Dufva, Tomi

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Maker Movement

creating knowledge through basic intention

Tomi Dufva

Maker movement is often celebrated as a rekindled interest in making by hand, as well as a promise for new forms of manufacturing and economic growth. In contrast to this popularized image, the theoretical background in the maker movement remains ambivalent. This article takes a look at the theoretical foundation of the maker movement and proposes a phenomenological approach to making by hand as a framework for maker movement.

A particular focus is on the knowledge making process in the maker movement following Finnish craft researcher Kojonkoski-Rännäli's account of making by hand. Basing her theory on Martin Heidegger's philosophical analysis, Kojonkoski-Rännäli sees making by hand an essential way of existing in the world: making by hand develops not only maker's handicraft skills but also her/his knowledge, responsibility and caring for the world as it appears to her/him through the act of making.

In this paper, I explore maker movements' relation to Kojonkoski-Rännäli's philosophy of making by hand. Moreover, I focus on how the maker movements approach to digital and digitalization relate to making by hand.

Keywords: Maker movement, code literacy, craft education, philosophy, making by hand

Introduction

In recent years there has been a growing interest towards the maker movement (also referred to as the maker culture). It has been touted to bring engineering and making by hand back to the western countries as well as to create new possibilities in the developing countries (See for example: Anderson, 2012; Halverson & Sheridan, 2014; Lang, 2013; Lindtner, 2015). In short, Maker movement has effects on manufacturing, culture as well as education.

Making in maker movement is seen as empowering as well as entrepreneurial (Lang, 2013). Makers take advantage of new manufacturing methods and the collective powers of the internet but also value handicraft skills. Still, most of the focus is on either the making processes or the commercial opportunities, than in the theoretical aspects of the maker movement.

In a hands-on book "Invent to Learn" Martinez and Stager tie maker movement closely to Piagetian pedagogical ideas and even to Rousseau's views on childhood (Martinez & Stager, 2013). Papert's views on using computer's in education are also often associated with the maker movement (Halverson & Sheridan, 2014; Martinez & Stager, 2013; Papert, 1980). Some of the ideas in maker movement are further developed by STEM & STEAM initiatives in the United States, and similar in the United Kingdom, and for example, in Finland. Common to these developments are the focus on science, technology and engineering aspects of the maker movement (James-Thomas, 2014; Mykkänen & Liukas, 2014; "National STEM Centre ," 2015; "STEAM: A Framework for Teaching Across the Disciplines," n.d.; "STEM to STEAM," 2016).

In this article, I want to expand on the theoretical side of the maker movement by comparing it to the Finnish craft researcher Kojonkoski-Rännäli's theories on making. All though her ideas relate to, and can be traced to, many other craft researcher views, I am basing my research mostly on the concepts she has developed in her work. Her ideas create a profound philosophical connection to phenomenological studies and connect making to deep ontological issues. Moreover, I am using some of the concepts she has defined as a frame of reference to look at the maker movement. My aim is not to give a general theory or educational method of the maker movement, but rather to show how some of the practices in the maker movement may have the abilities to create deep sense-making into our digitalized world.

Digital divide, a concept that was formerly used to describe the divide to those who had access to the internet and those who did not, could now be used to describe the gap between people who understand digital technology and those who do not (Digital Divide, 2011; Warschauer, 2004). My interest in this article lies in the possibility of if and how maker movement could be seen as a tool to bridge the gap of the digital divide, i.e., bring understanding to the digital world we live in.

In the next section, I define the maker movement more comprehensibly, as well as present some of the criticism towards the maker movement. Then I will expand on Kojonkoski-Rännäli's ideas on making and relate her work on a more larger context of the philosophy of making. The two last chapters will explore how the maker movement relates to Kojonkoski-Rännäli's ideas and outlines some of the outcomes of this method.

From bits to atoms - question of maker movement

A new way of making, or a new industrial revolution?

