Meanings in Digital Fabrication

Georgi V. Georgiev
Center for Ubiquitous Computing,
University of Oulu, Oulu, Finland
georgi.georgiev@oulu.fi

ABSTRACT

The aim of this study is to investigate the drivers of physical realization of meaningful objects, in particular, how these drivers can contribute to prototyping of products. An intensive digital fabrication workshop, a part of a summer school, is used as a case study. We discuss the results of the workshop in terms of the background of the participants and their motivation in the perspective of the rationale of their prototypes. We identify how the background and motivation of teams of the participants influenced the meaning making in digitally fabricated prototypes.

CCS CONCEPTS

• K.3.1. Collaborative learning

KEYWORDS

digital fabrication, meaning making, prototyping, FabLab, idea generation, meaningful object

1 Introduction

In this study, the results of an intensive digital fabrication workshop, entitled "Making Things That Matter", are used as a case study to investigate how the background of workshop participants influenced the meaning making in their digitally fabricated prototype. The aim of the workshop was the physical realization of meaningful objects. The setting of the workshop gave the participants a total of about five days for the generating and materializing their idea into a physical prototype using a digital fabrication laboratory (FabLab). The workshop concluded with the presentation of the outcomes and examination. The teams varied from one to three members, as no restrictions were imposed on the grouping in teams. The fourteen students that participated in the workshop grouped into eight teams based on the topics they selected to prototype.

2 Meaning Making with Fabricated Objects

Blikstein points that the "students' projects should be deeply connected with meaningful problems, either at a personal or community level, and designing solutions to those problems would become both educational and empowering" [1]. Encouraging imagination without creating too many restrictions is a significant challenge for fabrication and prototyping courses [2, 9]. Meaning making is essential in the process of design. Personalization, a key activity in sensemaking [15] is essential in the context of digital fabrication [3, 4, 5, 6, 11]. Meaningful interaction with technology is inspired by both the physical and social phenomena of everyday life. An artefact can stimulate reflection in users through the tangibility and materiality of the interaction [10]. Although reflection is a key for meaningful design processes, the considered reflection in the case of an intensive digital fabrication workshop can be seen as restricted. Enabling personal meaning-making can be aim of design of interactive experiences [14]. Embodied interaction takes a broad stance by envisioning meaningful interaction with technology as inspired by both the physical and social phenomena of everyday life [10]. Such interweaving of physical and social phenomena of everyday life is probably central when embodying meaning through the means of digital fabrication and making.

People invest meaning into artefacts and facilitate social interaction and reflection upon their activities [13] while encouraging practitioners to incorporate new forms into their work. Meaning making is placed along "an extended 'trajectory of use' in which reflective, meaningful 'data-things' can be created" [13]. Investment of meaning in artefacts is essential for making.

3 Case Study

The methodology of the study involves qualitative analysis of the workshop and documentation provided by the participants or recorded during the workshop. The data sources for analysis are: (1) Pre-workshop questionnaire; (2) Individual introductory presentations; (3) Pictures; (4) Final team presentations; and (5) Produced artefacts. The setting of the workshop was based on the idea that the participants are motivated to work on the topic and already have some experience related to digital fabrication.

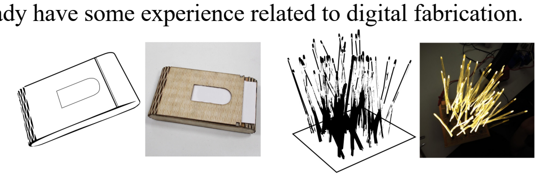

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Figure 1: Two prototype examples (Business Card Reminder (left) and Porcupine Installation (right))

The workshop asked the participants (graduate students or junior academics) to imagine the possibilities that arise from the new paradigm of digital manufacturing. It covered not only the physical and conceptual tools of making but also the benefits of contextual and project-based learning, as well as the potential for impact within these projects. In terms of content, the workshop reviewed a variety of example projects and reflected upon their meaning based on context and implementation. The participants were free to team up and choose a project area, come up with a suitable and well-scoped idea, then prototype, test, iterate, and realize it using the resources available at the available FabLab Oulu environment. On the final workshop session, each participant presented and demonstrated their work, along with an explanation of the context for which it was developed and criteria to measure possible success (see Figure 1 for ‘Business Card Reminder’ and ‘Porcupine Installation’ examples).

