Chapter 7
Fostering Computational Thinking With Arduino and Lego Mindstorms

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ABSTRACT

Educational robotics (ER) can be of great assistance to educators who aim to develop their students' computational thinking (CT) skills. The ideas of decomposing a problem, handling it more abstractly, looking for patterns, and creating algorithms for the solution can easily be explained through ER. The ER constructional part could be enhanced by DIY (do it yourself) trend and CoP (communities of practice) interactions while block-based or even text-based programming environments are used to program them. In this chapter, the authors present the most commonly used ER platforms, Arduino and Lego Mindstorms, as well as two projects that illustrate how CT characteristics are elicited by them.

INTRODUCTION

New technologies and information bring new challenges so educators have to modify their teaching models to strengthen their students' curriculum. Computing and technology have a great impact on our lives and there is a growing need to know how to formulate problems and express their solutions in a way that a computer can carry it out. Computational Thinking (CT) is a critical skill for all citizens around the world (González & Muñoz-Repiso, 2017).

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Educational Robotics (ER) are learning environments recently introduced in the teaching-learning process. Robots and other electronic components are used to enhance the skills and competencies in children and teenagers. It also supports the STEM (Science, Technology, Engineering, Mathematics) disciplines, but it can also support other learning areas such as linguistics, geography and history (Major et al., 2012).

A revolution both on teaching and learning process takes place as ER may impact students' performance by transferring their life experience into knowledge (Junior et al., 2013). ER consists of a substantial set of tried and tested materials that aim to explore deferent areas of knowledge (Catlin & Woollard, 2014), but they may also be used as CT resources.

Robot activities contribute in providing a practical maturity that helps CT theory become a successful practice. These activities can be used by teachers to develop their students' CT skills and develop a successful curriculum (Papadakis, 2019).

In this chapter, the value of educational robotics, particularly in CT development, is presented. We go on discussing the idea and components of CT and demonstrate how these concepts are revived through robotic project development. Specific teaching techniques and educational robotics are used. In order to make learning interesting, practices from everyday life are employed such as do-it-yourself and communities-of-practice.

BACKGROUND

Teaching CT by using ER is a challenging process. Papert's theory about constructionism (Papert, 1980) is adopted in ER, as students work in teams and develop projects to discover new knowledge under the surveillance of their instructors.

Students are guided to make their artefacts, not in an arbitrary way but through a well-formed educational process. The project-based methodology helps educators to gradually supply students with a part of new knowledge as they work in teams and discover most of it by themselves.

This chapter focuses on CT concepts, how ER can be used to promote it and how it could be taught. To support this case the authors used the current bibliography and their experience in teaching educational robotics.

EDUCATIONAL ROBOTICS AND COMPUTATIONAL THINKING

ER has emerged as a unique learning tool that can offer hands-on, fun activities in an attractive learning environment feeding students' interest and curiosity (Eguchi, 2010). ER can be used as a tool for advancing CT, coding, and engineering (Constantinou & Ioannou, 2018).

The learning theories that support ER are constructivism and constructionism. Educators offer opportunities for children to engage in hands-on explorations and provide tools for students to construct knowledge in the classroom environment. ER creates a learning environment in which students can interact with their environment and work with real-world problems; in this sense, ER can be a great tool that offers students learning experiences while they are constructing (Alimisis, 2013). Robotics can also be conceived as a "black box" for young children who start playing or interacting with a robot without