The understanding of the maker movement is multifaceted. It is seen as a remedy, as a cultural movement as well as a new pedagogical method. Naturally, all of these ideas overlap each other, rather than contradict each other, but choose to emphasize different qualities or notions of the maker movement.

The maker movement is often associated with the rekindled interest in hardware design and manufacturing accompanied by the proliferation of inexpensive production tools (Anderson, 2012; Halverson & Sheridan, 2014). The Internet has helped in expanding the maker movement into a global movement, often connecting people in ways that otherwise would have been unlikely. Chris Anderson, a former editor-in-chief of Wired magazine and the author of "Makers: The new industrial revolution" calls the maker movement a new industrial revolution which happens "when the web generation turns to the real world" (Anderson, 2012, p. 42). As such The movement is celebrated as a new way to create more ideas and products that otherwise wouldn't have been possible (Anderson, 2012; Buechley, 2014; Hatch, 2013; MacMillan, 2012; Martinez & Stager, 2013; Mellis & Buechley, 2014).

However, to think of the maker movement merely as an interest in affordable production, manufacturing platforms or creation of novel products is somewhat misleading. Dougherty, the founder of Make magazine, - a magazine aimed at enthusiastic makers, describes makers as enthusiasts who want to explore the possibilities of both new and old technology (Dougherty, 2012b). Similarly, Martinez and Stager tie the maker movement to constructionism finding it as an invigorating way of utilizing constructionism, even if the practitioners are not aware of the underlying formal knowledge (Martinez & Stager, 2013). The maker movement is seen to blend the formal and informal learning together. This blending can happen through the emphasis on the making, instead of theory, as well as through using makerspaces as educational space (Blikstein & Krannich, 2013; Halverson & Sheridan, 2014).

Dougherty refers to Dewey's views on education in his article on the maker movement emphasizing Dewey's belief in learning by doing (Dewey, 1998; Dougherty, 2012b). Martinez and Stager walk on the same lines and trace the roots of the maker movement to constructivist learning theory, to the Reggio Emilia approach as well as to the Piagetian idea that to understand is to invent (Martinez & Stager, 2013). In these approaches, maker movement is seen as a tool to gain necessary 21st-century skills, a digital age pedagogy and continuation of the works of Dewey, Piaget and later Papert's ideas about the use of computers in education (Blikstein & Krannich, 2013; Halverson & Sheridan, 2014; Papert, 1980). Just as a pencil or brushes give opportunities to explore the visual world with lines and colors, the maker movement gives tools for the exploration of digital and electronic techniques.

The maker movement's educational views can also be seen from the critical pedagogue's standpoint. By offering a critical understanding of our everyday digital products, making can empower the user in the digital world. Furthermore, makerspaces, hackerspaces or FabLabs offer tools and tutoring on various subjects of making. This can help democratize the tools and production as well as engage communities in working together (Halverson & Sheridan, 2014; Konopasky & Sheridan, 2015; Mellis & Buechley, 2014).

Or just a continuation of the Arts & Crafts movement?

The Maker movement can also be seen as a continuation or as a new version of the 20th-century Arts & Crafts movement. It does share similar goals, such as giving people the freedom to not be satisfied with monotonous industrial products and the possibility of breaking free from tedious corporal jobs to find more meaningful jobs in self-employment (Morozov, 2014b; Patokorpi, 2014). However, unlike the Art & Crafts movement, which failed in producing anything of great usefulness or value to ordinary people (Morozov, 2014b), the maker movement might just have found suitable niches to serve in the global marketplace (Hatch, 2013).

On the downside, the commodification of the maker movement can already be seen everywhere. More and more products that might have little to do with the maker ethos are marketed for budding makers to be. The danger being that the theory of learning by doing might be commercialized to products that fail to teach anything about making and working with your own hands. Moreover, at the same time the real products, the ones we use every day, are left to professionals and are further enclosed through hamper-free bolts and proprietary software. This is the exact opposite of the ideology of curiosity, openness, and exploration inherent in the maker movement.

