Low-Threshold Access to Fab Labs through Training Programs and Outreach Activities

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Abstract

Since 2010 Happylab in Vienna is Austria's first and so far only Fab Lab. With currently about 1,000 regular users and a growth rate of 1 to 2 users daily the demand in the metropolitan region of Vienna is clearly visible. Key to this development is the combination of professional equipment and low-threshold access. Besides low cost this includes regular welcome evenings for first-timers as well as training courses for the machine usage. Our goal is to provide Fab Lab infrastructure throughout Austria in the medium term. In order to survive economically aside from large cities such as Vienna new approaches are needed to address a larger target group. Therefore special offers for children and teenagers as well as people without technical knowledge have been developed. These include mobile formats to address schools, youth centers and craft shops in the surroundings specifically. Furthermore, the workshops were expanded from mere trainings on the machines to comprehensive courses themed "from ideas to products". In this paper we present our new training concepts and the experience gained so far.

Paper presented at Fab9, Yokohama, 21-27 August 2013

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Abstract Since 2010 Happylab in Vienna is Austria's first and so far only Fab Lab. With currently about 1,000 regular users and a growth rate of 1 to 2 users daily the demand in the metropolitan region of Vienna is clearly visible. Key to this development is the combination of professional equipment and low-threshold access. Besides low cost this includes regular welcome evenings for first-timers as well as training courses for the machine usage. Our goal is to provide Fab Lab infrastructure throughout Austria in the medium term. In order to survive economically aside from large cities such as Vienna new approaches are needed to address a larger target group. Therefore special offers for children and teenagers as well as people without technical knowledge have been developed. These include mobile formats to address schools, youth centers and craft shops in the surroundings specifically. Furthermore, the workshops were expanded from mere trainings on the machines to comprehensive courses themed "from ideas to products". In this paper we present our new training concepts and the experience gained so far.

1 Introduction

Ideas need space in order to be developed and realized. A Fab Lab offers not only the required space, but also the necessary equipment for people to carry out their own projects. Fab Lab is short for fabrication laboratory – the term refers to an open high-tech workshop equipped with computer-controlled machines that people can use to manufacture a wide variety of products on their own. Fab Labs are the result of an initiative by Prof. Neil Gershenfeld (MIT, Center for Bits and Atoms) in 2002. There are currently already over 200 Fab Labs worldwide [6] and they are

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becoming ever more important as interdisciplinary research and development facilities. The development and rapid dissemination of digital fabrication technologies is comparable with that of personal computers in the 1970s [4].

The following sections present a model that offers low-threshold access to a Fab Lab in order to make it interesting and useful for a broad target group. The Austrian Happylab will first be briefly presented before its individual measures to reach new target groups are explained in detail.

2 Background and Objectives

The Happylab is Austria's first and only Fab Lab to date [2]. It was opened in late 2010 and already has more almost 1,000 members. Its rapidly increasing membership and the frequent demand of potential users from other regions clearly underline the need for Fab Labs outside the metropolitan area of Vienna. On an area of 250 m^2 (see Fig. 1), Happylab provides access to numerous machines and tools, including:

- 3D printer (Dimension Elite and Dimension BST 768)
- Laser cutter (GCC Spirit GX)
- Vinyl cutter (GCC Bengal)
- CNC milling machine (BZT PFK 1607 PX)
- Electronics workstation (soldering station, laboratory power supply unit, oscilloscope, rework station, reflow oven, UV exposure unit, etching machine, etc.)
- Darkroom
- Lathe

The way we see it, however, a Fab Lab is far more than just a room with machines that can be used by the interested public. A key aspect is providing low-threshold access in order to appeal even to those not yet equipped with the relevant prior knowledge.

In addition to its low cost for the public, this model also includes an inviting offer for first-timers, such as an open house with a tour of the lab for first-time visitors every Wednesday. Other low-threshold or easy access events, such as an annual Happylab birthday party – open to the public and featuring the exhibition of and awarding of prizes for the best Fab exhibits by visitors –, will provide additional opportunities to get to know the Fab Lab without any obligations.

It is also important that a newcomer's entry into the world of digital manufacturing is made as easy as possible. Regular initial training, free of charge, on the machines (laser cutter, 3D printer, vinyl plotter, CNC milling unit and lathe) helps users get started. These 1-2 hour workshops are meant to show how to operate a machine by means of a simple example and provide a good basis for gaining further experience on one's own. Since summer 2011 2,386 persons (1,294 individuals) have attended our initial trainings. 35.8 % of them use the machines afterwards for their own projects. Table 1 shows the conversion rates for each machine individually.

