust and emphasis create hidden and overt curricula that can either cultivate or silence criticality. We also identify the hidden curriculum of makerspaces. Finally, we address the effects of uncritical exuberance for educational making by outlining practices that would characterize a critical, state-of-the-art approach to making in education.

Conceptual Clarification: Making, Makerspaces, Production Pedagogies as State-of-the-Art

Developed in the spirit of anti-consumerist, hands-on production and hacktivism, the maker movement originated outside of education and has since mutated into diverse branches, including school-based pedagogies, corporatized makerspaces, and specific events such as maker faires (Pinto, 2015). Its original do-It-yourself (DIY) ethos emphasized self-reliance and ingenuity. Early DIY-makers recycled, repaired, gardened, sewed, built, and so forth as acts of anti-consumerism. Part of the early maker movement included a hacktivism component, arising from concern about labour exploitation and digital monopolies (Pinto, 2015). A Canadian example of this is Toronto's Repair Café, which organizes monthly gatherings where volunteer "fixers" help visitors learn how to repair to build a more sustainable society. The café states the following on its website:

We throw away vast amounts of stuff. Even things with almost nothing wrong, and which could get a new lease on life after a simple repair. The trouble is, lots of people have forgotten that they can repair things themselves or they no longer know how. Knowing how to make repairs is a skill quickly lost. Society doesn't always show much appreciation for the people who still have this practical knowledge, and against their will they are often left standing on the sidelines. Their experience is never used, or hardly ever.

Another popular version of maker culture has to do with "artisanal" production. Artisanal in this context refers to the attempt to "recreate traditional production practices *de novo* in contrast to the industrial apparatus" of large scale production (Heath & Meneley, 2007, p. 596), and is marketed as small-batch or hand-made commodities. While artisanal often refers to commodities (especially artisanal food products such as cheese or wine), neo-artisanal production of digital products refers to customization for individual consumers by the producers (Norcliffe & Rendace, 2003). Wark (2013) notes that much so-called artisanal production is blind to the actual manufacturing of things, creating a fetish of "artisanal quality" while avoiding the question of labour. Making devolves into the "paradoxical act of artisanal labour as consumption" (Wark, 2013, p. 302). This position reflects a historical mistrust and contempt for artisans described by Arendt (1954) in which fabrication threatens to apply utilitarian standards to everything, thus threatening culture.

The vast popularity of the maker movement is evident in O'Reilly Media's 2005 launch of *Make Magazine*, a quarterly publication that boasts 7.8 million monthly pageviews and a readership of approximately 300,000 (Pinto, 2015). The maker movement emphasizes collaboration for social learning over independence. According to the *Makerspace Playbook*, "everyone is a maker [. . .] We share what we make, and help each other make what we share" (Makerspace Playbook, 2013, p. 2). The maker

movement led to the creation of locations in which individuals come together to create makerspaces.

Makerspaces take on multiple forms and configurations: open access spaces with tools and resources available; spaces that are tied to curriculum; spaces that are scripted and based on the makerspace director; and/or, a combination of all of these compositions (Burke, 2013; Chu, Angello, et al., 2017; Gierdowski & Reis, 2015; Harron & Hughes, 2018; Mersand, 2021). Makerspaces exist in physical buildings, as well as in mobile and temporary locations (Blackley et al., 2017; Mersand, 2021).

Mainstream makerspaces appear in schools and community venues including on university campuses (e.g., Queen's University's SparqLab, University of Victoria's MLab), libraries, and other public institutions (e.g., Toronto Reference Library's digital media lab), and some independent venues (e.g., Hamilton, Ontario's Idea|Haus).

The mobile DH Maker Bus was established in London, Ontario in 2013 using Indiegogo crowdfunding. The bus allows teachers and students to travel throughout the surrounding region. While dedicated makerspaces like these are gaining popularity, making also occurs in conventional classrooms through specific pedagogical approaches, though the purpose of makerspaces in schools is often vaguely defined and not explicitly understood (Mersand, 2012, 2019).