Furthermore, the maker movement is criticized as serving a relatively small percentage of the maker population. For instance, Leah Buechley, a former professor at MIT, has criticized the maker movement as being mostly targeted to wealthy white males (Buechley, 2014; Halverson & Sheridan, 2014). Her criticism targets primarily the Make-magazine, -a prominent publication for the makers-, but these problems connect more widely to the consumeristic aspects of the maker movement, and point out problems that should be addressed in the maker movement.

The way back from digital

Despite the criticism, the maker movement does include a diverse field of practitioners. One of the difficulties in describing the maker movement might just be its varied and multidisciplinary nature. As already stated the maker movement can be seen from the constructivist perspective as an educational tool, or from the economic view as a new entrepreneurial possibility. Alternatively, it can be criticised as being a fad and continuation of the neoliberal agenda or it can be seen as offering democratizing and empowering tools for everybody (Halverson & Sheridan, 2014; Mellis & Buechley, 2014). In addition, the maker movement can also be associated to the DIY-movement, hacker culture and to free and open software cultures (Gauntlett, 2013; Levy, 1984; Lindtner, 2015; Söderberg, 2007; Tochetti, 2012).

These diverse subcultures give the maker movement a unique twist as well as varied character. Moreover, the maker movement has gained a widespread attention over the globe. From studies of Chinas maker spaces (Lindtner & Li, 2012; Lindtner, 2015) to the new emergence of DIY synthetic biology (Tochetti, 2012) the movement has accelerated from hobbyist movement into a global force (Hatch, 2013).

In sum, the maker movement conveys the idea of makers that can utilize new digital tools, such as 3D-printers or laser cutters or even biotechnology, but at the same time, it celebrates the lost arts of traditional handicraft skills (Anderson, 2012; Lang, 2013). It is also a societal and political movement, closely tied to hacker culture and open software & hardware movement as well as it is a new commercial trend ("Maker-kulttuurissa vertaisuus ja avoimuus ovat oppimisen käyttövoimia | Sitra," n.d.; Morozov, 2014b; Patokorpi, 2014). Moreover, it can be seen as an empowering platform for children and adults, enabling new ways of expression and understanding (James-Thomas, 2014; Lang, 2013).

One possible common idea in all of these interpretations might be what Anderson calls "Bits to Atoms" (Anderson, 2012). The idea being that the new manufacturing methods, such as 3D-printing bring digital bytes back to the "real" physical world. This notion can be seen to some extent to complete the circle of digitalization; In his famous book "Being Digital" Negroponte proclaimed that everything that can be digitized will be digitized; that the life will move from atoms to bits (Negroponte, 2015). For Anderson, the idea of bits back to atoms completes the circle of digitalization, but it could be seen as being the common thread of all of the interpretations of the maker movement: a way of making by hand in the digitalized era.

Kojonkoski-Rännäli's phenomenological philosophy of making

To give a different perspective on to the maker movement, I am going to contrast it with the philosophy of doing by hand and more specifically to Kojonkoski-Rännäli's writings (2016, 2014, 1995)Doing by hand has deep connections to our being and understanding of our being as well as the world around us. Kojonkoski-Rännäli has focused on this knowledge making process and offers detailed and exciting views on making by hand (2014, 1995).

Unfortunately, most of her writing is in Finnish, making the use of her research problematic to other than Finnish speakers. At the end of this chapter, I will connect her thinking to other researchers' views on the craft to connect her research to a broader picture. However, the aim of this article is not only to present Kojonkoski-Rännäli's work but rather use some of her concepts as a lens to look at the maker movement.

