

# Critical making takes a holiday<sup>1</sup>

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**DRAFT** of paper presented at Philosophy of Education Society Conference, March 18, 2016, Toronto, ON. Please do **NOT** cite without permission.

## Introduction

In 1954, Hannah Arendt identified the existence of a perpetual “crisis” in (North) American education, a rhetorical theme since the middle of the 20<sup>th</sup> century<sup>1</sup> 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.<sup>2</sup> In part 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.<sup>3</sup> The Maker Education Initiative describes *making* as “a strategy to engage youth in *science, technology, engineering, math, arts, and learning* as a whole” (no emphasis in the original).<sup>4</sup> In this context, educational making is an attempt to engage students in subject-specific learning, though clear emphasis is placed on science, technology, engineering and math (STEM). An example of the political support is the 2016 U.S. Department of Education Career and Technology Education (CTE) Makeover Challenge<sup>5</sup> which invites schools to compete for \$20,000 grants to build makerspaces.<sup>6</sup> As schools – K-12 and higher education alike – rush to establish makerspaces and fabrication labs, consideration of their philosophical grounding has lagged.

This paper attempts to interrogate the popular maker movement’s “state of the actual” in education with respect to its criticality. I will begin by conceptually clarifying the movement with respect to its semantic disarray. Next, I will situate maker pedagogies philosophically, and discuss how their thrust and emphasis create both hidden and overt curricula that can either cultivate or silence criticality. Finally, I will problematize the effects of uncritical exuberance for maker pedagogies against philosophical thought on the aims and practices of transformative education by contrasting the state-of-the-art against the state-of-the-actual. In that discussion, I will call attention to the departure from making’s original, critical roots as well as its effects on identities of those who embrace and resist the maker-moniker.

## 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 in to diverse branches, including school-based pedagogies, corporatized makerspaces and related events such as makerfares.<sup>7</sup> Its original DIY (Do It Yourself) ethos emphasized self-reliance and ingenuity. Early DIY-ers 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.<sup>8</sup> An example of this is Toronto, Ontario’s Repair Café which organizes monthly gatherings where volunteer “fixers” help visitors learn how to repair in order to build a more sustainable society. The café states the following on its website:

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<sup>1</sup> Some of the descriptions of maker spaces and their activities presented here are adapted from: Laura Elizabeth Pinto, “Putting the Critical Back Into Makerspaces,” *CCPA Monitor* 22 no. 1 (2015): 34-39.

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" refers to the attempt to "recreate traditional production practices *de novo* in contrast to the industrial apparatus" of large scale production,<sup>9</sup> and 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.<sup>10</sup> Wark 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 "paradoxical act of artisanal labour as consumption."<sup>11</sup> This position reflects a historical mistrust and contempt for artisans described by Arendt in *Between Past and Future*, in which fabrication threatens to apply utilitarian standards to everything, thus threatening culture. Arendt observes that the "mentality of fabrication"<sup>12</sup> has invaded the political realm.

In recent years, maker movement has been mainstreamed as an educational vehicle. The current (general) 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.<sup>13</sup> 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."<sup>14</sup> The maker movement led to the creation of locations in which individuals come together to create, known as *makerspaces* (also called digital fabrication labs [FabLabs], and hackerspaces). Makerspaces have been mainstreamed in the form of school-based and community-based venues housed in both public schools and universities (e.g., Queen's University's SparqLab, University of Victoria's MLab), public and university libraries and other public institutions (Toronto Reference Library's digital media lab), and independent venues (e.g. Hamilton, Ontario's Idea|Haus). In 2013, the mobile DHMakerBus, was established in London, Ontario using Indiegogo crowd funding, to travel southwestern Ontario so that teachers and students can engage in digitally-focused making. While dedicated makerspaces are gaining popularity, making also occurs in conventional classrooms through specific pedagogical approaches.

