# Chapter 2
# Educational Robotics:
## A Journey, Not a Destination

**Maria Blancas**
*Synthetic Perceptive Emotive Cognitive Systems (SPECS) Lab, Barcelona Institute of Science and Technology (BIST), Bioengineering Institute of Catalunya (IBEC), Pompeu Fabra University (UPF), Spain*

**Cristina Valero**
*Synthetic Perceptive Emotive Cognitive Systems (SPECS) Lab, Barcelona Institute of Science and Technology (BIST), Bioengineering Institute of Catalunya (IBEC), Spain*

**Vasiliki Vouloutsi**
*Synthetic Perceptive Emotive Cognitive Systems (SPECS) Lab, Barcelona Institute of Science and Technology (BIST), Bioengineering Institute of Catalunya (IBEC), Spain*

**Anna Mura**
*Synthetic Perceptive Emotive Cognitive Systems (SPECS) Lab, Barcelona Institute of Science and Technology (BIST), Bioengineering Institute of Catalunya (IBEC), Spain*

**Paul F. M. J. Verschure**
*Synthetic Perceptive Emotive Cognitive Systems (SPECS) Lab, Barcelona Institute of Science and Technology (BIST), Bioengineering Institute of Catalunya (IBEC), Catalan Institution for Research and Advanced Studies (ICREA), Spain*

## ABSTRACT

*The aim of this work is two-fold. On the one hand, the authors wish to provide relevant information to educators willing to develop an educational robotics (ER) curriculum. They thus provide the current state of the art in the field of ER and the various approaches reported in the literature. They also provide examples of how computational thinking (CT) can be applied in ER and main theories behind ER: constructivism, constructionism, and inquiry-based learning. As ER requires problem-solving abilities, they discuss the link between CT and metacognition, which is considered one of the required educational improvements of the 21st century (also related to the role of gender in STEM methodologies). On*

DOI: 10.4018/978-1-7998-6717-3.ch002

*the other hand, they wish to present their methodology to teach coding and ER (coding robots through exploring their affordances – CREA), how it was designed, and its main outcomes. It aims at teaching programming and robotics to children in primary school, focusing not on only the performance of the students, but also the cultivation of collaboration, communication, creativity, and critical thinking.*

## INTRODUCTION

Advances in modern technology have significantly facilitated all aspects of daily living to such an extent that technology is ubiquitous. Typically, most people know how to use technology but do not understand how this technology works. For that reason, digital literacy is crucial as it not only helps in shaping the professional competencies of the future generations but also contributes in the acquisition of a variety of other skills such as the capacity to reflect, analyse and create. Robotics is a trending field with several potential applications and can be a powerful tool that shapes learning, and numerous researchers consider robotics as an educational tool. We, therefore, have witnessed an increase in the availability of robotics courses (Benitti, 2012; Cruz-Martín et al., 2012; Matarić, 2004) and a significant increase in studies on Educational Robotics (ER) since 2000 (Davcev, Koceska, & Koceski, 2019). Regardless of the robotic platform and the educational level, many schools all over the world offer activities to teach children and teenagers Computer Science (CS) and robotics (Karp, Gale, Lowe, Medina, & Beutlich, 2010; Petre & Price, 2004; Varney, Janoudi, Aslam, & Graham, 2012). Currently, a total of 16 countries in Europe have integrated robotics as part of their curriculum (Balanskat & Engelhardt, 2014).

A relevant part of ER is teaching children how to code; however, programming can be complicated for young students (Kelleher & Pausch, 2003). Children can face difficulties in learning the syntax and commands of a programming language; they can also face problems in using the coding environment itself (Cockburn & Bryant, 1997). Most of the programming languages are predominately used by adults and were not initially conceptualised to be used by children. For this reason, most programming language environments can be overwhelming for young coders; instead, "open-sandbox" environments represent a better solution for them. ER makes coding tangible, which has been proven to provide more considerable learning gains (Smith, 2007). As technology has a high impact on our daily lives, coding can be considered a new form of literacy (Bers, 2017). Teaching children about robotics and coding provides them with tools to understand the world surrounding them, as it allows them to look at the world from the critical perspective of a creator (and not a mere user), and consequently to demystify technology.

Furthermore, ER provides hands-on and fun activities (Eguchi, 2010), and at the same time allows learners to assimilate information about fundamental concepts that include programming and the link between sensors and actuators among others. In parallel, ER positively impacts learners not only in subject areas such as math or science (Bers & Portsmore, 2005) but also in their personal development, as they acquire skills like communication, problem-solving and critical thinking while allowing for the development of creativity. The skills gained by learning robotics or coding expand to other disciplines, and the processes underwent while learning to code instruct them about productive failure, that is, to learn from their mistakes. Therefore, using ER is not the destination, how to simply teach children how to code and make robotic applications that work, but the journey, as through this process, they acquire new skills, new knowledge and the tools to abstract such skills to other domains.

## Related Content