Kojonkoski-Rännäli first formulated her views of the philosophy of craft in her dissertation *Ajatus käsissämme: Käsityön käsitteen merkityssisällön analyysi* [Thought in our hands: an analysis of the meaning of the concept handicraft] (1995). She has further developed her ideas in her recent book "Käsin tekemisen filosofiaa" ("The philosophy of doing by hand") (Kojonkoski-Rännäli, 2014). In these books, she offers interesting perspectives on making. For Kojonkoski-Rännäli making by hand is existing in the world: Humans have intention in their making. As active bodily creatures, doing by hand is customary to our being; thus it is fundamental to our way of being in the world.

Kojonkoski-Rännäli backs her theory with Martin Heidegger's philosophical analysis on being (Heidegger, 2009). According to Heidegger, the way in which we exist in the world is by dwelling (wohnen). This existing, living, is realized through making (bauen). In this way doing by hand is one of the core components of existing in the world.

Kojonkoski-Rännäli further analyzes the basic concepts of doing by hand with Heidegger's concept of ready-to-hand (zuhandenheit) which, according to Kojonkoski-Rännäli, is more direct and immediate than perceptual experience. Kojonkoski-Rännäli sees Heidegger's ready-to-hand (zuhandenheit) to be near to Merleau-Ponty's concept of grasping: We can already grasp something before we know it. (Merleau-Ponty, 2015). In Finnish language, grasping can be translated to a word käsittää, which means understanding through hands (Kojonkoski-Rännäli, 1995).

This form of knowledge creation predates intellectual comprehension. Thus existing occurs primarily through bodily experience. In this way, Kojonkoski-Rännäli sees that making by hand is essential to human existence. Relating making by hand to Heidegger's concept of making (bauen) Kojonkoski-Rännäli notes that making is not only an act of creating an artifact but that it also includes aspects of caretaking and belonging to the world the maker creates. Heidegger calls thus this making as "tending" of the world, an act that creates deep connections between the maker and the world (Heidegger, 2009; 2005). In a similar note, Kojonkoski-Rännäli calls this grasping of the world the original work of man, giving emphasis on the making as a core function of being (Kojonkoski-Rännäli, 1995).

From existing to creating a relationship with the world

However, for Kojonkoski-Rännäli craft is not just a bodily experience, but also a skill to be mastered: Craft needs both practice and knowledge. When immediate grasping-being in the world happens together with comprehension acquired through practice and intellectual knowledge, Kojonkoski-Rännäli calls the act of making a basic intention.

The concept of basic intention is important in Kojonkoski-Rännäli's work as it describes both the importance of making by hand and the optimum way of making by hand.

> When the maker is both experientially and emotionally attached to her work as well as rationally, and intentionally, then the maker gains knowledge of her material and the world wherein she belongs to, writes Kojonkoski-Rännäli. She continues:
>
> …she gets to know the possibilities of her work and her limits. She is engaged with her material and feels responsibility for her work. For these reasons, I entitle the intention of making as the basic intention. (Kojonkoski-Rännäli, 1995, p. 48 translation by article author)

To further illustrate her meaning of basic intention, Kojonkoski-Rännäli uses the Greek term techne (tekhniké) to describe further the process of making. Techne has a dual meaning. It can be understood as a making by hand, as an art, as being able to do something. On the other hand, it can also be interpreted as understanding and knowing in its widest possible meaning: as surviving and accomplishing something in the world (Kojonkoski-Rännäli, 1995).

Techne is making that brings forth something that can't come out itself, but which has the possibility to arise. For example building a house or a boat can be such making (Heidegger, 2009; Kojonkoski-Rännäli, 1995). For Kojonkoski-Rännäli techne fuses knowing and doing into one: problem-solving and molding of the material, thinking and motor skills are closely combined.

Techne also implies that basic intention demands the maker to be personally involved in the whole process of making: From planning to the finished product. According to Kojonkoski-Rännäli, this intentional process creates knowledge not only of the material and making of the artifact but also of the world around it. Furthermore basic intention binds the maker ethically and empathetically to the surrounding world (Kojonkoski-Rännäli, 1995).

