Empowering academia through modern fabrication practices

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Empowering academia through modern fabrication practices

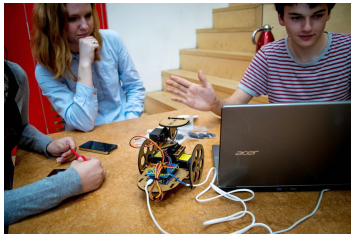

Figure 1: High school students have their first interaction with the single sensor, head tilting, two wheeled robot.

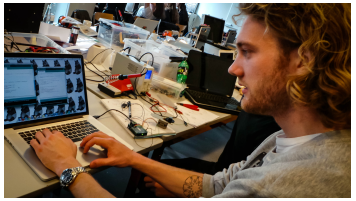

Figure 2: Participants learn programming as part of the media itself, not as a programming course.

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Abstract
We posit that modern fabrication and rapid prototyping practices can empower non-technical academic environments. For this to resonate with academic learning and research environments in a university context we must view FabLabs not only as machine parks but as creative environments, producing knowledge contributions in the form of processes, designs, artifacts and products. We must embrace thinking through the material, and embrace physical products as valid, accessible and assessable on an equal footing with traditional textual media. We describe two cases: workshops focused on exploration through the physical and digital media itself, without a traditional textual component.

Author Keywords
Fablab; rapid prototyping; teaching; education; material as media; experimental approach; research through design.

Introduction
Modern digital production facilities are moving boundaries for how educators and researchers think: ideas can be tested with a working prototype in a way infeasible until recently. The path from thought to reality, mind to matter, no longer requires words and paper before realization. The flourishing FabLab movement has been embraced by educators and innovators globally as a means

Figure 3: Students directly observe and alter the media, viewing it as primary.

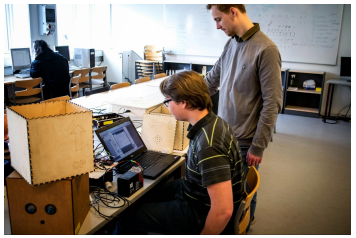

Figure 4: Construction of "mystery boxes" using laser cutting, electronics, Arduino, sensors, servos and programming.

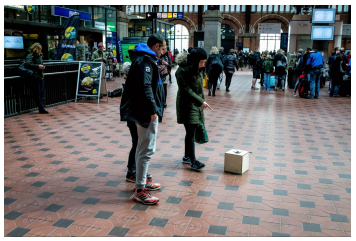

Figure 5: Passersby carefully intrigued by a "mystery box".

to enable low-cost R&D and as a tool for creating exciting and engaging learning environments.

FabLabs offer facilities for supporting entrepreneurial and community based technological development [12] and offer models of learning capable of engaging children in technology, yet we contend that in order to fully embrace the possibilities for educational innovation provided by digital manufacturing technologies we need to more carefully reflect on what it means literally to think-through-things. To read creativity as innovation is, as Hallam and Ingold [6] emphasize, to read creativity backwards. Creativity and improvisation are fundamental and generic cultural resources. Hence, the study of design - understood in terms of creativity, improvisation and exploration is, and should be, a crucial concern not only in anthropology [13] but broadly in the human sciences. Viewed from this perspective FabLabs become an ongoing experiment in human creativity and improvisation.

FabLab RUC

FabLab RUC is an experimental research and learning environment at Roskilde University closely linked to Humtek - the humanities and technology bachelor program established with the vision of integrating technical science, social science, humanities and design [5] (see [2] for an overview of this). The main forms of study relate to student-directed project work (The Roskilde Model [7]). Whereas this model of learning had its origins in the European architectural schools and later engineering colleges [9]; its popularization in Academia (at least in Europe) has largely been associated with critical social science – hence, the establishment of the workshops at Humtek in 2008 reflects a return of craft and hands-on based methods to Academia, with a broader scope as digital technologies and prototyping offer a toolbox with general usability also in cultural and social sciences. While common-sense definitions of design tend to equate it with industrial design or the arts, this environment has provided facilities for experimenting with educating social designers [11]. "Fablearning" offers a radical possibility for crossing disciplinary boundaries, tying into approaches aiming at bringing design, user experience, idea generation and research in a closer dialogue, e.g. research through design (Cross 2006; Zimmerman et al 2007), constructive design research (Koskinen et al 2011) and situated design methods (Simonsen et al 2014).

Experimental approach to learning

In the following we will show how we at FabLab RUC seek to integrate learning, rapid prototyping, iterative design and user testing into learning processes which previously resulted in only a written report.