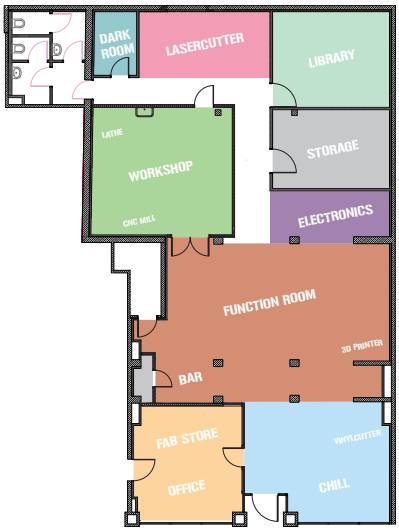


Fig. 1 Map of the Happylab in Vienna

Machine	Attendees	Active Users	Conversion Rate
3D Printer	525	72	13.7 %
Laser Cutter	954	390	40.9 %
Vinyl Cutter	331	106	32.0 %
CNC Milling Machine	427	76	17.8 %
Lathe	149	38	25.5 %
Overall	1,294	463	35.8 %

Table 1 Attendees (individual persons) and conversion rates for regular initial training since July 2011

Learning from each other is another important point in the Happylab community. In addition to the physical meeting place provided for joint working and tinkering, a web-based forum and a wiki page also offer the opportunity to exchange experiences.

Despite the above-described offerings, Happylab has – until recently at least – been directed mainly at those already familiar with digital design and who want to use the lab's manufacturing machinery to realize their ideas.

As of today, 21.3% of the 974 active Happylab users are female and 78.7% are male. We are noticing, however, that the proportion of female users has steadily risen since we began offering regular initial training on the machines. The majority of users are active or former students who have already come into contact with digital fabrication through their studies (e.g., architecture, engineering, design). 47.5% of

users are between the ages of 20 to 29, a further 29.5% are 30 to 39 years of age. The majority of users, namely to 83.7%, come from Vienna.

The prototypical Happylab user is therefore in his or her twenties, has some technical or artistic training and lives near the Happylab. However, many inquiries that we receive indicate that there is also a demand outside of this traditional group, a demand that our previous offerings have not managed to address sufficiently.

Our goal is to provide the widest possible group of people an opportunity to implement their ideas in the Fab Lab. To achieve this goal, we are implementing measures to expand the Happylab target group in the following directions:

- Disciplinary extension by involving interested parties with no prior know-how
- Offerings for an expanded target age group
- Spatial extension through a mobile offering ("Fab Box")

The specific measures are presented in detail in the following section.

3 Measures to Expand the Target Group

To make a wider public familiar with the opportunities offered by "digital design" and "digital fabrication," we created hands-on workshops for technical and creative work in Fab Labs. These workshops require no explicit prior know-how. The entire innovation process from idea to finished prototype is demonstrated in a workshop. Such courses are offered for both children and adolescents (10-15 years) as well as for adults.

To reach a wider catchment area, so-called "Fab Boxes" have been developed. A "Fab Box" is the mobile version of a part of the Fab Lab. The "Fab Box" can serve to actively build up awareness and know-how without depending on the Fab Lab site.

3.1 Disciplinary expansion by involving interested parties with no prior know-how

Learning complex software programs in order to create a digital design represents a major obstacle for many potential Fab Lab users. There is a high probability of abandoning the project due to this entry barrier. Many innovative ideas are never realized because of this.

This is why the target group has thus far been limited to people who already possess significant prior knowledge in digital design. To make a wider public familiar with the opportunities offered by "digital design" and "digital fabrication," a new way of imparting knowledge is needed, namely hands-on workshops for technical and creative work at Fab Labs. Prior knowledge is neither assumed nor required. The entire innovation process from idea to finished prototype is worked through

and acquired in a workshop. Participants can contribute their own ideas and realize them in small groups under expert supervision.

Initial training has been offered for many of the machines in Happylab for quite long time already. However, this only provides an introduction to the safe handling of each machine and its control software. The creation of digital designs that serve as a template for the computer controlled production machines would go beyond the scope of these workshops. The combination of several technologies, which is often useful in practice, cannot be adequately conveyed in the initial training on the machines.