Classroom-based making relies on *production pedagogies*. A production pedagogy is one in which learners engage in (multi)literacy, artistic, and/or practical design challenges and aptitudes through the making of authentic artefacts (Thumlert et al., 2015). Production pedagogies as means of critical making are situated within educational theory as constructionist forms of learning. Within constructionist theory, learning is thought to be most effective when people are active in making tangible objects in the real world (Sabelli, 2008), and draw their own conclusions through experimentation with various media (Ratto, 2011). As such, production pedagogies stand in opposition to "routinized, low level, and intellectually thin work essay assignments" (de Castell, 2010, p. 14) where production rests upon "exacting demands and high-level challenges which require intense and concentrated attention, [where that] production leads to design leads to critical thinking, and not the other way around" (de Castell, 2010, p. 15).

Production pedagogies emphasize the learner as a whole person who fully participates, not a passive receiver of official knowledge held by the teacher. In doing so, they recenter authority in the classroom. The complexity of making demands a community of practice in which people develop identity in context, where learners take control over the identification of problems to solve and the sorts of solutions to be designed. Thus, learning becomes far more than a mere "how-to" demonstration or passive transmission through a YouTube video produced by a so-called expert. This necessarily involves dialogical sharing; meaningful "figuring out" to arrive at unique and creative solutions to problems identified by individual members of the maker community (not problems presented by the teacher). The promises of production pedagogies are many: de-centring of traditional modes of authority in education,

greater student engagement in learning, addressing the alleged STEM crisis, and even taking on consumerism with the DIY ethos that led to the original maker movements.

Philosophically Situating Making: Disruptive Practices

The maker movement's very name points to its connection to philosophical concepts of basic human activity. Aristotle elaborated three basic human activities, each corresponding to a type of knowledge: *theōria* (contemplation) corresponds to *episteme* (knowledge, know-what), to which the end goal is truth; *poïesis* (making) corresponds to *technē* (the method involved in producing an object, know-how), to which the end goal is production; and *praxis* (doing) corresponds to *phronēsis* (practical wisdom), to which the end goal is action (Aristotle, 1976). Aristotle implied that *poïesis* and *praxis* precede any mode of *theōria* in that attending to “everyday material and practical needs and responsibilities comes before the non-practical and non-productive activities of seeing and knowing” (Smith, 2003, p. 84).

In the standard interpretation, *poïesis* results in a tangible end; for instance, woodworking results in a piece of furniture, writing results in a poem. Thus, making (in education or otherwise) corresponds to *poïesis* in that they share a concern for production and result in a tangible artifact. The “doing” activity associated with *praxis* is not orientated towards a specific goal, and no tangible artifact is produced. Instead, *praxis* occurs “within an action that is itself full of meaning” (Kristeva, 2001, p. 14). Similarly, *theōria* involves a contemplative mode to achieve wisdom in the absence of tangible object production.

However, some contemporary philosophers have called attention to interpretative difficulties and paradoxes that have obscured the distinction between *poïesis* and *praxis*. These interpretive difficulties originate in Aristotle's work, and recur in various modern permutations of the dichotomy. In the *Nicomachean Ethics* Aristotle makes a seemingly clear distinction with respect to the ends of each: “*Poïesis* has an end other than itself: *praxis* cannot have; for good action is itself its own end” (Barker, 1958, p. 10). This means-ends distinction can be summarized this way: what is required of the thinking of *technē* through *poïesis* that liberates the will of *praxis*, where *praxis* through *phronēsis* wants only itself. Yet, Markus (1986) asserts that elsewhere, Aristotle assigns ends to *praxis*, blurring the actions-ends distinction. Moreover, Aristotle assigns heterogeneous examples of *praxis* that range from a sensation to virtuous deeds (a well-lived life, consumption, accomplishments such as playing the harp well, healing someone from illness, and various political and military activities, and management of a household) that it becomes difficult to meaningfully assert anything about this class of activities (Markus, 1986).

Despite attention to the interpretive difficulties just described, contemporary philosophers lack consensus concerning the *poïesis-praxis* dichotomy. Agamben

(1999) argues that Western cultural traditions have progressively obscured the distinctions between three kinds of human doing: poïesis, praxis, and work (Agamben does not address theōria). He observes that virtually all activity is incorrectly classified as praxis in contemporary, populist thinking, “that of the artist and the craftsman as well as that of the workman and the politician” (Agamben, 1999, p. 42). For Agamben, the central distinction is this: poïesis is to produce as bringing-into-being and experience of production into presence in the form of unveiling, whereas praxis is the will that finds expression in the act. Agamben’s poïesis departs from the Greek conception in its being an unveiling which produces or leads things into presence.

