Considering HCI Mindsets and Practices in the Making Phenomenon: A Value-Based Approach

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Abstract
Our research is grounded in several years of experience in establishing and running an academic makerspace that is open for our entire campus community. As part of developing the goals and purpose of our space, we have identified the need and opportunity for HCI mindsets and practices to be more prevalent in the making phenomenon. In this paper we discuss: how this need resonates with the challenges and questions in HCI education; our own value-based approach to understanding and supporting HCI in the making phenomenon; and implications for HCI education of both the value-based approach and the relationship between HCI and the making phenomenon.

Author Keywords
Makerspace; Values; HCI education.

Introduction
In addition to developing best practices for educators within the classroom, a significant challenge faced in HCI education is how HCI should best be integrated into academic contexts — this naturally includes defining formal curricular structures, but also taking advantage of opportunities for informal learning. Open questions include where HCI should be taught, who would benefit from learning it, and how to overcome preconceptions that HCI is not really necessary. For example, Jordan et al. ask what department HCI be-

longs in, given its interdisciplinary nature, and how when HCI is taught in different places, it contributes to a "scattered" perception of HCI [9]. While requiring HCI courses as part of the curriculum can help reach more students, HCI education researchers report difficulties when students are not engaged in HCI courses, especially when the course is required [1, 11]. Addressing some of these challenges includes overcoming students' mindsets that HCI is just making things look pretty, or that everything in HCI is common sense. A contributing factor to students' mindsets are general societal tendencies to value hard sciences over soft sciences and humanities.

We have encountered strikingly similar questions and challenges in a related context over several years of developing and running an academic makerspace. As HCI researchers and educators, one goal of the makerspace is to support HCI and other coursework, while also making the space open for more informal use by the entire campus community. While HCI education for makers is not typically a focus in HCI or in making communities, we have made observations in our makerspace and drawn conclusions from HCI literature on making that point to the value and even necessity of HCI-like mindsets and practices being present in the maker world. Makerspaces and the vision of what makerspaces could become represent a shift in the control of technological production: what was once in the hands of designers and researchers to create is now in the hands of the average individual. As more individuals have access to the means to create technologies for themselves and others, what HCI educational resources does the HCI education community hope they have access to? How far should the work of HCI educators reach? Just as not all technologists see the value in integrating HCI perspectives throughout development, it is likely that not all makers would see the value of HCI being part of their practice. In both these

circumstances, we face the challenge of promoting HCI without being imposing.

Our approach to this challenge of bringing HCI to new communities, such as the making phenomenon, is to focus not on the specific methods and processes of HCI, but rather the *values* of HCI that drive those processes. We explore the following possibility: If the making phenomenon and contexts for making were to emphasize and communicate the importance of certain considerations or the responsibilities that creators of technologies have, then individuals and communities might adopt HCI practices and mindsets to a greater degree.

In this paper, we present insights that we have gathered as part of an ongoing project theoretically and empirically investigating the promise and pitfalls of the making phenomenon. Our investigation has shed light on the need for a shift in the values of the making phenomenon from artifact-based, individualistic, and internally-facing towards values that are evident in HCI such as interaction-based, societal, and externally-facing mindsets and practices. Here we discuss key aspects of our project and how they can contribute to HCI education: (1) a value-based approach to fostering HCI practices and mindsets in formal and informal learning; and (2) a discussion of how these values connect with the making phenomenon in relation to the HCI education community.

In the next section, we discuss the relationship between HCI and making and provide support that favors HCI embedded in the making phenomenon. Then, we introduce our value-based approach to developing an understanding of which specific aspects of HCI should be part of the making phenomenon. Finally, we discuss implications for the EduCHI community and our research agenda going forward.

HCI and Making

We use the term the "making phenomenon" to refer broadly to a recent emphasis in research, libraries, schools, and communities on making, hacking, DIY, digital fabrication, crafting, and other related activities. In many ways, the making phenomenon embodies a sort of utopian future envisioned within the HCI community [2], where participation, access, and empowerment in the area of technology are abundant. HCI researchers have pointed out that making shares not only some of HCI's broad goals of democratization and empowerment [2], but also that makers create the same kinds of artifacts we might expect to see as products of HCI research (e.g., Internet of Things devices for the home) [12]. Roedl et al. suggest that HCI designers shift from designing end artifacts for end users to designing tools for making, hacking, and repurposing [14], and indeed, a large body of HCI design work focuses on such tools under the guise of promoting democratization, empowerment, and participation. Baudisch and Mueller detail an extensive review of HCI-designed tools for making, drawing attention to how the tools lower the barrier to access to knowledge about the machines and the materials [3].