3.1.1 Fab Lab Boot Camp

To circumvent the limitations described above, we have developed a new workshop format called the "Fab Lab Boot Camp." It is aimed specifically at people with creative and innovative ideas who lack specific prior knowledge. The target group thus includes inventors, start-up entrepreneurs, students from all disciplines, hobbyists and all those who want to make initial prototypes and finished products using 3D printers, laser cutters, CNC milling machines and vinyl plotters.

In one week participants learn how to create two and three dimensional models on the computer as well as the subsequent production using Happylab's digital production machines. Only freely available software is used in the design process, giving participants the opportunity to deepen their knowledge at home at no additional cost.

The Fab Lab Boot Camp is divided into two days of an intensive workshop and five days of free project work under professional supervision at Happylab. The number of participants is limited a maximum of 12 people. The concept is already fully developed. The first two pilot workshops will be held in late September and early October of 2013. Since the workshop has never taken place before, we cannot draw from past experiences. However, the booking numbers already show that there is a substantial demand for such a format.

3.2 Offerings for an expanded target age group

New manufacturing techniques will permanently change the job landscape. The following offerings for children and adolescents help orient them in a rapidly changing work world [7]. Participants are acquainted with emerging professions through play.

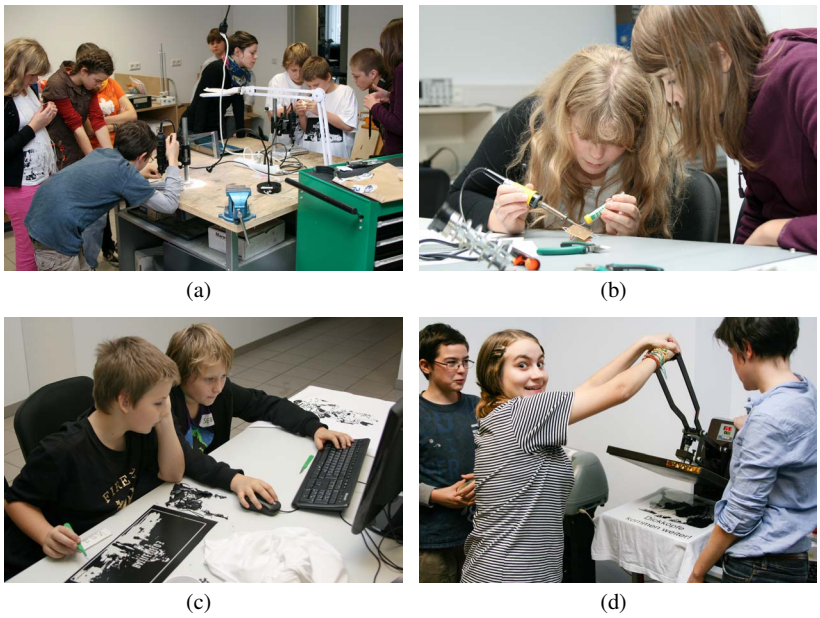
3.2.1 Jigsaws were yesterday!

Two-day workshops are regularly held at Happylab during the vacation season and on select weekends, under the slogan "Jigsaws were yesterday!" Children and ado-

lescents get acquainted with modern technologies and computer controlled production machines that are becoming increasingly important in a playful and project-oriented way.

They are encouraged to work independently under professional supervision and can indulge their creativity during different projects. Over the course of two workshop days, they create their own 3D models, printed t-shirts, electronic music instruments ("Drawdios") [8] and self-programmed computer animations using Scratch [5]. The finished products can be taken home at the end of the workshop. As with the Fab Lab Boot Camp, no prior know-how is needed for these workshops either.

More than 200 children and adolescents have participated in this training since 2011 (see impressions in Fig. 2). The courses have always been fully booked so far. There was very positive feedback from the children as well as from their parents. Parents have often become interested in Fab Labs via their children.



(a) (b) (c) (d)

Fig. 2 Impressions of the "Jigsaws were yesterday"

3.2.2 Junior Lab

The "Junior Lab" is an easy access offering for children and adolescents aged 10 to 15 years, regardless of their educational and social background. The Happylab opens specifically for children and adolescents once a week in the afternoon. The young participants realize their own projects under expert guidance and professional

supervision and using the computer-controlled production machines – from their own engraved door signs made with the laser cutter to cell phone stands made with the 3D printer.

The planned initiative combines afternoon childcare with exciting educational opportunities in a technologically creative environment. It is also considered by many as a continued training opportunity following participation in the "Jigsaws were yesterday" program.

