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Open resources for thinking with computational artefacts at school

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ABSTRACT
This workshop will address the theme of open resources for learning. A small series of case studies at the intersection between the world of education, technology, and making will be presented with the aim of discussing the opportunities and challenges of open source materials for practitioners. The case studies consist of projects developed across different European countries, focused on different aspects of learning and dedicated to different school levels. Nevertheless, these projects share the use of open source resources and the aim of contributing with materials and examples to the resources available for educators and designers. The workshop will combine the case studies presentations with a round table.

Author Keywords
Computational thinking; reflective thinking; learning through play; digital fabrication; open-source.

INTRODUCTION
The use of computational artefacts for supporting thinking and learning is becoming more and more popular. This is phenomena is also accompanied by a change in the educational approaches that is increasingly becoming playful and project oriented [1]. In this scenario in which teaching become less structured and open to student driven explorations, open source materials and resources can play a strategic role [2]. However, the use of these kind of resources might still be challenging for educators. Thus, the aim of this workshop is to share best practices at the intersection between the world of education, technology, and making through a series of case studies, and at discussing opportunities and challenges of open source materials for practitioners. The case studies consist of projects developed across three different countries, focused on different aspects of learning and dedicated to different school levels. Nevertheless, these projects share the use of open source resources and the aim of contributing with materials and examples to the resources available for educators and designers.

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CASE STUDIES
The cases studies presentations will address the theme of open resources for thinking and learning with the intent of pointing out how these might be successfully introduced in the school, at various levels.

Open resources as artefacts
One way in which open resources are often introduced in education is the use of artefacts that are freely available, documented and released on-line as open source projects. Examples of this category are *DotBot*, *Shybo, V.1 and V.2,* and *Square*. DotBot [3] is a project started in 2015 with the aim of creating an affordable and open-source educational tool for teaching robotics and computer science in schools. The project combines open-source hardware and rapid prototyping techniques with an online community of teachers and makers. The fact of being an open project enabled, over time, various opportunities for customization. For instance, DotBot-ROS is a custom version adapted for supporting the use of ROS, a standard software for industrial applications that is not supported by most of educational robots. *Shybo V.1* and *V.2* are two small low-anthropomorphic robot able to learn simple combinations of sounds and colours, and to react through minimal nonverbal behaviours [4]. These were designed to be used as a character for stories, aimed at letting children construct knowledge that can be related to academic contents or more abstract concepts such as identity and agency. Both were developed as part of a broader research project about the theme of child-robot play, and used to conduct two different playful learning experiences in primary schools.



Figure 1. Some examples of the case studies that will be presented at the workshop. From the left: DotBot, Shybo, Square, Ethafa.

Project *Square* addresses the challenge Swiss primary schools have in bringing computational thinking into the classroom as an intellectual discipline, beyond the screens. Created together with educators, Square aims to empower primary school teachers and children to experience concepts related to algorithm design through unplugged interactions. Differently from the previous two examples, Square do not imply the use of open source hardware or software, rather the use of simple materials like printed paper released as open design. Nevertheless, by harnessing the power of productive failure in learning [5], Square is at an initial stage of development of an open source, low-cost play kit to lower the barriers related to the adoption of emerging technologies.

Open resources as design materials

Another way of using open resources in the educational context is their use as design materials. From high school to doctoral studies, in fact, it is becoming more and more frequent to develop prototypes and demonstrators of ideas by adopting fast prototyping processes and open source hardware and software. Furthermore, in some virtuous cases these demonstrators are also documented and released as open source projects providing a contribution to the communities. This approach will be discussed through the presentations of projects developed by students as part of master studies in design at Politecnico di Torino (IT) and at SUPSI (CH). These example projects include Kime [6] and Ethafà [7], two projects that demonstrate how the concept of open resources can be used both in terms of materials employed in the design process as well as in the dissemination of the outcomes.

STRUCTURE AND OBJECTIVES

The workshop will be structured in three main parts: general introduction, case studies presentations, and a roundtable. The case studies presentations are aimed at sharing possible approaches and to develop open source computational artefacts and the related learning experiences. The roundtable, instead, is aimed at highlighting the challenges of using these materials and computational artefacts in general, and at identifying opportunities for designers. To this end, the participants presenting cases studies will be asked, in advance, to describe the types of technologies used to develop the project, the type of open source license used and, most of all, the types of challenges they faced while using open resources for education.

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