Case 1: The Build-a-bot workshop

Our robotics platform has been used in several workshops for high school and university students. Participants built a robot, gave it personality and experimented with the interaction between humans and technology. We provided laser cut robot parts, the Arduino open source rapid prototyping platform, electronics and programming building blocks. A single distance sensor and different behaviours coded as modular functions allow a range of behaviours to be combined. We provide the participants the possibility to think, experiment and express themselves through the material, the media of the behaviours, look and feel of a robot - rather than more well known, established media such as a film or a written report. Expression through the material itself, not through words in a pamphlet about it. The material is the media, we think through the material, the material is primary.

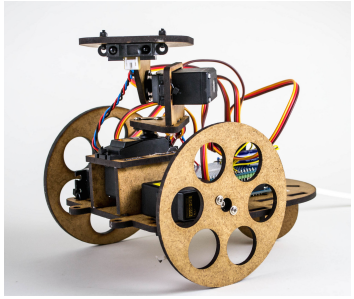

Figure 6: The "friendly" robot platform incorporating one sensor and a tiltable head. Developed with illutron collaborative interactive art studio.

Figure 7: One of the mystery boxes. A receipt printer in the box asks passersby to perform tasks, e.g. have an ice cream with a stranger.

Case 2: Building objects for engagement with society
Second year students at Humtek used the FabLab as an integrated part of their explorative process in an interaction design course. The theme was "reclaiming the streets", with emphasis on understanding ways of facilitating socially playful interactions [4, 8] in everyday life. To explore this they designed multiple mystery boxes. The boxes were placed in various public places and requested different forms of performance from bypassers, e.g. "carry me to <a specific location>", "give another bypasser a hug" and so on to experimentally explore how people behave and interact (or not) in public spaces. Through the designs students were able to gain understanding of the social dynamics in context and understanding of the consequences of design choices made in the process.

Discussion

Integrating the more craftsmanship-like approach to knowledge production into a more traditional academic environment poses multiple challenges. We hope that the two cases have exemplified the value of integrating a FabLab in an academic environment. We would like to highlight a few of the challenges and strategies around FabLab Ruc:

Return to the reflective practitioner
Whereas traditional design/art/technological schools may emphasize the professional skill of one particular domain (i.e. architecture, music composition), FabLabs intend to facilitate creativity and improvisation across domains and disciplines. We encourage users to choose, explore and work through design problems with the ambition that through this process they build valuable competencies and knowledge - a vision related to and inspired by learning theorist Donald Schön's call for a reflective practicum. An inspiration that has been central to the foundation and development of the Humtek bachelor program as well. In Schöns words [a] reflective practicum must establish its own traditions, not only those associated with project types, formats, media, tools and materials, but also those embodying expectations for the interaction of coach and student [14]. In a university context the FabLab becomes an experimental environment for developing such new concepts.

Knowledge production beyond the written report
A particular problem relating to integrating thinking-through-things-and-technologies into Academia is related to the forms of representation presently used for presenting, evaluating and examining students and for documenting research. The 'fab' research process more often than not takes the form of a series of instances, interventions, sketches, trials, experiments and product. At FabLab RUC we attempt to facilitate a continuous documentation process (photos, video, writing guides for others), however it is challenging, and examiners are not used to assessing a multidisciplinary 'thing'. The byproducts of the exploration with the artifacts become just as relevant a knowledge contribution in a wider discourse [10], but mainstream Academia is still geared primarily towards the textual medium. The bachelor program in Humanities and technology presently requires designs to be documented as a substantial written contribution to a report; however, the newly established international masters programme Spatial Designs and Society at Roskilde University acknowledges text, photos, sound recordings, illustrations, maps, physical 3D models, and IT-based 3D visualizations/simulations as approved deliverables on an equal footing in relation to assessment (Study regulations for the masters program in Spatial Designs and Society [1], 15).

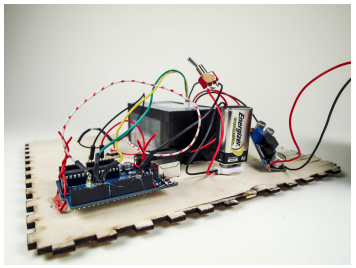

Figure 8: The electronics inside the box – Arduino, battery.

Figure 9: The robot kits are designed as products to be inviting and provide both initial success and later hackability. They are mass produced with basic laser cutting materials.

Spaces for experimental design exploration
Within the umbrella of research-through-design (constructive design research) the FabLab offers a space for design exploration that enables us to move beyond Buxton's low-fi prototyping approach [3] to a more working prototypical approach, while somewhat maintaining low threshold and iteration cycle. It gives the students the possibility to sketch digitally [8]. By offering the possibilities for thinking through prototypes, technologies and materials the FabLab offers a learning and research environment that encourages experimentation and instant evaluations of research and design ideas.

Conclusion

Integrating FabLabs' enabling possibilities in Academia is both a return to craft and hands-on based methods in Academia and a work in progress. Easy access to production of never before seen media offers new possibilities for learning, research and documentation within all subjects, not merely technological subjects.

Acknowledgements

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