Since HCI is invested in spreading participation in the production of technology, a question we must ask ourselves is what the implications of that shift are. Roedl et al. point out that focusing only on understanding and spreading the tool aspect leaves significant blind spots, particularly in terms of the social and societal implications [14].

In our own work, we point out how HCI research has yet to consider differences between the processes and considerations of HCI designers and makers, even when their end goals are similar artifacts. For example, in HCI, researchers and designers employ explicit Human-Centered Design or Participatory Design processes to take into account the nuances of the user experience at all stages of the design process. Perhaps makers are employing some of the same processes in their practice, but little about the making phenomenon as it is currently set up invites or prompts those considerations into the making experience, meaning that consideration for the human is not explicitly embedded into the design of the artifacts coming out of the maker world.

Empirically, we have also noticed this difference manifesting in mindsets and practices of maker communities we have worked with. For example, there is a student organization that uses our makerspace to 3D print prosthetic devices for children with limb differences. In a series of interviews with some of their volunteers, we found that participants were more focused on the technology and the device than the relationship with the recipient and social aspect of the experience [13]. As HCI researchers, we recognize an opportunity. If these volunteers had a background in needfinding, they might approach the endeavor differently and create a more meaningful experience for the recipient and themselves.

While it would be unreasonable to expect makers to conduct formal needfinding or evaluation as part of every personal making endeavor, our reasoning here emphasizes the need for there to be *something* in maker mindsets and practices that resembles HCI in terms of consideration for the human experience throughout the course of the making endeavor. If we accept and consider this imperative as HCI educators, we face questions similar to the rest of the HCI education community: Where does HCI education happen? Who should be included? How do we best reach those audiences?

To help address this challenge, we propose a value-based approach to better understand the issues and to reach the

growing number of people engaged in technological production with HCI mindsets and practices.

Summary of Value-Based Approach

Our approach considers a comparison of key values present in the making phenomenon to values in HCI, seeking to understand which of those values are more desirable for the making phenomenon to align with. The values focus draws upon Value-Sensitive Design, a technique that ensures values are explicitly discussed and taken into account at all steps of the design process [5]. We chose to focus on values rather than processes because (1) making tends to be rather homogeneous in terms of process, and (2) there is evidence that makers can already be strongly guided by and discuss their work in relation to emergent values [15]. There are even some commonly shared values among makers such as creativity and sharing [10].

Based on our impressions of the rhetoric surrounding the making phenomenon locally and in the literature, we consider the prevalence of *individualistic*, *artifact-based*, and *internally-facing* mindsets and practices (Table 1). For example, citing the success of a makerspace in terms of the number of people who are active within it and the number of cool things they have made embodies these values. The common rhetoric of "we are all makers" and the focus on the affordances of the making phenomenon for personalization also resonate.

In contrast, while early HCI primarily focused on individuals, artifacts, and looked internally, HCI has evolved to encompass alternate values of *societal*, *interaction-based*, *externally-facing* mindsets and practices. For example, the waves of HCI roughly show this progression from focusing on the form factor of interfaces relative to humans' physical abilities to considering more complex interactions such

Values in Making	Values in HCI
Individualistic	Societal
Artifact-based	Interaction-based
Internal-facing	External-facing

Table 1: Comparison of values that are prevalent in making and HCI communities.

as the dialogue between the human and computer, to even broader considerations such as cultural factors and dynamics within communities at varying scales [7]. These values manifest in various HCI mindsets and practices such as the User-Centered Design process, which de-emphasizes the artifact in favor of the human. These values are also evident in Activity Theory and HCI's general understanding of artifacts not as the end goal of research but rather a mechanism through which to investigate various interactions.

This set of values is not intended to be all-encompassing or universally agreed upon among HCI researchers. However, it does capture some of the contrast between what happens in HCI compared to the making phenomenon. We have yet to conduct a formal thematic analysis to validate these preliminary insights and additional details on our methodology or grounding are out of scope of this paper, but there are still relevant implications to consider.