Heidegger’s reexamination of poïesis in his Presocratic turn attempted to address the obfuscation between poïesis and praxis, leading to his conclusion about the centrality of *phusis* (Di Pippo, 2000). Rather than associating poïesis with technē, Heidegger argued that phusis is characterized by poïesis: “For what presences by means of phusis has the irruption belonging to bringing-forth” (Heidegger & Krell, 1993, p. 17). Poïesis, in Heidegger’s view, is the blooming of the blossom, the coming-out of a butterfly from a cocoon, the plummeting of a waterfall when the snow begins to melt (Heidegger & Krell, 1993). Heidegger positions poïesis as a threshold occasion: a moment of *ekstasis* (a state of displacement or trance) when something moves away from its standing as one thing to become another. Neither technical production nor creation in the romantic sense, poietic work reconciles thought with matter and time, and person with the world. This moves poïesis from its close association with the term technē, which Aristotle interpreted as art or technical skill, and also as “a reasoned productive state,” (Aristotle, 1976, p. 208) reinforcing poïesis as a principle of origination, of a bringing forth, which seeks to be known by being. Departing from Aristotle’s concern with the good, Heidegger argued that conscience sharpens the vision of phronesis (Heidegger & Krell, 1993).

Arendt (1958) argued that Aristotle separated poïesis from praxis, and incorrectly conflated them in relation to political activity:

Legislating and the execution of decisions by vote are the most legitimate political activities because in them men ‘act like craftsmen’; the result of their action is a tangible product and its process has a clearly recognizable end. This is no longer or, rather, not yet in action (praxis), properly speaking, but making (poïesis) which they [the Greeks] prefer because of its greater reliability (p. 195).

When work and action are conflated in the manner that Arendt describes, society emphasizes making and fabrication at the expense of praxis (Norris, 2011). Here, we extend this criterion to maker education—where educational making must not emphasize the ends produced at the expense of praxis.

These three human activities—poïesis, praxis, and theōria—have been used throughout the ages to form the content of education, each leading to different results (Volanen, 2009). Unlike more traditional instructionist approaches to learning, where the knowledge—episteme as the end goal of theōria—is delivered by teachers and

received by students in the absence of poïesis and praxis, production pedagogies, including maker education, encourage learners to create artifacts based on their active engagement with raw materials (where raw materials can be virtual, such as code). This appears to be consistent with the Aristotelian idea that making and doing would precede theōria. Yet, critical making goes beyond simple “making” and technical know-how to involve critical perspectives, thus suggesting an important connection to praxis and phronēsis.

To understand how making can take different forms (namely, critical and uncritical), Arendt makes an important distinction between the dual understandings of poïesis (Coulter, 2002). She recognizes two aspects: labour (routine ephemeral behavior to meet basic human needs, and conducted by *Animal laborans*) and work (production of lasting artifacts, usually by artists or artisans, that comprise the artificial world carried out by *Homo faber*) (Coulter, 2002; Norris, 2011). *Homo faber*, according to Arendt (1958), knows “how to do” but fails to know “what to do,” leading to the dominance of labour receiving the highest status in *vita activa* (the active life, which is in contrast to the contemplative life) (Norris, 2011). Arendt’s critique suggests that she is skeptical about the potential of educational making to achieve democratic or transformational ends where learners participate uncritically in assembly-type work, thus learning “how to do” in the absence of criticality, in which they might learn “what to do.” Therefore, a critical form of making would necessarily address “what to do” through praxis with respect to transformation.

Arendt (1958) calls praxis the highest and most important level of the active life and the true realization of human freedom, arguing that philosophers need to engage in praxis as action aimed at different purposes distinct from poiesis (Coulter, 2002). In this vein, Paulo Freire takes the position that theory is part of a praxis, “reflection and action upon the world in order to transform it” (Freire, 1993, p. 36). Freire’s conception is based on an ontological argument that posited praxis as a central defining feature of human life and a necessary condition of freedom, and must be an essential part of education. In his view, human nature is expressed through intentional, reflective, meaningful activity situated within dynamic historical and cultural contexts that shape and set limits on that activity. For Freire, praxis means disavowing the traditional separation between abstracted learning and real life, and is thus necessarily a transforming act. By transforming, praxis is linked to a vision of a better world through critical reasoning and a belief in the common good. Praxis is a mechanism to apply practical wisdom, but also fully addresses ethical issues in its concern with the good life in contemporary permutations.