The Junior Lab has been held twice thus far and was attended by a total of 12 participants. The children even presented their results in a blog online [3], some impressions can be found in Fig. 3. Junior Lab – at that time under the name "Fab Lab Kids Club" – was honored with the Google RISE award in 2012 [1].

3.2.3 Workshops for school classes and youth groups in Happylab

Tours of Happylab and workshops on specific topics related to the keyword "digital fabrication" can be booked for school classes and youth groups at any time. In the context of hands-on workshops, children and adolescents are acquainted with modern production technologies and new vocational fields.

The offer is aimed at students ages 10 and up. Depending on interest, workshops on individual machines or one-hour introductory tours of Happylab can be booked. Workshops can last two to four hours, depending on the topic.

3.3 Spatial extension through a mobile offering ("Fab Box")

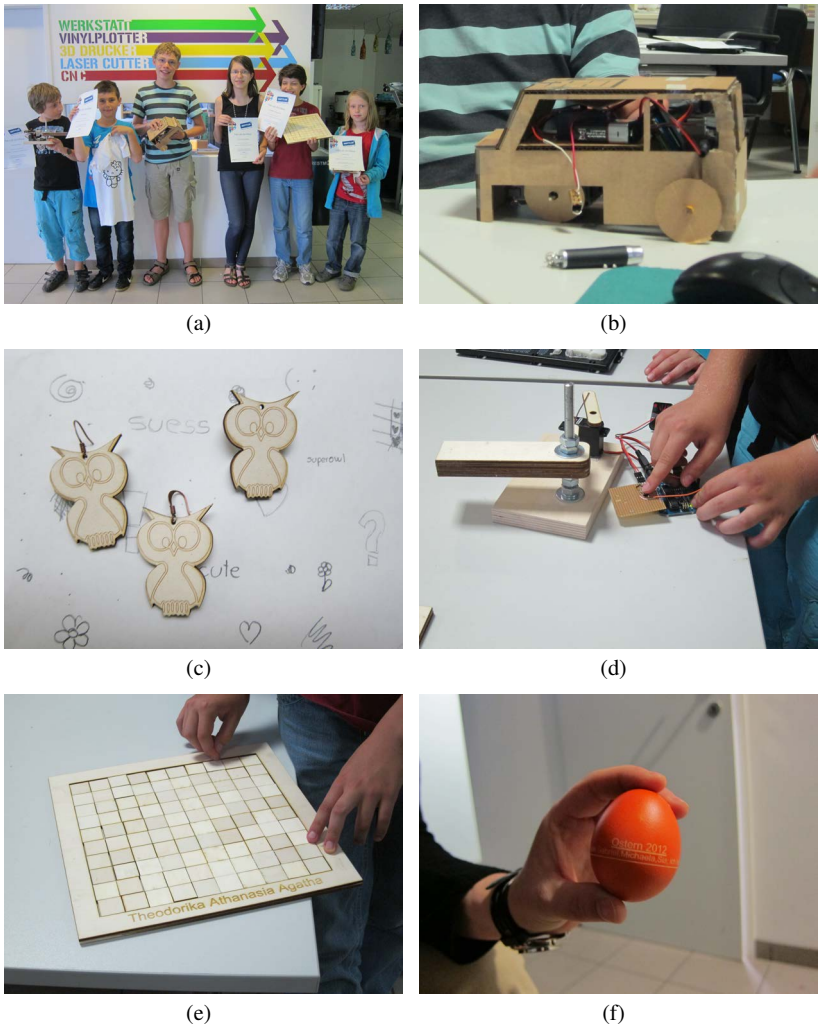
So-called "Fab Boxes," which mobilize parts of the Fab Lab, actively build up awareness and know-how in a wider catchment area. The "Fab Box" enables design and production workshops or technology presentations to be conducted in schools, businesses or youth centers, for example. There are currently three Fab Boxes that are suitable for mobile use:

- 3D printer (Makerbot Replicator 2)
- Vinyl plotter (Silhouette Cameo, transfer press)
- Electronics (soldering, PCB production)

3.3.1 Happylab on Tour

Under the slogan "Happylab on Tour," experts from the Happylab hit the road with 3D printers & co. in tow. The mobile "Fab Box" allows us to hold workshops and presentations on digital production technologies across Austria.