Another aspect of our value-based approach involves reasoning about (and eventually measuring) what happens when makers or contexts for making exhibit either of these sets of values. For example, we return to our use case of volunteers who 3D print prosthetic devices for children with limb differences. If the volunteers had less of an artifact-based focus, then perhaps they would have a different perspective on how to approach the recipient and work to-

gether throughout the experience. Another example comes from a common discussion surrounding digital fabrication labs as mechanisms through which we can achieve a more sustainable society by using the technology to produce locally everything that we consume [8]. While this is certainly external-facing and societal, it is artifact-based in that this particular vision focuses only on the technological possibilities. By disregarding the social infrastructure needed to make it possible, there is the possibility that pursuing this technological promise does more harm than good [6]. Reasoning about these different scenarios will help us understand if these two sets of values are mutually exclusive, whether there is a spectrum between them, or whether there are instances where they both need to be present.

By considering these different scenarios, we begin to see the value to individuals, communities, and society more broadly if the HCI-aligned values were more prevalent in the making phenomenon. This theoretical work is leading to a formal definition of and support for a normative theory of making, intended to guide makers and maker leaders towards values they should align with for more desirable direct and indirect outcomes.

Discussion

Value-based Approach

We have discussed key aspects of our nascent value-based approach to fostering HCI mindsets and practices in the making phenomenon. Typically, HCI education focuses on teaching formal methods, processes, and principles. Our approach is to instead consider HCI as a set of values that drive or manifest in certain mindsets and practices. Having these HCI-aligned values might lead to a process that resembles User-Centered or Participatory Design in some ways even if the individual never learned these methods formally.

A natural question will be how to implement and instill the values that align with HCI in makers and maker contexts. Not only is this a difficult design task, but it is particularly difficult to do so in a way that is not imposing. Some possible directions for that future research include the following: an ambient value approach, where we draw upon our understanding that physical spaces communicate values [4] and can perhaps be designed to cultivate certain ones; a discourse approach, where maker leaders are trained in how to bring certain conversations or topics into focus for makers to navigate and consider when reflecting on their work.

Explicitly cultivating, communicating, or reflecting on values in a formal HCI setting might augment formal or traditional learning methods. Perhaps the sets of values we identified would be helpful to characterize the mindsets and practices of students in formal HCI settings and activities could be designed to accommodate different shifts in values. Or perhaps understanding the values embedded in the larger educational context or institution could help identify what sort of preconceptions about computing the instructor should ask the students to confront in order to move forward with HCI.

The Making Phenomenon

The making phenomenon is of general interest to the HCI community due in part to ways in which the making phenomenon embodies some of HCI's overarching agenda items of widespread participation in the production of technology [2]. The making phenomenon introduces a few considerations and opportunities for HCI education. For example, as we have presented in this paper, considering the necessity of HCI or HCI values in the making phenomenon echos some of the existing questions of the community, such as who should be doing HCI and how to promote it even when individuals do not see the value in it.

Considering HCI education relative to the making phenomenon draws attention to the increasing prevalence of informal settings where people are participating in the production of technology for themselves and others. The HCI courses in formal educational settings (where we typically expect HCI mindsets and practices to be learned) are reaching an increasingly smaller subset of the people participating in technological production. Perhaps the outcomes of the HCI education research community naturally apply to informal settings; perhaps they might be expanded such that they do; or perhaps reaching informal settings is a completely different research endeavor. In any case, it is important that these endeavors are related such that they have a similar perception of what aspects of HCI they deem important, or are at least aware of what aspects of HCI are most appropriate in other contexts.

Makerspaces, particularly those that exist in a university or other formal educational settings, also provide an opportunity to bridge formal with informal learning of HCI or instilling of human-centered values. Our makerspace, for example, supports students working on projects for courses that relate to HCI such as an Interaction Design Studio, coursework that involves interaction but has a focus other than HCI, and personal projects. The makerspace could work to facilitate discourse between these different perspectives, prompting students to consider the different goals and benefits of alternate approaches. Or perhaps if the space itself were able to embody these values, it might prompt students to continuously integrate and negotiate their work in relation to these values throughout their degree, reinforcing the more concrete learning outcomes of their HCI-related classes.

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