“I am not a maker,” educator Debbie Chachra declared in *The Atlantic*, offering a contemporary version of Arendt’s argument. “In a framing and value system that is about creating artifacts, specifically ones you can sell, I am a less valuable human” (Chachra, 2015, para. 12). In her challenge to the maker movement, Chachra (2015) cautions that it “re-inscribes familiar values, in slightly different form: that artifacts are

important, and people are not” (para. 7). In other words, poïesis is legitimized, and Arendt’s Animal laboran becomes the legitimate identity. Chachra (2015) argues,

the alternative to making is usually not doing nothing—it’s almost always doing things for and with other people, from the barista to the Facebook community moderator to the social worker to the surgeon. (para. 8)

Chachra’s argument echoes Biesta’s concern that conceiving of education as poïesis is problematic. It is not about bringing forth some *thing*, rather it is a social art, with the goal of wisdom, and through a path of caring (Biesta, 2013). These goals become obscured within the hidden curriculum of making that over-emphasizes the production of things, which we unpack in the next section.

State-of-the-Actual: The Absense of Criticality from Making’s Overt and Hidden Curricula

What is the current state of popular educational making with respect to a critical ideal? In this section, we begin by clarifying our conception of critical making, against which we contrast state-of-the-actual maker pedagogies to underscore the differences. Next, we identify and discuss three aspects of the hidden curriculum that emerge from such uncritical making activities in educational settings. The hidden curriculum we describe points to the problems of the state-of-the-actual and provides a groundwork for the section that follows, outlining ways in which the uncritical hidden curriculum might be countered.

To reiterate, educational *making* refers to the design of experiences in which learners create digital or material objects with an emphasis on production consistent with poïesis. Plainly put, instead of, or in addition to, writing a test or an essay to demonstrate content or skill mastery, learners produce an object that showcases their abilities. *Critical making* refers to production that necessarily integrates reflective processes, thus emphasizing a certain type of critically infused process over the production of an end product (Ratto & Boler, 2014) with overt attention to the importance of praxis. Beyond simply creating objects for the sake of creating objects (*poïesis* or making), critical making concerns itself with the relationship between technologies and social life, emphasizing its liberatory and emancipatory potential (Pinto, 2015) through material and conceptual exploration that lead makers to novel understandings (praxis) (Ratto, 2011). Critical making, therefore, goes beyond mere production for production’s sake, connecting humanistic practices and scholarly exploration to that production through transformative and liberatory action.

Unlike instructionist learning (where the learners receive pre-packaged knowledge from teachers), constructionism demands that the learners cocreate new knowledge based on active engagement with raw materials or digital code. Such approaches contribute to deeper learning that would not be possible with superficial crafting, and also engage makers to think about—and do something about—social and

environmental issues of fundamentally importance to them through deliberate acts of praxis.

Production pedagogies, in their ideal critical form, correspond to Heidegger's conception of *poiesis* (Agamben, 1999). In practice, the making that is central to production pedagogies, whether critical or consumerist in nature, results in some type of material or digital object with a practical purpose, but necessarily requires the maker to engage in praxis consistent with Freire's (1993) ideal of transformational learning. However, the state-of-the-actual appears very different in most makerspaces.

Like the multitude of failed educational projects over the 20th century, superficial implementations of state-of-the-actual production pedagogies appear to have fallen short of their goals and far from the critical ideal we just described. State-of-the-art conceptions of making, such as those described by Kafai and Ratto (2011), situate critical making with constructionism: the idea that learning is most effective when people are active in making tangible objects, and construct new relationships through the real-world creation of tangible objects. That type of transformational learning demands praxis to critically reflect on the act of making.

However, the state-of-the-actual tends to reify the problematic "Greek preference for making over doing" (Arendt, 1958, p. 188), leading to the marginalization of praxis. The term "making" can far too easily—even inaccurately—be applied to just about anything. Some might argue we *make* conversation, we *make* curriculum, we *make* term papers or other in-class assignments, or as with the 2014 National Football League campaign, "we make football" (Johnson, 2016, p. 12). Arendt (1958) argues that people "do" many types of activities, but the "idea that we can 'make'. . . institutions or laws, for instance, as we make tables and chairs [is a] delusion" (p. 188). Along these lines, she might also consider a person's identity as a maker to be similarly inaccurate.