4 Qualitative Analysis and Discussion

The qualitative analysis focuses on participants backgrounds. We then use the self-reported questionnaire (prior to the workshop) to identify the most high-level motivation and expectations, and the most specific activities and interests that relate to the workshop topic (Figure 2). We consider the high-level motivation and expectations and specific activities and interests as indicative of what is meaningful for each participant and what are the drivers behind it. We also focus on the rationale (context) of the projects as the participants objectified in their presentations of the project outcomes. Figure 2 lists the rationale (context) of the projects as the participants objectified in their presentations of the project outcomes. The motivation seems strongly related to what was chosen as a topic/functionality. Notable for several teams is that the chosen idea is distinctly representative of the initial motivation of a single participant. This observation points to meaning making being related to personal experiences, needs and aspirations (e.g., solve a personal, work, family, community problem [12], need for (artistic) expression, or activism). For example, for ‘Business Card Reminder’ the factors of motivation (based on personally perceived problem) and background of one of the participants influenced their design/meaning making.

The meaning has been identified as a contextualized learning in STEM education; namely, the students have the opportunity to come across several concepts in engineering and science in a profoundly meaningful, engaging, and contextualized fashion, thus enabling abstract ideas and entities become meaningful [1]. The prototype of ‘Porcupine Installation’ is with abstract ideas from the set. Different projects in varying degree implement particular functions. Often these functions are solving perceived everyday life problems of participants. Facing the open-ended brief and time-constrained making process the participants struggled to find meaning rather than deliberate or intuitive idea generation. Motivation and interest are active drivers in the open-ended ideation and define the prototyping of products in the context of digital fabrication.

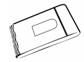
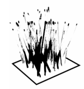
	Background of team members	Motivation and expectations	Rationale of the prototype
	Computer sciences, Design & Ergonomics / Engineering Design / Architecture	Searching for a simple and elegant way to teach the design process / process of creating design products …; the application of heuristics to generate ideas, methods of design and evaluation / prototyping, digital fabrication, design creativity and innovation; good practices and ideas	[Business card case that:] easy to slide / alerts when empty / virtual business card integrated (QR code)
	Materials Science & Engineering / Industrial Design & Chemical Engineering / Architectural Design Computing	Design for user experience; packaging design; creating beautiful objects with minimal materials / connection of the digital and the physical / the relationship between architecture, engineering, and fabrication; relationship between form, force, and digital fabrication; development and creative use of structurally and materially informed computational methods in design	A transformable surface Inspired by: Organic motion from digitally designed parts / Optical properties of fibres, both natural and human made / Features: Individually lit quills

Figure 2: Example background, motivations and rationales

To compare this with other experiences, we take the cases of two-week long digital fabrication workshop [16] and nine-week long digital fabrication course for university students [7, 8]. These education activities in digital fabrication were in the same FabLab. The cases of the two-week workshop and nine-week course are also open-ended, meaning that they are not limited in terms of what idea should be prototyped. However, these two cases are subject of more requirements in terms what should be used as processes, sensors and actuators. The participants in these courses are less experienced in digital fabrication in general.

First, the resulting prototype objects (finally selected and prototyped ideas) in our case study are influenced in a higher degree by the personal motivations and background. Second, subjectively judged, these objects represent a higher variety in terms of ideas (broader conceptual space), thus possibly more creative ideas. It can be speculated that variety is due to the time pressure and background experience of the participants. At last, our case shows only limited cross-pollination of ideas compared to the two-week long workshop and nine-week course, where clusters consisting of similar ideas can be observed [7, 8].

To gain further insights into motivation and meaning-making, approaches that support (automated) data collections in time may be suitable for case of intensive workshops. Such approaches can involve ubiquitous sensing as those proposed by Georgiev et al. [9] or video data analysis. Also, approaches supporting documentation, registering of annotations (evaluations) and descriptions of knowledge [17], may provide related data, which if qualitatively evaluated, will serve as an indicator of dynamics of meaning creation.

5 Conclusion

In this study, a digital fabrication workshop was used to investigate the drivers of physical realization of meaningful objects. We identified the factors of the background of participants (team members with particular expectations) and motivation influenced the meaning-making in their digitally fabricated prototype. When compared to other education activates in digital fabrication, the resulting prototype objects and the meaning-making process are influenced in a higher degree by these two factors, the objects represent a high variety in terms of ideas, and the cross-pollination of ideas is limited.

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