This ethical and emphatic connection is an important aspect of basic intention as it, along with the real artifact, creates inner qualities, physical and psychological capabilities, and characteristics of the maker

(Kojonkoski-Rännäli, 1995). For Kojonkoski-Rännäli making with basic intention is an important contemporary and future skill as it develops makers creative skills to deal with open-ended and multi-faceted problems of modern life (de Vries & Mottier, 2006; Kojonkoski-Rännäli, 2006; 2014).

Head, hand and heart

Kojonkoski-Rännäli's philosophy bares many similarities to other craft researchers' studies. For instance, the importance of making by hand as an important 21st-century skill (Vanada, 2014; Veeber, Syrjäläinen, & Lind, 2015; Wright & Davis, 2014). In combining head, heart, and hand as the most important characteristics of craft and making by hand, Kojonkoski-Rännäli's research echoes many other craft researchers. (e. g. Peach, 2012; Sennett, 2009). Kojonkoski-Rännäli's theories on making as a part of knowledge making and growing processes also bear a resemblance to Dewey's philosophy on making and education (Dewey, 1998). In a recent debate 1 in Finland, Kojonkoski-Rännäli amplified her views on making by hand, citing Risatti that craft is something that is done using hands or with hand tools and by molding concrete materials, combining theoretical, abstract knowledge into practical making process (Sinervo, 2013; Risatti, 2009). Notable in Kojonkoski-Rännäli's research is that by the concept of basic intention she clarifies and deepens the significance of making by hand.

Basic intention of the digital era

The disintegration of the making process

The problem for Kojonkoski-Rännäli is that modern making often includes automated machinery, pre-designed parts, instructions, or other aspects that distance the maker from the making process. Making in this way distances making from the original experience of doing by hand, and the connection maker has with the material happens only on an intellectual level. The intellectual emphasis further separates our rational thinking from the rest of our embodied experience, preventing the basic intention of making happening.

Furthermore, the differentiation between body and mind weakens our comprehension of nature, and the inherent connection we have with nature. The act of making becomes only a vehicle for something. The work and the process have no value on their own. Kojonkoski-Rännäli calls this the instrumental intention (Kojonkoski-Rännäli, 1995).

Kojonkoski-Rännäli does not directly address maker movement in her work. 2 Although, in her recent book and blog posts, she acknowledges that making is gaining traction and recognizes, for instance, the Pro-AM (Pro-amateur) movement and craftivism (craft + activism) as ways in which making is both renewing as well as sustaining itself (Kojonkoski-Rännäli, 2006).

Regardless, Kojonkoski-Rännäli doubts whether making that is done through modern technology is ever able to give its maker the same kind of feeling nor knowledge that one acquires through making with basic intention. Machinery creates abstractions and distance that take away the characteristics of the basic intention. By forwarding some stages of the process to machine or automated processes, we lose the grasp of that process and the world connected to it (Kojonkoski-Rännäli, 1995, 2012).

Owning the digital technology

However, maker movement might offer some ways of working that may counterbalance the automation and distancing aspects of modern technology. The maker movement could be seen as a way to bring basic intention into the modern technological craft making processes. I will first compare some of the similarities of the maker movement and basic intention, and on the next chapter provides two example case to illuminate my meaning.

On a general level, the maker movements manifesto, coined by Mark Hatch (Hatch, 2013, p.11-31.) seems to share many characteristics with Kojonkoski-Rännäli ideas on making. They both see it as fundamental to our being and as a way of experiencing the world. They both stress the wholeness of the process of making: that it is embodied knowledge together with intellectual knowledge.

These qualities tie the maker movement to a craft education on a more general level. Veeber, Syrjäläinen and Lind allege that craft education, and making by hand, is an important 21st-century skill. By making we advance the understanding of diversity and challenges in life (Veeber et al., 2015). This signifies a similar aspect of making than Kojonkoski-Rännäli: That making is not only skill to be mastered but a way of meaning-making and existing in the world (Kojonkoski-Rännäli, 1995).