Wark (2013) expresses concern that popular maker culture (and therefore some education practices labelled as production pedagogies) is nothing more than postproduction that relies on the assembly of prefabricated materials that fail to explore the sources of materials or labour processes. In classrooms, postproduction takes the shape of sewing a microcontroller onto a holiday ornament or garment, or using a 3D printer to create a prefabricated item using a ready-made, store-bought code template such as a comb or key fob. These superficial forms constitute little (if anything) more than crafting to produce objects that will ultimately wind up in a landfill. A review of websites for several Ontario makerspaces revealed that children participating were merely (re)producing trinkets, in tandem, using various technologies but following very prescriptive instructions such that the output by each student was identical.

Postproduction forms of making fall prey to consumerism, since the makers-as-crafters use consumer materials (e.g., the sort one procures from a big-box retailer, or printer filaments from an office supply store), rather than more innovative or learner-imagined inputs. Moreover, unlike making, postproduction crafting lacks a sense of

innovation and uniqueness achieved through ingenuity; otherwise, the output of crafters would not be identical.

Consumerism runs rampant in the state-of-the-actual quest for gadgets used for making. Lists of must-have items for educational makerspaces abound, mostly consisting of gadgets for student use. Commonly used items include class sets of pre-assembled circuit board kits (such as the \$70 LilyPad Arduino for textiles, the \$50 Makey Makey to create a keyboard out of anything, the \$150 Sphero robotic ball, the \$13 Makedo Kit that merely contains a bag of hardware items to be used to create cardboard crafts, and the \$32 Blink Blink kit to affix circuits to paper products such as greeting cards). Many of these kits contain circuits that will be used once to create a craft (such as a light-up greeting card), thus perpetuating a cycle of purchase and consumption within makerspaces.

These kits and products are purchased and used with the goal of “teaching” youngsters how things like programming and circuits work, but making constitutes assembly of a pre-fabricated item. For example, the immensely popular Sphero is “a robotic remote-controlled ball capable of rolling around on its own in any direction at multiple speeds” used to teach basic programming concepts (Jones et al., 2014, p. 425). Learners “program” the ball by selecting drag-and-drop actions (“on start,” “roll forward,” etc.) and prompts (“on user touch”) (Jones et al., 2014, p. 426) on a smartphone or tablet. While programming the Sphero may acquaint users with logic structures and can be used to create a ball-themed game, the drag-and-drop nature of the interface is limited by the app itself and by what the ball can do. Makey Makey is a kit that makes a keyboard out of anything, but the only skill required is alligator-clipping wires to objects (not coding). Similarly, the LilyPad Arduino (a kit that contains a circuit board, LED lights, and conductive thread) is widely used to enhance felt toys, ornaments, or garments so that they light up. The LilyPad is intended to acquaint makers with the concept of a circuit, inviting them to apply basic circuitry through sewing. But again, the users are limited to envisioning a solution to the question, “to what can I sew this gadget?” rather than engaging in critical issues and implications, or even developing artisanal sewing skills. This type of crafting reproduces the problems Arendt (1958) associated with *Homo faber*, in which the maker learns “how to do” but fails to know “what to do.”

Even when taken up in the rich, critical forms proposed by Ratto & Boler (2014) and Thumlert et al. (2015), production pedagogies create inevitable hidden and null curricula. The hidden curriculum of makerspaces elevates status of poietic making over praxis. But ideally, as we just described, maker education ought to incorporate praxis as action aimed at different purposes distinct from poiesis, such that makers develop a broader and contextual awareness surrounding the act of making. If we accept Arendt’s (1958) and Friere’s (1993) conceptions of praxis as ideals, then maker education would include dialogue aimed at exercising human freedom and responsibility. Here, we explore three aspects of maker education’s hidden curriculum that contribute to the reproduction of *Homo faber* in the absence of Arendt’s (1958)

ideal of praxis: STEM-focused making over doing; emphasis on work over play; and the overt emphasis on consumerism.