However, some contemporary makerspaces exist as for-profit businesses. While this is not true of all makerspaces, the for-profit variety is workshop based, with user fees for individuals, and some corporate events billed as "team building" activities. For example, Toronto's The Shop has provided corporate events for Shiseido, Shopify, Grolsch, and Capital One in order to "promote creative collaboration amongst co-workers" (often in the form of crafting). This runs contrary to the original "community learning" model – and is in stark contrast to Toronto's Repair Café, which is volunteer run, and offer expertise through free community learning.<sup>15</sup>

Educational *making* in the context of the maker movement centers experiences in which learners produce digital or material objects. Plainly put, instead of writing a test or an essay to demonstrate content/skill mastery, learners produce an object that showcases their abilities. Making can occur in place of or in addition to more conventional forms of learning and assessment. A related term, *critical making*, refers to production that necessarily integrates reflective processes – thus

emphasizing a certain type of critically-infused process over the production of end product.<sup>16</sup> Beyond simply creating objects for the sake of creating objects (making), *critical* making concerns itself with relationship between technologies and social life, with emphasis on their liberatory and emancipatory potential<sup>17</sup> though “processes of material and conceptual exploration...and creation of novel understandings by the makers themselves.”<sup>18</sup> Critical making, therefore, goes beyond mere production for production’s sake, connecting humanistic practices and scholarly exploration to that production.

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,<sup>19</sup> often “something instrumental with a clear use for [students].”<sup>20</sup> 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,<sup>21</sup> and draw their own conclusions through experimentation with various media.<sup>22</sup> As such, production pedagogies stand in opposition to “routinized, low level and intellectually thin work essay assignments”<sup>23</sup> 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.”<sup>24</sup>

Production pedagogies emphasize the learner as whole person who fully participates - not a passive receiver of official knowledge held by the “teacher”. In doing so, they re-center authority in the classroom: an issue that Arendt raises in *Past and Future*. The complexity of making demands a community of practice in which people to develop identity in context, and which 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 an “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 do DIY (-it-yourself) ethos that led to the original maker movements.

### Philosophically Situating Making: Disruptive Practices

The maker movement’s very name points to production pedagogy’s 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; *poiēsis* (making) corresponds to *technē* (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.<sup>25</sup> Aristotle implied that *poiēsis* and *praxis* precede any mode of *theōria* in that attending to “everyday material and practical needs and responsibilities come before the non-practical and non-productive activities of seeing and knowing.”<sup>26</sup> Those three human activities have been used to form the content of education, each leading to different results.<sup>27</sup>

Clearly, making corresponds to *poiēsis*, in that they share a concern for production. Unlike more traditional instructionist approaches to learning (where the knowledge – *theōria* – to be received by students is already embedded in objects delivered by teachers), production pedagogies as constructionist learning encourage learners to create novel solutions based on their active engagement with raw materials (where raw materials can be virtual, such as code). Yet, critical making goes beyond

simple “making” and technical know-how to involve critical perspectives, thus suggesting an important connection to *praxis* and *phronēsis*.

Arendt 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*<sup>28</sup> as action aimed at different purposes distinct from *poiesis*.<sup>29</sup> Arendt’s conception of *praxis* as ‘action’ and centres on public dialogue to exercise human freedom and responsibility.<sup>30</sup> In education, Paulo Freire takes the position that theory is part of a *praxis*, “reflection and action upon the world in order to transform it.”<sup>31</sup> 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. 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* must be 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.

Contemporary philosophers have called attention to interpretative difficulties and paradoxes that have obscured the distinction between *poiesis* and *praxis*. These interpretive difficulties originate in Aristotle’s work, and recur in various modern employments of the dichotomy. In the *Nicomachean Ethics* Aristotle makes a seemingly clear distinction with respect to the ends of each: “*Poiesis* has an end other than itself: *praxis* cannot have; for good action is itself its own end.”<sup>32</sup> This means-ends distinction can be summarized this way: what is required of the thinking of *technē* through *poiesis* that liberates the will of *praxis*, where *praxis* through *phronēsis* wants only itself. Yet, Markus asserts that elsewhere, Aristotle assigns ends to *praxis*, blurring the actions-ends distinction.<sup>33</sup> 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 causes great difficulty to meaningfully assert anything about this class of activities.<sup>34</sup> Agamben also argues that Western cultural traditions have progressively obscured the distinctions between three kinds of human doing, *poiesis*, *praxis*, and work (and like Arendt, Agamben does not address *theōria*, in place of ‘that work’ exists in addition to *poiesis* and *praxis*).<sup>35</sup> He views current popular opinion as fallaciously classifying virtually all activity ‘doing’ – ‘that of the artist and the craftsman as well as that of the workman and the politician’<sup>36</sup> as *praxis*. For Agamben the central distinction is this: *poiesis* 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 *poiesis* departs from the Greek conception in its being an unveiling, a making known which produces or leads things into presence.