Besides sharing similarities with modern craft research, the maker movement can offer altogether fresh perspectives to making with digital technologies. One of the foundations of the maker movement is a curiosity to look under the hood, the aspiration to not only consume but to understand technologies. ”If you can’t open it, you don’t own it” goes the famous maker motto, emphasizing the importance of knowing your way around your machines (Anderson, 2012; Lang, 2013). The way maker movement approaches technology may provide modern maker with tools and skill sets that offer direct, graspable, knowledge on things Kojonkoski-Rännäli sees as automated and distancing (Kojonkoski-Rännäli, 1995, 2014)

Sense-making in the digital world

The relation between making by hand and digitality is complex and far reaching. It encompasses discussions from technical perspectives to the philosophical debates on the post-human. My aim here is first to present two example problems inherent in the digital making. Then I suggest ways how these problems could be seen from the view of the maker movement and how the maker movements attitude towards making could be considered as a making with basic intention.

Abstracted and invisible

The first problem stems from the nature of digital technology. Digitalization of tools has created an abstraction into making process. This means that some part of, or even the whole tool is presented by software, by digital bits.

The software itself is an abstraction: through code, software represents the structure and logic of the tool. That code is then run on the digital device that interprets the code and runs the software. The outcome is a reprogrammable instrument that has abilities beyond ”normal” physical tools: The tool can be changed, reprogrammed on the fly, without changing any physical parts of the device. The drawback is that the abstraction makes some of the functionality of the tool invisible: Part of the making process becomes detached. Furthermore, without the maker being able to read that invisible code the ”how does this tool work” becomes unclear, or even magical.

Rapidly advancing technology can create products that may have been unthinkable only a few years ago. Mobile phones, smart watches, predictive algorithms (e.g. Google’s search suggestions) and the advances in machine learning (e.g. intelligent assistants such as Apple’s Siri or Google’s Now) all have features that may fill us with wonder.

Marketing and popular culture have further emphasized the amazing and magical aspects of technology. The way digital products are presented in commercials as life changing and unbelievable or how tv-series represent computer viruses, or AI (artificial intelligence) gives us the impression of the digital as a supernatural entity. This popularization of the digitality abstracts the abstract nature even further. (Lanier, 2010; Morozov, 2014a; Rushkoff, 2010; 2013).

As mentioned earlier the digital technology differs from other technologies in that it is programmed. The code is in the heart of every digital technology and substantially shapes its behavior. Code shares only an indirect connection to the physical nature where we live in through the electronic, physical layer of the device. Otherwise, the products created in the digital realm are indifferent to the physical world and its laws: An apple falling from a tree in the virtual world does not have to fall at all. The only way for it to fall is through someone coding the falling mechanism into it. This makes it hard to have preconceptions of the ways digital tools or methods behave. In other words, digitality and programming create a world is difficult to grasp or understand.

We might have the knowledge how to use modern tools, be it a digital camera, a dishwasher or a software tool such as Adobe Photoshop, but we usually do not have the understanding of how they work. Thus, the possibilities to form emotional, experiential connection, or embodied connection toward digital becomes challenging.

The problem of the black box

The second problem could also be seen as another way of looking at the same problem. While the abstract nature of code is inherent in digital technology's nature, it is also affected by the politics governing it. Patent laws, copyrights and proprietary software create a wall between the user and the process.

Proprietary software means software where the user has no possibility, or right, to see the way the software is built i.e. to read the devices source code (Stallman, Gay, & Lessig, 2009). When the user cannot see how the program is constructed, he or she must rely on the outcomes of the software, making the software a black box without any access. Similar barriers are created by copyright and patent laws, disabling makers from creating their versions of the tools even if they figure out the way the tool is built.

These kinds of restrictions create a societal and a political barrier that can be understood from the neoliberal economic point of view, but because of the aforementioned nature of the code, creates an obstacle that hinders the basic intention happening in the making process. Furthermore, these restrictions may alienate the maker from her/his tools by retaining part of the ownership of the instrument to themselves and discouraging the maker of tinkering with the device.

