Designing Digital Technology and Materials for Digital Fabrication in Schools: a Hackerism Perspective

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Abstract
We suggest using seven hacker ethic values as lenses in a conceptual "tool-to-think-with" when designing digital fabrication technologies and materials that aims to develop *digital design literacy* among adolescents in school. We discuss how this conceptual tool can be used to help promote critical reflection on design values, and provide a language to qualify a discussion of hackerism when designing digital fabrication technologies and materials for school.

Author Keywords
Hackerism, digital design, digital fabrication, digital design literacy, maker movement, design

Introduction
Developments in digital fabrication [1] are often understood in terms of its sociocultural imprint left by the so-called *maker*- or *hacker-movement* [1], [2], a scattered term for a do-it-yourself culture [3] that is getting increasingly popular with technology enthusiasts and *hackers*. This paper takes a *hackerism* perspective on the design of digital fabrication technologies and materials [4]–[7] that aims to enhance and empower adolescents in acquiring *digital design literacy*.

We define a *hacker* as a person who lives and encourages a life of passion and freedom, that motivates activities of social worth, caring and openness through playful cleverness and creative curiosity in working with digital technology and materials [5], [8], [9] [10].

Our research aim is to explore hackerism in relation to design, in order to understand how hacker ethic values can be used as lenses in a conceptual "tool-to-think-with" when designing future generations of digital fabrication technologies and materials, that aims to scaffold adolescents in developing and acquiring digital design literacy in school.

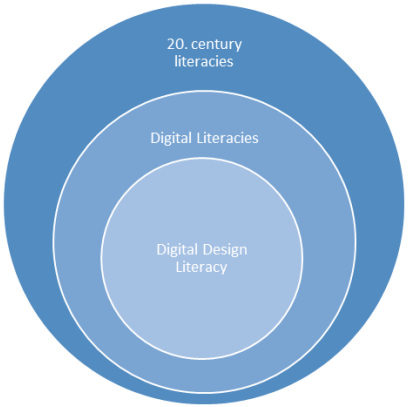

Figure 1. Relationship between the different levels of 21. Century literacies.

Related work

By combining the work of Buckinghams multiple digital literacies [11] with pragmatic design understanding [12], [13], we give a preliminary definition of *digital design literacy.* Buckinghams plural definition of digital literacies follows with Lankshear & Knobels description of a diverse and expansive view of multiple digital literacies [11]. Digital design literacy is one such literacy, combining design fundamentals [12] with digital literacy [12] (figure 1). This notion of digital design literacy resembles Nelson & Stoltermans notion of what constitutes designerly thinking – but in an educational context. Buckingham emphasize that in acquiring digital literacies, students must work through a dynamic process of critical thinking and hand-ons making [11]. Such activities should encourage reflective and critical understanding of how digital technology work, and hence promote reflective ways of using them, thus transcending schools' instrumental use of such technology and media production [ibid.]. Buckingham further states that adolescents experience digital media as new cultural forms, but that they do not necessarily understand the underlying technologies and systems that constitutes these cultural forms [11]. The market of new technologies that try to implement digital fabrication into schools are in a period of rapid development[1]. But according to Lankshear & Knobel, the majority of students continue to be educated through popular proprietary and commercial consumer products. Such basic ITC skill activities does not scaffold students in developing and acquiring digital design literacy.

Following the inconsistences in defining *a single digital literacy of the 21. Century*, Lankshear & Knobel summarizes a framework with four generally agreed upon components of digital literacy that integrates multiple literacies. The 4. component represents *attitudes and perspectives,* and are at the highest level of digital literacy, which reflect literacies such as *independent learning* and *moral / social literacy*. These attitudes and perspectives constitute a moral and social framework that reflects the idea, that the ultimate purpose of digital literacy is to help each person learn what is necessary for their particular situation. We use this framework as a basis for our conceptual "tool-to-think-with", and in the following we expand and relate the social / moral attitudes and perspectives on digital fabrication with that of hackerism.

Hackerism *attitudes and perspectives*

Himanen defines hackerism as an opposition to the dominating morals of the industrial and information age, and through his sociocultural analysis, questions

[1] E.g. Raspberry Pi, Arduino, makey-makey, RepRap 3D printers or visual programming software like Scratch.

the Protestant work ethic that is and has been guiding peoples life in the western capitalist world [9]. Hackerism proposes a range of alternative attitudes and perspectives in relation to ethics in our information network society. The ethical values embedded within digital technology are important to consider when designing new generations of fabrication technologies for adaption in school environments, as students adopt the intrinsic values placed in the design of digital technology [14]. This point is elaborated further in Lankshear & Knobels remix of Lawrence Lessigs ideal of "Free Culture" [11]. One example of such design values is that of overly regulated copyright that is persistent in the majority of the software used in schools. As DRM technology gets layered into the very fabric of a network, it becomes increasingly difficult for most people to be creative and remix digital resources [11]. Lessig notes that adolescents will still engage in creative remixing activities, and try to *crack* e.g. Digital Rights Management technology, and thus pushing them into illegal activities. Another consequence of this development is that we cannot formally teach how to speak and write with digital materials [ibid.]. The hackerism community have a strong tradition in discussing such sociocultural issues in relation to technology and networks. That is why we suggest using hackerism as a "tool-to-think-with" in guiding the designer through a process of critical reflection on how central design values can affect future design and implementation of digital fabrication technologies and materials in school.