Heidegger’s re-examination of *poiesis* through his “turn to the Presocratics” attempted to address the obfuscation between *poiesis* and *praxis*, leading to his conclusion about the centrality of *phusis*.<sup>37</sup> Rather than associating *poiesis* with *technē*, Heidegger argued that *poiesis* characterizes *phusis*: ‘For what presences by means of *phusis* has the irruption belonging to bringing-forth.’<sup>38</sup> *Poiesis*, 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.<sup>39</sup> Heidegger’s metaphors position *poiesis* as a threshold occasion: a moment of *ekstasis* 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 *poiesis* from its close association with the term *technē*, which Aristotle interpreted as ‘art’ or ‘technical skill’, but also as ‘a

reasoned productive state', reinforcing *poiesis* 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' becomes a sharpening of the vision of *phronēsis*.<sup>40</sup>

The *poiesis/praxis* dichotomy can be problematic, as articulated by Arendt.<sup>41</sup> Arendt discusses how Aristotle separated *poiesis* from *praxis*,<sup>42</sup> and in doing so she describes how he links and (in her view) conflates 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 (*poiesis*) which they [the Greeks] prefer because of its greater reliability.<sup>43</sup>

Work and action are conflated, and society emphasizes making and fabrication.<sup>44</sup> Arendt further divides *poiesis* into 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*).<sup>45</sup> Arendt's *homo faber* knows "how to do" but fails to know "what to do," leading to the dominance of labour and its resulting status in the highest position in *vita activa*.<sup>46</sup>

### State-of-the-actual: Criticality absent from making

Like the multitude of failed educational projects over the 20<sup>th</sup> century, superficial implementations of production pedagogies appear to have fallen short of their goals. "State of the art" conceptions of making (such as those described by Kafai and Ratto) situate critical making with constructionism: the idea that learning is most effective when people are active in making tangible objects in the real world, and construct new relationships through the real-world creation of tangible objects. Unlike instructionist learning (where the learners receive pre-packaged knowledge from teachers), constructionism demands that the learners co-create 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 fundamental importance to them. The "state of the art" makerspaces must emphasize the learner as 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 to 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). Production pedagogies, in their ideal form of critical making, correspond to Heidegger's conception of *poiesis*. 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* in the Frierian ideal.

However, the "state of the actual" appears to look very different in most makerspaces. Wark expresses concern that popular maker culture (and therefore some of the education practices labelled as production pedagogies) is nothing more than postproduction that relies on the assembly of pre-fabricated materials (ready-made code, basic electronic circuits that are purchased, and knitting patterns), without exploring the sources of these materials or actual labour processes.<sup>47</sup> In practice, this takes the shape of sewing a LilyPad Arduino onto a holiday ornament, or the use of a 3D printer to

create a pre-fabricated item using a ready-made, store-bought code template such as a comb or keyfob. These superficial forms constitute little (if anything) more than crafting in order to produce objects that will ultimately wind up in a landfill. A review of websites of several Ontario makerspaces revealed that children participating were merely producing objects, in tandem, using various technologies but following very prescriptive instructions such that the output by each student was identical.<sup>48</sup>

Postproduction forms of making fall prey to consumerism, since the makers-as-crafters use consumer materials (either the sort one procures from a big-box retailer like Michael's, or printer filaments from an office supply store), rather than more innovative or learner-imagined inputs. Moreover, unlike making, post-production crafting lacks a sense of innovation and uniqueness achieved by way of ingenuity – otherwise, the output of crafters would not be identical. Consumerism runs rampant in the quest for gadgets used in the “making” process. Lists of must-have items for educational makerspaces abound – largely consisting of gadgets for student use. Commonly used items include 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, 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 to create a craft (such as a light-up greeting card) and removed from the space – thus perpetuating a cycle of purchase and consumption within the makerspace.