Hacking into the digital world

Maker movement, as a movement born of the digital age, offers some ways of addressing these problems. For instance, by taking control of the black boxed processes. "If you cannot open it you do not own it" -ethos contains an idea of getting to know the insides of the machines and taking back control of the devices (Hatch, 2013; Martinez & Stager, 2013). A research project done at MIT Media Lab Buechley and Mellis held workshops on creating a working mobile phone from DIY-materials. One of the results of the study was the increased understanding of the formerly obscure technology. At the same time, the understanding promoted critical thinking and engagement (Mellis & Buechley, 2014).

This empowerment may result to both in an activity where maker learns how programming or other technologies work, but also to a political stance that questions the purposefulness of proprietary software and hardware. As such maker movement may be seen to eliminate the invisible and abstract parts of the code.

Hacking, a term originating from the software world, meaning the unintended or clever use of the code or software can now be seen to have spread into the physical world through the maker movement, as suggested by Dougherty (Espinoza, 2014). Steven Levy describes hacking as closely related to maker movement's ethos:

> Hackers believe that essential lessons can be learned about the systems – about the world – from taking things apart, seeing how they work, and using this knowledge to create new and even more interesting things (Levy, 1984, p. 27–36.)

Hacking in the maker movement consists of the opening of both physical (machines) and abstract (software) products, by which a maker gets to know how the products or tools operate by way of doing by hand. One of Kojonkoski-Rännäli's thoughts of basic intention is that making is tending, a way of taking care and belonging to the surrounding world. Through the ethos of hacking it is possible to draw a correlation between the Kojonkoski-Rännäli's tending of the world and the maker movements caring of the digital world (Hatch, 2013; Kojonkoski-Rännäli, 1995).

Making in the maker movement is seen as a way of looking at the world and suggesting new possibilities to existing in the world (Martinez & Stager, 2013). Even though the maker movement did not start the free software movement or open source movement – the movements which are providing alternatives to closed proprietary software – it can be seen to embrace the ideologies of these movements. By promoting makers rights to read, and even write the code, the maker movement partakes into the tending of the digital world; Who of us would like to live in a world where making is restricted?

This care-taking and engagement can be seen clearly in the popularity of various online forums, websites and mailing lists as well as in real-world gatherings, such as Maker Faires (Dougherty, 2012a; Branwyn, 2015). Lang further emphasizes the communal parts of the maker movement, naming it as the DIT (Do-IT-Together) culture (Lang, 2013).

In sum maker movement could be seen as a way of creating belonging to the world that is vastly digitalized, or to put it another way around, the maker movement belongs to both the ”real” and the digital world.

Digital hands?

Another important aspect of basic intention in the making process is the direct use of hands, or tools worked directly by the hand. In comparison, many of the digital tools often touted as a central part of the maker movement, such as 3D-printers rely on automating parts of the process and fall out of the category of direct use. However, the hacker ethos, along with the empowered control of the machines may provide a different interpretation.

Common users of digital manufacturing tools might be satisfied with using the tools in the ways it was intended and instruction to be used. However, maker movement encourages the maker to go further, encouraging the maker not just to learn how the tool works, but also to hack and reprogram the instrument to work in ways the maker feels most comfortable. In the process, the maker gets to see inside the black box and make it their own.

Many makers feel a kind of pride and engagement over their machines. The artifacts produced by them are shaped by the code created by the makers themselves (Lang, 2013). In other words, the difference between makers use versus the standard use of these tools could be seen as the difference between using a program, for example, image editor versus creating the program themselves.

Even if the result comes from a tool that automates some processes, these processes can be seen to be in direct control of the maker: She/he can alter the process, work directly with the code and see the results of her actions. This can lead to a knowledge that is not only intellectual but embodied in the maker himself. The abstract code can become a graspable process, wherein the maker feels to be deeply involved in.

