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[Overview of technologies for building robots in the classroom](#)

Cesar Vandeveld, Jelle Saldien **UGent**, Maria-Cristina Ciocci **UGent** and Bram Vanderborght (2013) *International Conference on Robotics in Education, Proceedings*. p.122-130 [Mark](#)

abstract

This paper aims to give an overview of technologies that can be used to implement robotics within an educational context. We discuss complete robotics systems as well as projects that implement only certain elements of a robotics system, such as electronics, hardware, or software. We believe that Maker Movement and DIY trends offers many new opportunities for teaching and feel that they will become much more prominent in the future. Products and projects discussed in this paper are: Mindstorms, Vex, Arduino, Dwengo, Raspberry Pi, MakeBlock, OpenBeam, BitBeam, Scratch, Blockly and ArduBlock.

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Overview of Technologies for Building Robots in the Classroom

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Abstract. This paper aims to give an overview of technologies that can be used to implement robotics within an educational context. We discuss complete robotic systems as well as projects that implement only certain elements of a robotic system, such as electronics, hardware, or software. We believe that Robot-Master and SFX (which offers more open opportunities for teaching) will lead the way, but become work item-providers in the future. Hardware and projects discussed in this paper are: Mindstorms, Eze, Arduino (Simple, Easy, Pro, Mega, Uno, Nano, Leonardo, Micro:bit, Raspberry Pi, BeagleBone, OpenBoard, BeagleBone Black, BeagleBone Black and BeagleBone Black).

Keywords: (Self-)Directed Education, Open Source, Open Hardware, Project-Based Learning, Digital Manufacturing, Robotics, STEM

1. Introduction

The demand for engineers in Europe has almost tripled over the past six years, while the number of engineers who graduate from universities and colleges in that period decreased drastically. Different engineers associations, such as the IEEE, IFPE and Association of Engineers, stress that the gap in number of students is connected to an image problem of STEM-related knowledge domains (Science, Technology, Engineering and Mathematics) as perceived by parents and students. Action plans focused on promoting interest in the engineering profession are set up. Understanding the highlights of the latest developments in this field is critical to this, with pedagogical approaches an also important aspect [1].

Students suggest that certain teaching strategies may hinder the STEM participation and achievement and give some evidence that using scientific equipment and hands-on activities are related to higher science and mathematics achievement [2]. As a consequence project-based education and problem-based learning are becoming the alternative approaches to engineering education and fundamental science education [3, 4]. Also, it seems that there is a positive relationship between new technologies and new pedagogical methods, even though this relationship is complex and not only

instrumental, the simplest explanation is that new technologies are the instruments to realize new pedagogies. According to the model of future worlds of Paper [5] there is a strong link between mental acquisition of knowledge and actual manipulation of the objects of knowledge. Simply put, one learns by doing. Nevertheless, the pedagogical perspective needs a new frontier with the commercialization of programmable toys (e.g. Lego Mindstorms), the opening of affordable 3D printers (e.g. Formlabs) and the rise of 3D printers equipped with IoT protocols and local networks. These systems make it possible to design and construct and robots whose working is determined by a computer program. From the moment that robotics entered our houses and started influencing our everyday life it has become important the presence in form of least a basic understanding of such technologies. To introduce robotics in schools, there is a methodological choice in the comparison of top-down teaching and bottom-up learning.

Building robots is a project-based choice for the implementation of problem-based learning (PBL) in classrooms. The reason why it is such a popular choice can be explained by the multidisciplinary nature of the topic: robotics requires many different scientific, technical and technological skills, such as physics, electronics, mathematics, and programming. It is an ideal subject because in many different contexts can be linked to [6]. Additionally, robots themselves capture the imagination of children and teenagers, providing inspiration and motivation [7].

The PBL approach in general and the use of robotics in education in particular have a number of other differences with more traditional ways of teaching. Whereas such problems typically have one, and only one, correct answer, PBL emphasizes that most real-world problems have many different solutions. With PBL, students learn to deal with these real-world problems using creative problem-solving, an important skill in addition to technical skills. The PBL approach also allows the students to learn important social skills, such as communication, leadership, planning and cooperation [8].

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