These kits and products are purchased and used with the goal of “teaching” youngsters how things like programming and circuits work – by way of “making” something where making constitutes assembly using the pre-fabricated item. For example, the 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<sup>49</sup> is immensely popular. The Sphero is “programmed” by selecting actions (“on start” and “roll forward”) and prompts (“on user touch”) into 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 (not coding). Similarly, the widespread use of the LilyPad Arduino (a kit that contains a circuit board, LED lights, and conductive thread) is commonly used to embellish felt toys/ornaments or clothing items so that they light up. The LilyPad is intended to acquaint makers with the concept of a circuit, and invites 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?”

The use and assembly of the prefabricated kits and items need not occur uncritically. Certainly, assembling things is an entrée to a potentially compelling investigation of manufacturing labour. Students might explore the experience of pre-fabricated assembly in relation to factory work, and piecemeal production. The origins of the kits and technologies beg questions about who manufactured them and can be used to explore the supply chain, and 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 filament, etc.) will ultimately wind up. The problem, however, is that these issues appear to be absent from the overt curriculum of the makerspaces I have seen in practice. Instead, maker culture's emphasis on “amateur labour processes” fails to ask “questions about what labour is, and how the organization of labour limits how the world can be thought objectively”<sup>50</sup>

## Making's Hidden Curriculum: Identity, Worth, and a Rejection of the Poietic

Even when taken up in the rich, critical forms proposed by Ratto, Thumlert, de Castell, Jensen, and Boler, in themselves production pedagogies create inevitable hidden and null curricula. Whether critical in nature or not, all makerspaces are concerned with making *something*. All makers, when engaging in production pedagogies, produce a null curriculum. The hidden curriculum is the elevated status of *poietic* making over *praxis* (doing). In practice, certain making activities have a higher value (the political, rhetorical and practical emphases on STEM in makerspaces ultimately privilege science and technology as the most valuable, especially given funding to establish them). By no means is the hierarchy of perceived educational value a new phenomenon – Noddings has long described the way in which service and humanities education lack the same (higher) status of mathematics, and Arendt observed, nearly 70 years ago, the ways in which emphasis on fabrication marginalized the “process character of action.”<sup>51</sup>

The term “making” can far too easily 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 the infamous 2014 National Football League hashtag campaign, “we make football.” Arendt rejects what she terms the “Greek preference” for production over action.<sup>52</sup> She views argues that we “do” many of these activities, but the “idea that we can ‘make’...institutions or laws, for instance, as we make tables and chairs,” Arendt argues, is a “delusion”<sup>53</sup> – and so along these lines, she might also consider “making” identity and gender to be similarly inaccurate.

“I am not a maker,” 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.” In her challenge to the maker movement, Chachra cautions that it “re-inscribes familiar values, in slightly different form: that artifacts are important, and people are not” in other words, *poiesis* is legitimized, and Arendt’s *Animal laboran* becomes the legitimate identity. Chachra 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.<sup>54</sup>

Chachra’s argument echoes Biesta’s concern that conceiving of education (or the act of teaching) as *poiesis* is problematic – it is not about bringing forth *something* (emphasis in original), but rather it is a social art, with the goal of wisdom, and through a path of caring.<sup>55</sup> This becomes obscured within the hidden curriculum of making. Moreover, the ethic of care is especially important, since as Noddings observes, contemporary schools do much of the work once charged to families: “the best schools must resemble the best homes,” which necessarily means communities of caring.<sup>56</sup>

If we accept Noddings’ Deweyan position that schools must represent homes, and contemporary arguments and empirical evidence about the importance of play in children’s development, the “amateur labour” focus of popular makerspaces comes into question. Making’s *poietic* focus production that educational “work” obliterates “play:” a long-standing criticism made by Arendt:

Play was 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...<sup>57</sup>

Arendt cautions that “the substitution of doing for learning and of playing for working”<sup>58</sup> 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."<sup>59</sup>

### Conclusion: Criticality Goes on Holiday

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 characteristic of the original maker movements. Production pedagogies and the maker movement in education bring *poïesis* to the fore of educational activity. In their ideal form, articulated by Ratto, Thumlert, de Castell, Jensen, Boler, and others, have the potential to transform education from narrow, instructionist practices to more vibrant constructionist practices. Yet, privileging *poïesis* over other human activities can overshadow, or even subvert, other laudable goals of education proposed by Arendt, Freire and Noddings. Uncritical acceptance and superficial application of production pedagogies reinforce consumerism, historical privileging of STEM over humanities, and making over doing.

