Fab Labs and Interdisciplinary Academic Teaching: A research agenda

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ABSTRACT
This contribution summarizes the agenda and some first results of a three-year research project on the integration of Fab Labs in German universities and academic practices.

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Fab Labs; University Teaching; Maker Culture; Education

ACM Classification Keywords
• **Social and professional topics~Adult education** • Human-centered computing~Empirical studies in collaborative and social computing

INTRODUCTION
Maker activities, Fab Labs and related phenomena have been subject of increasing research and practice activities in recent years. Domains ranging from Innovation, Economics, Humanitarian Aid to Design and more have concerned themselves with their potential. One of the most long-term and steady streams of activity is related to Education [1]. Work on Maker-topics ranges from Constructionism as one of the central theoretical framings [4] trough many studies on Making in school settings (and, to a lesser degree, universities) up to the establishment of more and more Fab Labs and similar spaces in/with educational institutions.

Project FAB101 (grant number 16DHL1026) establishes a research infrastructure of four existing German Fab Labs at universities, each run by a research group with a different disciplinary background, located in two federal states and in differently sized and structured cities (overview included in the accompanying poster). Over the course of three years, the project enables in-depth research into the context of the four Fab Labs as well as the participatory development and

evaluation of new cooperative practices. FAB101's goals are to systematize and generalize insular solutions e.g. relating to governing a Fab Lab in academia, to develop new and cooperative teaching formats and to foster the integration of Maker-type practices in academic infrastructures in Germany. FAB101 aims to provide a *socio*-technically grounded, long-term (action) research infrastructure due to the field's complexity:

"There are several critical elements that need to be in focus for digital fabrication to be successful in education, e.g. digital tools, community infrastructure, and the maker mindset. One further element that needs to be present is a curriculum and digital strategy in education that provides a framework [...]." [2]

This contribution intends to outline FAB101's research/practice agenda, sketch out some first results and to encourage input and discussion for the project in conjunction with the associated poster for FabLearn 2018.

METHODOLOGY
In broad terms, the three-year project can be broken down into four major steps: First, multiple studies, mainly using qualitative methods such as interviews, media analyses, and field visits to understand each Lab and its context. Second, the co-development of new local as well as cross-location teaching concepts. Third, research and development into (ICT-based) support systems such as Lab user management or access control to machines. Fourth, the development of guidelines, templates and recommendations for the governance of open (Fab) Labs in (German) academia. Methodological foci for the project include:

Transdisciplinarity
The groups running the project consortium's Labs are from Media Informatics, Human Computer Interaction, Education and Didactics as well as from Design. Furthermore, each Lab has users and community members from outside their universities including regional and global networks.

Action-oriented research
Research activities comprise the practical evaluation of new educational concepts, the development of functional prototypes for support systems and the active involvement of project researchers with the Labs and their communities.

Meta-perspectives from CSCW

Computer Supported Cooperative Work concerns itself with forms of work which include complex socio-technical systems as well as the shaping of such systems. Viewing a Fab Lab as such a system, CSCW domains such as *Infrastructuring* may offer insight into how to govern/develop them in a way that reflects all stakeholders and technological possibilities.

RESEARCH FOCI

Based on first (pre-)studies, we have identified four broad foci for further research and development in FAB101:

Cooperation

Maker-activities are associated with new forms of distributed work and collaboration and Fab Labs themselves are a global network emphasizing collaboration. However, in practice there is not a lot of substantial cooperation between the German Fab Labs at universities at the time of writing. There are also other aspects such as emerging structures of cooperation between different stakeholders and disciplines in/around Fab Labs that can be challenging to manage.

Tools

Tools and platforms to support Maker-related cooperation and sharing do exist but there are hardly any standards and lots of knowledge is not retained/shared. Furthermore, the usability and user experience of Maker-tools (hard- and software) is not necessarily always appropriate, especially given a rapidly varying user-base for such tools.

Education

Integrating Maker-type approaches in different disciplines of study requires appropriate didactic and pedagogic strategies. Discipline-specific educational building blocks should bridge the gap from discipline to application-/machine-focused "blocks" in a Fab Lab (such as safety and usage instructions for a Laser Cutter). Individual exploration and motivation should also be explicitly considered.

Infrastructure

Fab Labs require a certain amount of infrastructure in the sense of space, tools and trained personnel. Each infrastructure aspect has -local up to global considerations and ramifications which can be challenging to assess and to manage. Fab Labs in academia are also part of public infrastructure in a broader sense and have a range of challenges as well as opportunities associated with this state on organizational, legal, financial, ethical and other levels.

FIRST RESULTS & BRIEF DISCUSSION

Formal and legal aspects

There still seems to be a significant amount of unclarity, local/insular/informal agreements as to the organizational structure, legal status, financial structure, legal and personnel requirements, open access as well as other formal aspects of Fab Labs at universities in Germany.

"Basics Lecture"

All (Fab) Labs, especially those in educational institutions, need a way of enabling new users to use their Lab and their tools safely and fully. Such a "basics lecture" may be similar to MIT's *How to Make Almost Anything* [3] and may be maintained open and collaboratively. It should include considerations such as the attachment of discipline-specific modules as well as relate to the German educational system.

Regionality

The Fab Lab concept itself focuses on global standards and world-wide infrastructure. However, in order to be locally successful, a Lab also needs to be considered from the respective regional perspective relating to (potential) stakeholders and collaborators, space, location and multiple other factors.

Sharing

Documentation of users' projects, sharing and knowledge retention in general are an issue. They are hard to encourage, sustain and support. This is one of the domains which may benefit from better ICT support systems (also including machine access control and others).

Openness

"Democratic" access for non-academic users can be hard to implement and sustain in Fab Labs at universities for legal, political and financial reasons. However, the Labs and their communities generally view open access as one of their major success factors and/or principles [5].

OUTLOOK

In this brief contribution, we are only able to outline the project agenda and its direction in the broadest of terms. As indicated above, current work in progress / next steps include developing best-practice documents/templates for some of the central formal issues and work on the participatory design of prototypes for support systems, especially for sharing, documentation and access. Developing, testing and evaluating the "basics lecture" and discipline-specific didactic blocks will also be major steps for the project.

REFERENCES

1. Paul Blikstein. 2013. Digital fabrication and "making" in education: The democratization of invention. In *FabLabs: Of Machines, Makers and Inventors*, Julia Walter-Herrmann and Corine Büching (eds.).

2. Eva Eriksson, E., Carl Heath, Peter Ljungstrand and Peter Parnes. 2017. Makerspace in school- Considerations from a large-scale national testbed. IJCCI, 16, 9–15.

3. Neil Gershenfeld. 2005. Fab: The Coming Revolution on Your Desktop - from Personal Computers to Personal Fabrication. Basic Books.

4. Seymour Papert and Idit Harel. 1991. Situating Constructionism. In *Constructionism*, Seymour Papert and Idit Harel (eds.). Ablex Publishing Corporation

5. The Fab Charter. Retrieved March 18, 2018 from http://fab.cba.mit.edu/about/charter