On Learning Outcomes for Participatory Design in Digital Fabrication

Olof Torgersson
Department of Applied Information Technology
University of Gothenburg
SE-412 96 Gothenburg, Sweden
olof.torgersson@ait.gu.se

www.idac.se

FabLearn
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www.fablearn.eu

Abstract
This paper discusses what the learning outcomes for students using elements of Participatory Design in Digital Fabrication in a FabLab context could be. A number of possible learning outcomes are presented together with some general discussion about how the combination of Participatory Design and Digital Fabrication could be achieved from different perspectives.

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Digital Fabrication; Participatory Design; FabLab

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Participatory Design and Digital Fabrication can in some sense be said to be based on similar ideals – empowerment and involvement.

The basic idea in Participatory Design (PD) is that direct involvement of all stakeholders (employees, partners, customers, citizens, end users etc) in the design process will yield better results and products, systems, and services that are appropriately adapted to the real needs of the persons and organizations that are affected by them. PD goes beyond User-centred design in that it not only acknowledges the need for investigating the users' needs and opinions but also involves them directly into design and innovation activities. Thus, involvement is central to PD, but empowerment is also in some context seen as a central element of PD, where the belief is that for instance the users' self-esteem can be strengthened by letting them experience very concretely that their views are taken seriously and that they are given the power to affect their own circumstances of life [3].

Digital Fabrication (DF) can in principle be defined as a set of tools and technologies where a 3D-drawing created on a computer can be used to let the computer control a machine that turns the drawing into a physical artifact. The most common techniques include CNC Machining, 3D Printing and Laser Cutting. In a Fablearn context DF is closely connected to the concept of FabLabs, which encompasses suitable machinery and teaching material to allow the use of DF in schools. It is the hope of proponents of FabLabs that "Digital fabrication and 'making' could be a new and major chapter in this process of bringing powerful ideas, literacies, and expressive tools to children" [2]. FabLabs are among other things intended to empower the students, foster their creativity and enhance their interest for science and technology.

While both Participatory Design and Digital Fabrication have been researched in many ways the combination of them is less well understood. The purpose of this position paper is to discuss what could be learned from using PD in DF and that raising awareness of learning outcomes in PD in general is an area in need of further investigation.

The Idea of Learning Outcomes

A common approach in higher education is to use the principle of constructive alignment in course development. When this idea is applied the design of a course is based on a set of well-defined intended learning outcomes, which clearly describe what students are expected to be able to demonstrate upon completing the course [1]. The course should then be designed in a manner that ensures that these learning outcomes are met and they also define what topics should be covered in the examination.

At least in Sweden, course plans for pre-higher education are described in a similar manner. They contain a description of the subject and then a number of criteria stating what students should be able to demonstrate. For instance, in the subject handicraft, 6th graders should among other things be able to develop ideas based on given inspirational material and turn them into an artifact using appropriate tools and technologies.

Learning Outcomes in Participatory Design

Arguably, the focus of PD research has been on how stakeholders can be involved in a design process, how they can influence the design outcome and how design practitioners can learn from the users' design proposals and experience and use this as a basis to develop design solutions. As mentioned above, empowerment is sometimes mention in PD contexts, in the sense that participants are empowered by giving them the opportunity to influence their own lives through participation in design processes directly related to their own situation. Less focus has been put on what the participants actually *learn* from taking part in the process. Therefore, it is suggested here that the design of a PD process should also include reflections on the intended learning outcomes, i.e., what will stakeholders learn from taking part? how can what they are intended to learn be communicated? In what way do the learning outcomes for the participants affect the design of the process? and so on.

Combining Participatory Design and Digital Fabrication

The combination of PD and DF can be viewed from two different perspectives. Firstly, and perhaps most naturally, DF can be seen as yet another technique to use in a PD process: PD typically involves sketching or prototyping sessions where participants are given the task to try to come up with design proposals for what is being created, often using simple means such as pen and paper. Here, DF could be used as an alternative that would let the participants create more high-fidelity physical prototypes. Secondly, various traditional PD techniques could be brought into a DF process. That is, for instance focus groups or low-fi prototyping could be used to come up with design suggestions, that later could be realized into physical prototypes using DF techniques. While the first approach adds to the traditional toolset for PD it can be questioned if the second approach adds something new, or if it is mostly a matter of applying selected well-known methods in a new context. However, including PD in DF processes in schools is likely to enhance the learning experience for the students in matters of iterative and collaborative design and user-centred design values.

Possible Learning Outcomes for Participatory Design in Digital Fabrication

FabLab projects described in for instance [2] are mostly based on the students' own ideas or specific tasks presented by their teachers. For the use of PD to be meaningful, the projects would probably need to be framed differently, since the core of PD is that there are several stakeholders and that they should all be involved in the design. If students are designing for themselves, they can still go through an iterative design process and use various idea generation and prototyping techniques, but will it be PD?

So assuming that the context involves a task of suitable complexity and allow the involvement of several stakeholders a set of learning outcomes relating to PD could be something like:

Upon completing the course students should be able to

- Describe the relevance of involving all stakeholders in a design process
- Describe the key steps in an iterative design process
- Describe at least three simple methods for ideation with stakeholders
- Work with paper prototyping and simple physical materials
- Involve stakeholders in evaluation of design proposals

Note that this list is just a very tentative first suggestion and that it needs further development and adaption to various contexts.

Discussion

Participatory Design and Digital Fabrication can as stated above basically be combined in 2 ways, involving DF in PD activities or using elements of PD in a DF process. One question is if there really is a difference? An argument for that there is a difference is that the end-goal would be different. In a PD process the end-goal would be to produce some sort of product, which is not the same one as the prototype(s) produced using DF tools. In a Fablearn context the end-goal would be to produce the prototype that can be developed using technologies of DF. Most likely the context and the number of participants involved would differ as well. In a real PD process there would be many different types of stakeholders involved and the process would be run by a professional design team. In a FabLearn context it is likely that the group is smaller and that the students driving the process would also be the ones that would produce the prototypes. Further there would also probably be some kind of teacher in charge of managing the process.

If PD is going to be used in DF it is important to motivate why this is important or why it is a suitable approach and what students would learn from using it. This leads to the question of learning outcomes. It can be argued that the list of learning outcomes presented above is to a rather large extent about general design knowledge and to a smaller extent about PD. This is perhaps not surprising since basic ideas like iterative design and prototyping are natural elements to use in DF, while PD is less so since it requires the involvement of other participants than the design team. The key learning outcomes would probably be about design processes and methods as such, combined with the importance of involving different stakeholders into the design work.

Apart from re-fining learning outcomes it would also be important to look into which PD methods and techniques that are most suitable for use in a DF context. In this the 2 approaches merge to some extent since if one would like to introduce DF into a PD process this process will need to be adapted to involve elements of Digital Fabrication.

Finally, learning outcomes as such in PD processes are not much investigated and doing it in the context of DF could be a starting point, i.e., if a number of students are involved as stakeholders in PD activities in DF, what will they actually learn?

Conclusion

Participatory Design and Digital Fabrication in the context of Fablabs seem to share some basic values such as empowerment and involvement. In this position paper it has been discussed what suitable learning outcomes for Participatory Design in Digital Fabrication could be and also that the matter of learning outcomes for participants in Participatory Design in general could be a matter that is interesting to investigate further.

References

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