For schools and youth organizations who want to hold repeated workshops, Happylab additionally offers "Train the trainer" programs, in which teachers and youth



(a) (b) (c) (d) (e) (f)

Fig. 3 Impressions and projects of the "Junior Lab": (a) participants (b) car (c) earrings (d) door lock (e) board game (f) easter egg

workers learn to use digital production machines and can subsequently rent the "Fab Box" for workshops in their own institution.

3.3.2 Additional Locations

Mobile services enable us to raise awareness and provide at least some of the digital production opportunities without being bound to a specific location. Although Fab

Boxes are certainly no replacement for a fully equipped Fab Lab that is available to its users at any time, they are nevertheless a useful addition to a Fab Lab site in order to actively include the surrounding region. This is especially important for locations far from major metropolitan areas.

More locations are therefore needed to make the Fab Lab infrastructure available everywhere in Austria. Construction financing for a Happylab in Salzburg has already been secured. It is scheduled to open in the fall of 2014. Further locations are planned in Linz and Graz. The four sites would give Austria a density of one Fab Lab per 2 million inhabitants.

4 Conclusions

There are currently over 200 Fab Labs worldwide – and rising. Although all Fab Labs are more or less strictly committed to the same basic idea (see Fab Charter [9]), there are nevertheless enormous differences in the actual features of the individual sites. It is important for standards not to be overly detailed so that individual operators can find their own particular way to best meet the needs of their local community. This openness promotes the regular emergence of new Fab Lab models that can serve as an example for other operators.

Our experience from three years of operation and currently almost 1,000 active users has shown us that it is not enough to simply provide the machines. If your objective is to make the Fab Lab opportunities available to as many people as possible, low-threshold access programs are essential. First-timers need to feel welcome and be offered a program adapted to their personal level of know-how for a quick entry into the world of digital production.

This offering ranges from tours for first-time visitors and design workshops to initial training on machines. These training courses can, however, only convey basic knowledge and provide help for getting started. Further experience is then gained by working on specific projects and through the sharing of know-how within the user community. Online services, such as Wikis or forums, can also provide support.

It has been shown, that free regular trainings on the digital fabrication machines have a significant influence on the number of active lab users. Fig. 4 compares the growth rate of the Happylab community before and after we started with these trainings. Before this intervention the community grew by an average of 10 persons per month. Since then, more than 30 new individuals start working at Happylab every month.

Our hypothesis is, that the planned measures will achieve similar effects on the new target group. Therefore, Fab Lab infrastructure can be made available to a significantly wider audience. Providing low-threshold access to high technology in a Fab Lab also makes it possible to address people who, due to their educational or social backgrounds, would otherwise not be given the opportunity to become actively engaged in research and innovation. Fab Labs are helping to more effectively exploit the untapped potential in groups of people that are often neglected.

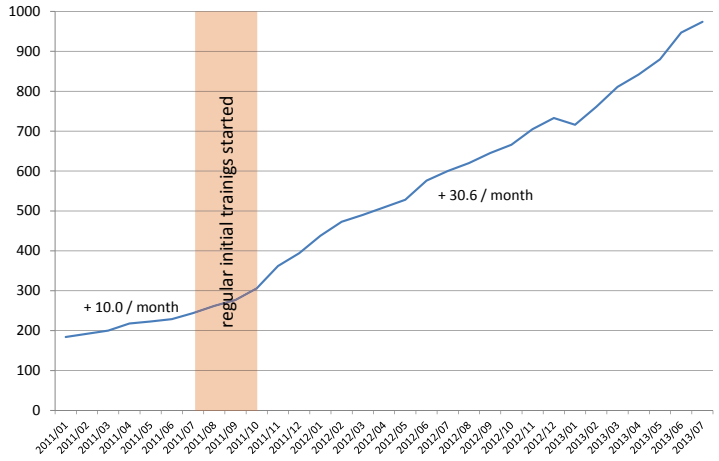


Fig. 4 Impact of regular initial trainings on the growth of Happylab users since 2011. The numbers represent active individual users with a valid user contract only.

Acknowledgments

We would like to express our special thanks to: (1) The Austrian Federal Ministry for Economy, Family, and Youth for supporting all the training programs at Happylab which are targeted to children and adolescents, (2) The Technology Agency of the City of Vienna (ZIT) for the financial support of the Fab Lab Bootcamp, (3) Austrian Economy Service (AWS) for set up financing of the new Happylab location in Salzburg, and (4) the Austrian Federal Ministry of Science and Research for their support of the Happylab project from the beginning.

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