### End Notes

<sup>1</sup> Hanna Arendt, *Between Past and Future: Eight Exercises in Political Thought* (New York: Penguin Books, 1954).

<sup>2</sup> Lauren Britton, "STEM, DASTEM, and STEAM in Making: Debating America's Economic Future in the 21st Century," *Technology & Social Change Group Update* (2014, December 3), <http://tascha.uw.edu/2014/09/stem-dastem-and-steam-in-making-debating-americas-economic-future-in-the-21st-century/>; Robert N. Charette, "The STEM crisis is a myth," *Spectrum, IEEE* 50, no. 9 (2013): 44-59.

<sup>3</sup> Kurt Thumlert, Suzanne de Castell, and Jen Jenson, "Short Cuts and Extended Techniques: Rethinking Relations Between Technology and Educational Theory," *Educational Philosophy and Theory*, 47 no. 8 (2015): 786-803.

<sup>4</sup> Maker Education Initiative (n.d.), <http://makered.org/pd-events/making-possibilities/>

<sup>5</sup> <http://www.ctmakeoverchallenge.com/>

<sup>6</sup> The competition defines a makerspace as: "an environment or facility that provides resources, materials, and equipment for students to conceive, create, collaborate, and learn through making."

<sup>7</sup> AUTHOR

<sup>8</sup> AUTHOR

<sup>9</sup> Deborah Heath and Anne Meneley. "Techne, technoscience, and the circulation of comestible commodities: An introduction." *American Anthropologist* 109, no. 4 (2007): 593-602, 596.

<sup>10</sup> Glen Norcliffe and Olivero Rendace, "New geographies of comic book production in North America: the new artisan, distancing, and the periodic social economy." *Economic Geography* 79, no. 3 (2003): 241-263; Alain d'Iribarne, "Towards a Neo-Artisanal Production Model of Bespoke Digital Services?" *European Journal: Vocational Training* 36 (2005): 5-14.

<sup>11</sup> Wark, "Lovingly Made," 302.

<sup>12</sup> Arendt, *Past and Future*, 214.

<sup>13</sup> AUTHOR

<sup>14</sup> *Makerspace Playbook* [School Edition] (San Francisco: Maker Media, 2013), 2; AUTHOR.

<sup>15</sup> AUTHOR

<sup>16</sup> Matt Ratto and Megan Boler (Eds), *DIY Citizenship: Critical Making and Social Media* (Cambridge, MA: The MIT Press, 2014); Roseanne Somerson and Mara L. Hermano (Eds), *The Art of Critical Making* (Hoboken, NJ: John Wiley & Sons, Inc., 2013).

<sup>17</sup> AUTHOR

<sup>18</sup> Matt Ratto, "Critical making: Conceptual and material studies in technology and social life," *The Information Society*, 27no. 4(2011): 252-260

<sup>19</sup> Thumlert, de Castell and Jenson, "Short Cuts."

<sup>20</sup> Suzanne de Castell, ""Exquisite Attention: From Compliance to Production." *Language and Literacy* 12, no. 2 (2010): 4-17, 14.

