Designing a Hands-on Learning Space for the New Generation

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ABSTRACT

In this poster paper, we present a "design document" for a fab lab in development at the University of Trento, in Italy. We discuss why and how some elements of the fab lab can be rethought for the current generation of Higher Education students, which, we argue, has different features than the one originally targeted by these structures. We discuss the three main design elements that we use: matching high- and low-tech fabrication; constructivist education; and interdisciplinarity. Finally, we outline relevant stakeholders for this type of initiative and how they can be empowered and integrated in the lab's architecture.

CCS CONCEPTS

• **Applied computing~Education**

KEYWORDS

Fablab, constructivist education, crafts, interdisciplinarity

Introduction

Since their inception in 2001, fab labs have undergone many radical evolutions, one among many being the introduction of easy-to-use electronics prototyping platforms such as Arduino. The increased accessibility of technologies such as 3D printing, laser cutting, the aforementioned Arduino etc. has proven in this sense to be a critical asset for the success of the fab lab. This success particularly helped in accomplishing one of the fab lab's implicit missions: building awareness ("evangelisation") in its users of the opportunities that these technologies represent.

Additionally, many studies testify to the validity of fab labs as test beds for pedagogical experimentation and innovation, promoting a culture of hands-on learning and practice, especially in K12 education[4]. However, a subtle but substantial change happened in their user-base (i.e., the students): in universities, current cohorts are part of a different generation than the one that fab labs were originally designed for[5]. For example, in 2001, MIT undergraduate students would be born between 1979 and 1983, while current students were born between 1996 and 2000. This second group has grown up with digital technologies being a pervasive reality in their lives. Therefore – we argue – they might be less interested in the "evangelisation" dimension, and instead benefit from other educational gains offered in fab labs.

This poster paper represents a "design document" for a fab lab that the authors are developing at the University of Trento, Italy. We will describe one such possible gain, namely how we aspire to contribute to bridge the skills and generational gap between "high-tech" and traditional "low-tech" fabrication. We will describe how, for this model to be successful, students/users need to be strongly empowered. We give a brief overview of who are the stakeholders that need to be involved for this educational mission to be achieved, and draw some possible conclusions on what are the opportunities stemming from this view.

Framework

We root our model on three pillars. We do not claim that these are novel to the digital fabrication context. Instead, we believe that the space in the intersection between these three elements and the Higher Education context can be explored further. These are:

1. Matching high-tech with low-tech fabrication
2. Constructivist Education
3. Interdisciplinary Education

The first stems from a reflection on the role of technology in the lives of the current cohort of students. As discussed before, current university students were born in the late 1990s, and grew up with pervasive technologies. This, combined with the changes stemming from the 2008 crisis, lead to a generation of students that does not need to be convinced about potentials of technology. These students, instead, might need a lab that brings "low-tech fabrication" skills (e.g., handi-crafts, professional crafts, and spatial reasoning) in the Higher Education context. These competences were fundamental for many economic activities once dominant in our cities (and in Northern Italy in particular). Nowadays, however, they are hardly represented in educational activities of universities. This is also true in ICT departments and curricula, which are the breeding ground for the affirmation of "high-tech" fabrication. From a practical point of view, a better integration of "low-tech" fabrication in the fab lab would allow students to move from conceptualization to prototypation with a lower technological barrier, while broadening their skillset.

Filling this educational gap requires the deployment of education methods that allow for a free exploration of these subject-matters. Our design relies on a constructivist approach[1], which implies the need to challenge traditional trainer-student relationships[3]. This can be seen as a source of complexity, but we deem this necessary because of two factors. On the one hand, students (and especially those in ICT-related fields) might be more up-to-date with technological trends than their trainers, opening opportunities to empower them more radically and remain more current. On the other hand, low-tech fabrication is the domain of experts which are also not teachers. These challenges become less complex through constructivism, which challenges the traditional roles of trainers as providers of knowledge and students as receivers[2].

Interdisciplinarity becomes a natural and desireable consequence of these first two elements. Fab labs are by their nature facilitators of idea generation and cross-pollination[5]. We think that inter-disciplinarity needs to be put at the forefront of the learning mission of the fab lab, using “making” as a field equalizer for students and experts. This way, no single actor can claim exclusive ownership of the learning process and space.