Hackerism as a "tool-to-think-with" when designing digital fabrication technology

We suggest including Himanens S*even Values of the Hacker Ethic* [9] in order to qualify the discussion on designing digital fabrication technologies and materials in relation to the literacy component of *attitudes and perspectives*. These seven values serves as lenses that guides the designer through different ethical attitudes and perspective, in order to help him critically reflect on his design process and make new inquiries into his work. The designer might discover design qualities that could otherwise have been overseen, or simply not thought of. In the following, we'll discuss the first six values in pairs of *work-, money-* and *network ethics*.

The 1. guiding value in a hacker life is that of *passion* [ibid.], described as some intrinsically interesting pursuit that energizes the hacker and contains joy in its realization. The 2. value is that of *freedom* through a dynamic flow between work and life's other playful passions without routinized and continuous time-money optimizing. The hacker work ethic consists of melding passion with freedom [ibid.]. Reflecting on the design of digital fabrication technologies through these lenses throughout the design process might help shed light on issues like *adaptation, empathy* and *privacy,* and raise questions like "how does the design respect individuals privacy?", "how open and free is the design, and how can it be adapted in other contexts and situations?" The concept of open standards is good example of a design that takes the issue of adaptation and empathy into account.

Following this comes the hacker money ethics. Hackers do not see money as a value in itself, but motivates their activities through values of s*ocial worth* (3. value) and *openness* (4. value), as a way to realize their passions together with others, and to create something valuable for the community and be recognized for it by their peers. The results of their work is freely shared

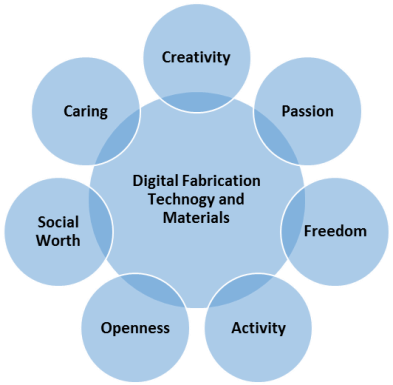

Figure 2. Hacker ethics expanding Lankshear & Knobels Attitudes and Perspectives. In relation to digital fabrication

with the community to be used, developed and tested by anyone, so that individuals can teach and learn from one another. Designers might question issues like "how is money a motive for our design?", "which parts of our design are free[2]?" or "what and how can other communities learn from our design?". These values are easy to spot in hacker communities, as many hackers distribute their work freely for others to test, use, remix and further develop – the Linux kernel is perhaps the best example of how a major software design manifests itself through hacker ethic values. Another important point made by Himanen is how hacker communities engage in peer-to-peer teaching and independent learning through free materials spread throughout the Internet and hacker communities - a learning model that resembles the idea of Platos Academy [9]. When technology is designed as a black-box, then it doesn't encourage the user to explore its insides – often the manufacturers discourages exploring its products insides, and might even fill lawsuits against individuals because of such activities. Proponents of Creative Commons and Open Design [15] talk of *WYS ≠ WYG*[3] to describe designs that become opaque through black-box design thinking [ibid.], suggesting that open and free hardware embodies the technical knowledge, and that such designs give users access to that knowledge as a result of this.

The network ethic denotes hackerism attitudes towards information networks, and is defined by the values of *activity* (5. value) and *caring* (6. value) [ibid.]. Activity involves freedom of expression, privacy to protect the creation of an individual lifestyle, and the rejection of passive receptiveness in favor of active pursuit of one's passion [ibid. p. 140]. Caring means concern for others as an end in itself [ibid. p. 141]. Such values are essential in grounding a moral and social framework, and to develop an understanding of sensible and correct behavior in a information network society [11]. Here the designer might think of questions such as "how do we support freedom of expression in action?", "how does our design invite others to participate in evolving and remixing our design?" and "what and how does our design care about the world?" – ask questions in relation to virtues that are often associated with good citizenship [3].

The 7. value is that of *creativity*, which Himanen describes as "the imaginative use of one's own abilities, the surprising continuous surpassing of oneself, and the giving to the world of a genuinely valuable new contribution" [9, s. 141]. Creativity in this sense relates strongly to the idea of independent learning, in that one should surpass oneself, but at the same time contribute to society in a positive and non-destructive manner.

Conclusion

In this paper we've put forth the suggestion of using seven hacker ethic values as lenses in a conceptual "tool-to-think-with", when designers are in engaged in designing and implementing future generations of digital fabrication technologies and materials that aims to develop digital design literacy among adolescents in schools. Designer may benefit from this by being able to make new inquiries into digital fabrication technology and materials.

[2] As in free speech, not gratis beer.

[3] What You See Is Not What You Get.

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