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- <sup>21</sup> Nora Sabelli, "Constructionism: A New Opportunity for Elementary Science Education," DRL Division of Research on Learning in Formal and Informal Settings (2008), 193-206, <http://nsf.gov/awardsearch/showAward.do?AwardNumber=8751190>.
- <sup>22</sup> Matt Ratto, "Critical making: Conceptual and material studies in technology and social life," *The Information Society*, 27no. 4(2011): 252-260; Sabelli, "Constructionism."
- <sup>23</sup> de Castell, "Exquisite Attention," 14.
- <sup>24</sup> de Castell, "Exquisite Attention," 15.
- <sup>25</sup> Aristotle, *The Nicomachean Ethics*, trans. J.A.K. Thomson (London: Penguin Edition, 1976).
- <sup>26</sup> Daniel L. Smith, "Intensifying *Phronēsis*: Heidegger, Aristotle, and Rhetorical Culture," *Philosophy & Rhetoric* 36, No. 1 (2003): 77-102, 84.
- <sup>27</sup> Matti Vesa Volanen, "Being, Doing, Making—A Paradigm for the Connective Curriculum" *Towards Integration of Work and Learning* (pp. 39-59) eds. Marja-Leena Stenstrom and Paivi Tynjala. (Springer Netherlands, 2009), 55.
- <sup>28</sup> Arendt, *The Human Condition*
- <sup>29</sup> David Coulter, "What counts as action in educational action research?" *Educational Action Research* 10, no. 2 (2002): 189-206.
- <sup>30</sup> Ibid.
- <sup>31</sup> Paulo Freire, *Pedagogy of the Oppressed* (New York: Continuum, 1970/1993), 36.
- <sup>32</sup> Ernest Barker, *The politics of Aristotle* (London: Oxford University Press, 1958), 10.
- <sup>33</sup> Gyorgy Markus, "Praxis and poiesis: Beyond the dichotomy," *Thesis Eleven* 15 (1986): 30-47.
- <sup>34</sup> Ibid.
- <sup>35</sup> Giorgio Agamben, *The man without content* (Stanford: Stanford University Press, 1999).
- <sup>36</sup> Ibid., p. 42.
- <sup>37</sup> Di Pippo, "The Concept of *Poiesis*," 5
- <sup>38</sup> Martin Heidegger, D.F. Krell (Ed.). *Basic Writings: from Being and Time (1927) to The Task of Thinking (1964)* (San Francisco: Harper Collins, 1993), 17.
- <sup>39</sup> Ibid., 317
- <sup>40</sup> Matthew C. Weidenfeld, "Heidegger's appropriation of Aristotle: *Phronēsis*, conscience and seeing through the one," *European Journal of Political Philosophy* 10 no. 2 (2011): 254-276.
- <sup>41</sup> Trevor Norris, *Consuming schools: Commercialism and the end of politics* (University of Toronto Press, 2011).
- <sup>42</sup> Arendt identified three facets of the human condition depart from the Aristotelian conception: work (*poiesis*), labor (necessary for biophysical beings) and action (*praxis*) in Hannah Arendt, *The Human Condition*, (University of Chicago Press: Chicago, 1958)
- <sup>43</sup> Arendt, *The Human Condition*, 195; p. 174 in *Doubleday Anchor Edition*
- <sup>44</sup> Trevor Norris, *Consuming schools: Commercialism and the end of politics* (University of Toronto Press, 2011).
- <sup>45</sup> David Coulter, "What counts as action in educational action research?" *Educational Action Research* 10, no. 2 (2002): 189-206.
- <sup>46</sup> Trevor Norris, *Consuming schools: Commercialism and the end of politics* (University of Toronto Press, 2011).
- <sup>47</sup> McKenzie Wark, "A More Lovingly Made World," *Cultural Studies Review* 19, no. 1 (2013): 296-304.
- <sup>48</sup> AUTHOR
- <sup>49</sup> Jones, Brennan, Kody Dillman, Setareh Aghel Manesh, Ehud Sharlin, and Anthony Tang. "Designing an immersive and entertaining pervasive gameplay experience with spheros as game and interface elements." In *Proceedings of the first ACM SIGCHI annual symposium on Computer-human interaction in play*, pp. 425-426. ACM, 2014, 425.
- <sup>50</sup> Wark, "Lovingly Made," 302.
- <sup>51</sup> Nel Noddings, *Happiness and Education* (New York: Cambridge University Press, 2003); Arendt, *The Human Condition*.
- <sup>52</sup> Arendt, *The Human Condition*, 188
- <sup>53</sup> Arendt, *The Human Condition*, 188
- <sup>54</sup> Debbie Chachra, "Why I am not a maker," *The Atlantic* (2015, January 23), <http://www.theatlantic.com/technology/archive/2015/01/why-i-am-not-a-maker/384767/>
- <sup>55</sup> Gert J.J. Biesta, *The Beautiful Risk of Education* (Boulder: Paradigm Publishers, 2013), 132.
- <sup>56</sup> Noddings, *Happiness and Education*, 260.
- <sup>57</sup> Arendt, *Between Past and Future*, 180
- <sup>58</sup> Ibid., 180
- <sup>59</sup> Ibid., 180-181