Chapter 4
Educational Robotics Between Coding and Engineering Education

Martin Fislake

iD https://orcid.org/0000-0003-3189-8741

University of Koblenz, Germany

ABSTRACT

The development and use of educational robotics offer almost unlimited chances for teaching design. In classrooms it results in numerous and continuously increasing possibilities for the promotion of competences and the differentiated and differentiating use of educational robots. Therefore, this paper reports long time experiences of the author and is intended to introduce into the history and the relevant literature of educational robotics in teaching settings, before it discusses the role of educational robots as technology artefacts, as educational technology and for technology education interconnected to coding and the engineering design process (edp). In addition, a structured overview is developed to provide orientation, discuss possible applications and offer basic assistance for teaching between coding and engineering.

INTRODUCTION

Education robots for use in schools and lessons have been undergoing enormous technical development since the early 1990s at the latest and are enjoying increasing popularity. At the same time, in addition to their widespread use, their variety, range of functions and applications are growing in ever shorter cycles.

Parallel to this, automation systems are pushing into all areas of life. The skills and abilities to manage them as smart devices in the home or as production robots in industry are thus becoming an essential part of everyday life and the mission of the educational system.

For the planning and implementation of teaching, this results in numerous, continuously increasing and changing possibilities for teaching different contents and competences in various subjects and didactic settings. They are flanked by political expectations, administrative frameworks, new technological developments, corresponding research and its results, ready-made materials from producers, forums and communities.

This paper aims to provide a theory-based study for the use of education robots in classroom settings, between coding and the engineering design process (edp), which takes into account both scientific and didactic implications in class. It is intended to provide basic orientation in this field, discuss background information and possible applications, and thus offer user-friendly support for the selection and use of education robots.

It begins with a short introduction to the topic, a look at the state of literature and a historical outline of the technical development up to modern times. This is followed by a review of educational robots as technology artefacts in order to classify their diversity, appearance and characteristic features.

Afterwards, in the section "education robots as educational technology", ideas of application will be developed in order to be able to provide support for lesson planning with robot systems with regard to more general questions. This is followed by the section "educational robots for technology education" and continues in a specific didactic discussion about teaching with edutainment robots between coding and edp. The last section summarizes the content once again in an overview and concludes the article.

EDUCATIONAL ROBOTS IN THE LITERATURE

The range of available literature on education robots themselves and their use for teaching and learning purposes is sometimes quite broad, probably starting with the development of the first programming languages for children such as LOGO in the 1960s, Paperts (1980) Mindstorms and the development of the first tangible, programmable physical computing devices in the 1980s.

The growing scientific interest in robotics applications at school is reflected in a growing number of topic-specific and, in part, related to this, in an increased number of publications as Anwar et al. (2019) and Angel-Fernandez & Vincze (2018) reported. They also indicate that in comparison to other and established subject areas, it is (still) comparatively unstructured and is driven by very different sources, disciplines and questions.

Only gradually is there a consolidation with constant and regular coverage in books or anthologies such as Smart Learning with Educational Robotics (Springer), Robotics in Education (Springer), Robotics in STEM Education (Springer), Educational Robotics in the Context of the Maker Movement (Springer) or topic-specific annual conferences, workshops and congresses such as Robotics in Education (RiE) or the International Conference Educational Robotics (EDUROBOTICS).

The contributions and scientific articles on educational robots range from simple descriptions of practical teaching applications in STEM subjects as in Bergs et al. (2018) or Tuluri (2017), reports of extracurricular applications (Filipov et al., 2017), papers on elaborate empirical studies such as Catlin & Blamires (2012), Sullivan & Heffernan (2016), Jung & Won (2018) and Pedersen (2020) in systematic reviews, or the attempt to conduct impact research under laboratory-like conditions such as Khanlari (2013), up to simple descriptions of constructions and applications.

Relatively frequent are didactically naive descriptions of technological features of new technical developments such as those of Mockel et al. (2018), Schöpping et al. (2018) or Cehovin Zajc et al. (2018). By contrast, education theory papers such as those by Eguchi (2017) are rather rare in the context of curriculum developments or the definition of educational standards, while vocational preparation-oriented concepts and demands like those of Khanlari (2013), Hirsch et al. (2012) and Fabiyi et al. (2016) are more common.

Related Content

Software for Membrane Computing
(2017). *Membrane Computing for Distributed Control of Robotic Swarms: Emerging Research and Opportunities (pp. 35-58).*
www.irma-international.org/chapter/software-for-membrane-computing/179457

Computational Emotional Thinking and Virtual Neurotransmitters
Max Talanovand Alexander Toschev (2014). *International Journal of Synthetic Emotions (pp. 1-8).*
www.irma-international.org/article/computational-emotional-thinking-and-virtual-neurotransmitters/113414

Identifiability and Detectability of Lyapunov Exponents in Robotics
Nikolay Nikolayevich Karabutov (2023). *Design and Control Advances in Robotics (pp. 152-174).*
www.irma-international.org/chapter/identifiability-and-detectability-of-lyapunov-exponents-in-robotics/314698

Self-Calibration of Eye-to-Hand and Workspace for Mobile Service Robot
Jwu-Sheng Huand Yung-Jung Chang (2012). *Service Robots and Robotics: Design and Application (pp. 229-246).*
www.irma-international.org/chapter/self-calibration-eye-hand-workspace/64668

On Integration Linguistic Factors to Fuzzy Similarity Measures and Intuitionistic Fuzzy Similarity Measures
Pham Hong Phongand Vu Thi Hue (2019). *International Journal of Synthetic Emotions (pp. 1-37).*
www.irma-international.org/article/on-integration-linguistic-factors-to-fuzzy-similarity-measures-and-intuitionistic-fuzzy-similarity-measures/238080