The implementation of this framework requires the identification of all possible involved actors, and the establishment of an organizational structure flexible and resilient enough to guarantee a balanced representation of all the diverse expertises that contribute to the lab. What this means concretely, and who are the actors that we plan to involve is the subject of the next section.

Stakeholders

The plan to implement the framework elements outilned above requires an involvement of multiple stakeholders at different levels, from within and outside the university. We will briefly discuss their roles, starting from the internal ones.

First of all, for daily operations, we plan to rely on a solid backbone of volunteers (in our case mostly students). Beyond operations, however, volunteers are also seen as the main content providers, and are encouraged to use staff as providers of solutions to make their ideas for prototypes, events and workshops real. As we are operating in an university context, we need to be aware of the fact that individual students are likely not to remain in the university in the long term. This can be a problem – as it makes harder for individuals to contribute to the long-term growth of the lab – but also a resource. A fast rotation of volunteers helps keeping a steady flow of fresh ideas, and mitigates the risk of burnout, especially when students are under high load for other academic reasons.

We argue that coordinators and staff do not need to be subject to the same speed of rotation, and indeed might benefit from being more stable positions. Most crucially, the complexity of understanding procedures in the public administration means that, if staff were to rotate quickly, substantial effort would be spent in recovering procedural know-how. Additionally, however, long-term retainment of staff establishes clear figureheads and responsibility for external stakeholders that wish to support our initiative and allows to incrementally expand the lab’s network rather than lose parts of it with departing staff. It should be stressed, however, that staff and coordinators are not the owners of the lab, and their main role is empowering the volunteers.

The final internal stakeholder are university departments. As we discussed in the previous section, one of our goals is to promote interdisciplinarity. This translates concretely in the need to involve as many departments as possible to participate in the creation of this learning space. Sharing this project not only ensures diversity, but also makes it more resilient, diversifying funding sources and catalyzing internal synergies.

External stakeholders are more heterogeneous, so they will only be given a cursory look. In this sense, the most im- portant class is that of practicioners, both from the “high-” and the “low-tech” fields. Startups, innovation hubs, accel- erators and foundations from the “high-tech” world that can support and benefit from the activity of the lab, gaining visibility, providing cases and challenges, and obtaining a more informal access to the talent pool of the university. Craftsmen, associations and groups of citizens on the other hand also benefit from the increased visibility, and act as gateways to those “low-tech” contexts that are less explored in their interactions with technology. Finally, local governments can act as network multipliers to broaden the reach of the lab.

Conclusions

At the turn of this decade, the model of the fab lab appears to be established and radicated, and many universities adopted it as a one of their facilities. However, we believe a strong focus should be placed on a reflection and revision of what their role is, especially as an educational space that should complement and enhance the teaching offer of higher education.

We argue that, as a side-effect of this reflection, some of the functions that fab labs perform might be put aside, to bring at the front one of the original goals of these spaces: provid- ing students with a safe space for hands-on learning centered on skills and expertises that are not taught in their regular curricula. We argue that, in these times, this is particularly relevant for “low-tech” ideas and elements, to be explored in their combination with the “high-tech” fixtures of fab labs.

As the technologies featured in fab labs have matured, the opportunity rises to refine the value proposition of these spaces. They no longer are a privileged space in which 3D printers or laser cutters can be found, neither they are the cheapest or fastest prototyping facilities. Instead they remain, especially in their university incarnation, a rare context in which all these technologies and many others can be freely experimented with, without fear of heavy repercussions for failure.

By this perspective, the fab lab becomes not a space for “service” in the way that we commonly understood in the latest years (i.e., prototyping/electronics/cutting service), but a real “service” for the whole community that hosts them: from students, to universities, to enterprises. The opportunities stemming from this view are broad and powerful. As our societies face broadening skill gaps, increasingly difficult intergenerational dialogue and a culture of education which tends to work in silos, these laboratories can become a versatile link in the complex chain of human activities.

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