For example, coding is seen as a craft by many developers and as such displays many of the characteristics of craft: Developers feel deep connection and responsibility of their code and even of the process and tools of writing that code (Cox, 2013). The fact that code is run on automatized machines and is digital does not seem to hinder the way developers feel about their code (Feller, Fitzgerald, Hissam, Lakhani, 2005).

A research project by Buechley and Perner-Wilson integrates many of these characteristics of the maker movement. In their project Buechley and Perner-Wilson demonstrated alternative ways of making electronics: Instead of using ready-made components, they constructed their own by carving, sewing and painting. The results displayed how such informal and hands-on approach expand makers understanding of electronics as well as create strong emotional connections to the electronic devices (Buechley & Perner-Wilson, 2012).

These two examples aim to clarify the depth of the maker movement and suggest ways how the basic intention might be seen happening, through the maker movement, in the digital world. Seymour Papert planned already in 1970's that computers should become like modeling clay or paper maché, moldable material that creates connections between the maker and the digital world (Martinez & Stager, 2013; Papert, 1980). It seems that maker movement has the potential to accomplish this plan.

Conclusion

As Kojonkoski-Rännäli proposes, making by hand is fundamental to humans as a way of existing and comprehending the world. Doing by hand is an important skill that should not be ignored in the age of information technology (Kojonkoski-Rännäli, 2006; 2012; 2014; 2016). Kojonkoski-Rännäli does not oppose modern technology per se but is concerned that it might hinder the connection humans have with the act of making. Automatized and closed processes may take away the wholeness of the making process, lessening the connection maker has with the object and diminishing both the inner and outer skills and abilities maker gains in the process (Kojonkoski-Rännäli, 1995, 2014).

The ubiquitous nature of the digital has altered the ways in which we exist in the world. The constructions of our society are as much digital as they are concrete. (T. Dufva & Dufva, 2016; Rushkoff, 2010; Warschauer, 2004). This being, existing in two worlds simultaneously emphasize the importance of understanding the digital world. If we do not comprehend the world we live in, how can we live or change it?

This article suggests the maker movement as a method of looking at the making by hand processes in the digital era. Through the maker movements ideology as well as the way the maker movement approaches digitality of modern making, it suggests ways how the basic intention could be possible in the digital era. Enthusiasm, open-ended inquiry, hacking, owning technology and curiosity can be seem to be important aspects in grasping digitality.

By empowering the makers to hack into their digital devices and make them their own, the maker movement makes the invisible digital processes invisible and even as an integral part of the making process. On the other hand, by disclosing both the abstract nature, as well as cultural, economic and political aspects of digital, the maker movement shows it care-taking, an ethical and emphatic relationship it shares with the digital world.

As this paper takes only a theoretical look at the making process, it does not claim that this is the case, but it does offer possible and far-reaching outcomes of maker movement that are often not considered when talking about maker movement. Even if the maker movement is heralded as the new industrial

revolution and at the same time criticized as a wealthy white's males free time, it could provide us with a set of tools and skills needed in the digital age.

1 In 2013, The Craft Museum of Finland chose cake-artist Emma Iivanainen as a maker of the year, which draw intense discussion in the craft circles about what can be called craft and what cannot.

2 On a very recent website, article Kojonkoski-Rännäli deals directly with the maker movement and many of the questions raised here, mostly based on an article I co-wrote and onto conference presentation I had concerning this article. (Kojonkoski-Rännäli, 2016), (M. Dufva & Dufva, 2016).

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Tomi Dufva is a doctoral student at Aalto-University, the school of Arts, Design and Architecture, a visual art educator and artist working primarily within new media. The author is also the co-founder of art & craft school Robotti, which combines science and art education. The primary research revolves around the topics of code literacy, media literacy, critical pedagogy, issues in AI (Artificial Intelligence) research, Machine learning as well as digitality and art.