Parametric Design and Digital Fabrication in Computer Science Education

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Abstract. The initiation of computer science education in formal and informal learning settings can be effectuated in various ways. This poster describes the use of parametric design and digital fabrication tools as a powerful combination and a motivating way to introduce core concepts of programming to students. We assume that this combination can contribute to constructionist learning through the creation of physical artifacts with the use of computational means, of projects that are personally meaningful to the students and enhance shareability and personal customization.

Keywords: Parametric design, digital fabrication, constructionism, computer science education, maker movement

1 Introduction

The initiation of Computer Science at K-12, can be effectuated in various ways, combining teaching aspects of computer science like programming, with elements from other fields like mathematics or science [1]. Five decades ago, Papert with his colleagues developed the LOGO programming language to engage thousands of children in programming and mathematics actions [3], through actively making and sharing projects with others [2]. Today, recent developments in technology, have led to a remarkable development of accessible parametric design (e.g OpenSCAD and BlocksCAD) and digital fabrication tools intended to manufacture complex shapes and forms of digital and physical artifacts by everyone. The term "Parametric design" is mostly associated with architecture and revolves around the idea of using parameters to control the properties of 2D or 3D CAD (Computer Aided Design) models. Parametric design practices are most likely to be associated with architecture but also include elements of programming like variables, logical equations, recursion and conditional programming statements. Aiming to investigate the motivational aspects and attitudes of students we developed an educational scenario which we describe along with the first results of our research.

2 The Educational Setting

The presented poster, describes running workshops on the use of parametric design and digital fabrication in the realm of computer science education.The participants have the opportunity to engage in a more practical, hands on learning approach to explore programming under the lens of parametric design and making. Our main goal is that participants will learn core principles of programming using parametric design tools in order to design projects according to their interests and materialize them using digital fabrication technologies like 3D printing or laser cutting. We aim to gain an understanding on how the combination of digital fabrication technologies and parametric design in a constructionist context can contribute to computer science education and engage students in programming activities. For the evaluation of the educational scenario that we developed, we collected qualitative data from interviews, observations and the evaluation of artifacts.

3 Discussion and Conclusions

After the first implementation of the educational scenario we found that parametric design software can provide possibilities to engage students in programming, developing core competences and skills on computer science constructs like variables and conditionals but also concepts of mathematics, science and arts.The fact that they would print their designs, motivated the participants to challenge themselves and put more effort than the ones in digital design workshops that we had before. This approach might fill the missing gap between students' expectations of the real world problem solving skills and their classroom's curriculum. In the poster session we will discuss about learning core principles of programming through parametric design, the connections of 3D modeling and programming, the participants' attitudes towards parametric design and digital fabrication, how these technologies can enhance the projects' shareability and which things need to be considered before integrating parametric design in CSE.

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