1. The Hidden Curriculum of STEM: Making Over Doing

In practice, certain making activities have a higher value. Political and rhetorical emphases on STEM makerspaces ultimately privilege science and technology as the most valuable educational pursuit, especially in light of the funding to establish them. By no means is this hierarchy of perceived educational value a new phenomenon. Noddings (2003) has long described the way in which service and humanities education lack the same (higher) status of mathematics, and Arendt (1958) observed, over 70 years ago, the ways in which emphasis on fabrication marginalized the “process character of action” (p. 188). This is not to imply that STEM lacks value in itself, but rather that STEM’s front-and-centre position occurs at the expense of other, laudable educational aims and pursuits such as transformation, liberation, caring, and cultivation of the humanities and arts (Noddings 2003).

2. The Hidden Curriculum of *Work, Don’t Play*

A second aspect of the hidden curriculum has to do with the elimination of play in favour of a certain type of work. Amateur labour processes, in which learners mimic production work that would be typical in a factory, dominate and replace play in classroom settings in the absence of critical reflection on labor and supply chains.

If we accept Noddings’ (2003) Deweyan position that schools must represent homes, and contemporary arguments and empirical evidence about the importance of play in children’s development, the focus of amateur labour common in maker education comes into question. That focus on production that obliterates play reflects a long-standing criticism made by Arendt (1954): Play was once looked upon as the liveliest and most appropriate way for the child to behave in the world, as the only form of activity that evolves spontaneously from his existence as a child. Only what can be learned through play does justice to this liveliness (p. 180).

Arendt (1954) cautions that “the substitution of doing for learning and of playing for working” (p. 180) attempts to infantilize children by taking away their autonomy to explore and construct meaning, where “under the pretext of respecting the child’s independence, he is debarred from the world of grown-ups and artificially kept in his own; so far as that can be called a world” (pp. 180-181).

An obvious danger of amateur labour processes substituting for inquiry-based education with broader aims is the inculcation of uncritical labour practices that would replicate and produce a compliant workforce (see, for example, Hyslop-Margison, 2000). Rather, learners would be better served asking critical questions about their role in work and production, and what responsibilities employers have to them instead of uncritically assembling items without regard for their role in production, the

implications of the objects they make, or how their participation affects the broader community of labourers. Those areas of critical reflection align with Arendt's (1958) vision of praxis that concerns itself with freedom and liberation that Freire (1993) envisioned.

3. The Hidden Curriculum of Consumerism

Finally, the preoccupation with postproduction making perpetuates a hidden curriculum of consumerism. When the only available variety of making involves assembly of mass-produced kits, the cycle of consumption is too easily and uncritically accepted. A parody publication titled *Made*, created by Garnet Hertz through UC Irvine's Concept lab, bears headlines that underscore this aspect of the hidden curriculum: "Open source secret revealed: Everybody just buys the kit!" and "How to use a 3D printer to make a 3-cent piece o' plastic" (Hertz, 2012). While postproduction kits might allow a learner to practice and develop some "know-how," this form of making doesn't challenge the learner to create in a poietic sense. Rather, it reinforces consumerist practices of purchasing and basic assembly.

A second consumerist aspect of maker education involves for-profit makerspaces, an industry largely dominated by wealthy white males (Buechley, 2014). The private, for-profit nature contradicts the original tenants of the maker movement described earlier, which had to do with collectivism and repurposing. While this is not true of all makerspaces, the for-profit variety is workshop-based, with user fees for individuals, and some selling corporate events billed as "team building." For example, Toronto's The Shop boasts that it has provided corporate events for Shiseido, Shopify, Grolsch, and Capital One in order to "promote creative collaboration amongst co-workers" (The Shop, n.d.), usually in the form of crafting. This runs contrary to the original "community learning" model (Pinto, 2015), and reinforces consumerist practices that are at odds with the maker movement's origins and, more strikingly, the idea of public education for democratic ends.

While a hidden curriculum in any educational endeavor is unavoidable, the lessons learned from uncritical makerspaces and pedagogies such as those we just described warrant disruption. In the section that follows, we explore ways to counter the hidden curriculum of makerspaces in ways that might achieve a critical ideal.

Countering Hidden Curricula: Towards State-of-the-Art

The hidden curriculum of making can be countered, at least in part, by untangling the conflation of work and action and questioning an over-emphasis on making and fabrication (Norris, 2011). Some of the pedagogical approaches recommended by Ratto and Boler (2014) and Thumlert et al. (2015) offer approaches to engage learners

to think about what they are doing, why they are doing it, and a more balanced view of labour processes, materials use, and consumption.

State-of-the-art, critical makerspaces must emphasize the learner as a whole person who fully participates—not a passive receiver of official knowledge held by the teacher. The complexity of making demands a community of practice in which people develop identity in context. Thus, learning becomes far more than a mere “how-to” demonstration or passive transmission through a YouTube video. Rather, it would involve dialogical sharing, meaningful “figuring out” to arrive at unique and creative solutions to problems identified by individual members of the maker community, not the teacher.

A first priority would be to replace crafting with meaningful making. Critical making and production pedagogies must go beyond merely making objects by inviting learners to engage in deep and reflective thinking about problems, solutions, and design. Teachers and students should also structure classroom making in ways that minimize negative environmental impacts, including waste. For example, Ratto’s Critical Making Lab at the University of Toronto engages its university-level learners in identifying community problems and devising innovative design solutions to address them (Critical Making Lab, n.d.). The lab provides a space for “conceptualizing and investigating the critical social, cultural, and political issues that surround and influence the movement of information processing capability into the physical environment” (Critical Making Lab, n.d.), laudable practices that are consistent with critical ideals.

A second priority would be to interrogate the representations of labour in makerspaces. Teachers can and should make concerted efforts to ensure that all learners are afforded time for play and wonder as forms of inquiry while eliminating amateur production practices. However, learners might reflect upon their role as amateur labourers if they happen to be engaging in assembly work. Learners in all contexts benefit from critically exploring the labour responsible for materials that they use in classrooms, and this is especially true of makerspaces. For instance, Pinto (2015) offers suggestions to trace the supply chains of makerspace supplies and the labour within those supply chains. Hyslop-Margison (2000) describes approaches that might be undertaken to subvert social engineering practices that cultivate a compliant workforce, which are applicable to makerspaces that involve students in any form of work.

A third priority would be for learners to overtly tackle the ways in which makerspace consumerism operates, and its impact on individuals, society, and the environment. This might involve interrogating technology and materials used in classrooms, exploring costs and profits, actively avoiding wasteful making, and “culture jamming” (Carducci, 2006, p. 116) using Hertz (2012)’s satirical *Made* magazine as a model.

Prefabricated kits should be critically assessed if used. Certainly, assembling things is an entrée to a potentially compelling investigation of manufacturing labour. Students might explore the experience of prefabricated assembly in relation to factory work and remote piecemeal production. The origins of the kits and technologies beg questions

about who manufactured them. This information can be used to explore the related supply chain, determine the conditions of those who produced the materials, and who profited at various points (from manufacturer to retailer). Students might also explore the environmental and ethical considerations of where their crafts (especially things like LED-lit ornaments and greeting cards, 3D printed trinkets, unused filaments, etc.) will ultimately wind up when discarded. The problem, however, is that these issues appear to be absent from the overt curriculum of the makerspaces we have seen in practice and described in published sources. In the state-of-the-actual, emphasis on assembly-based amateur labour processes repeatedly fails to ask “questions about what labour is, and how the organization of labour limits how the world can be thought objectively” (Wark, 2013, p. 302).

Conclusion

The promises of production pedagogies and makerspaces are many: de-centring of traditional modes of authority in education, greater student engagement in learning, addressing the alleged STEM crisis, and even taking on consumerism with the DIY ethos that is characteristic of the original maker movements. Criticality takes a holiday when maker-based learning privileges poïesis over other human activities while overshadowing other laudable goals of education proposed by Arendt (1954; 1958), Freire (1993), and Noddings (2003). Praxis, which is largely absent in conventional maker education, is a necessary condition for freedom, transformation, and education that cultivates the whole child. The conscious incorporation of praxis is, itself, transformational (Freire, 1993).

As articulated by Ratto & Boler (2014), Thumlert et al. (2015), and others, makerspaces in their ideal form have the potential to transform education from narrow, instructionist practices to more vibrant constructionist practices, thereby disavowing the traditional separations between abstracted learning and life, i.e., between poïesis and praxis. A more robust and critical version of making should counter the hidden curriculum we identified in this paper by infusing criticality through praxis. Uncritical acceptance and superficial application of production pedagogies reinforce the hidden curriculum of consumerism, historical privileging of STEM over the humanities, and making over doing. Maker education ought to be intentional and reflective so that the act of making is a meaningful activity situated within dynamic historical and cultural contexts.

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