Chapter 22
The Contribution of Open Educational Robotics Competition to Support STEM Education and the Development of Computational Thinking Skills

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ABSTRACT

Educational robotics is increasingly emerging as an educational approach to support the development of STEM education and the development of 21st-century skills such as critical thinking, creativity, collaboration, computational thinking, coding, algorithmic thinking. Ministries, policy makers, educators, and stakeholders are always looking for new strategies and teaching methodologies and approaches for developing these skills in students. By using open robotics technologies, students explore, invent, discover, and engage in real problems and situations. This chapter presents the Open Robotics in Education Competition in Greece and investigates its effect on the development of the pre-mentioned skills in students and on the development of STEM education. It describes the organization of a national competition, team formation for accomplishing project activities, and discusses their relation to the curriculum. The chapter concludes with listing online resources and discussing statistics collected by during and after the competition.

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BACKGROUND

Robotics is an interdisciplinary research area at the interface of computer science and engineering. Robotics involves the design, construction, operation, and use of robots. The goal of robotics is to design intelligent machines that can help and assist humans in their day-to-day lives and keep everyone safe. Robotics draws on the achievement of information engineering, computer engineering, mechanical engineering, electronic engineering, and others.

Robotics develops machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for many purposes, but today many are used in dangerous environments (including inspection of radioactive materials, bomb detection, and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space, underwater, in high heat, and clean up and containment of hazardous materials and radiation). Robots can take on any form, but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviours usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics (Wikipedia, 2020).

Robotics contributes to persist and solve problems, to analyse them, to increase their maturity levels and prepare them for real-world situations in the present and future. Robotics technology will influence shortly every aspect of work and daily life. It has the potential to positively transform human activities, raise efficiency in the work environment and safety levels and provide enhanced levels of service in key domains of human activity, health, education, economy, defence, technology, environment, etc.

Educational robotics allows for the exploration, design, modelling, programming, constructing, and testing of unitary knowledge concepts (motion, force, traction…) but also more complex and realistic systems that require a combination of different concepts and methodologies from different disciplines. Educational robotics can support individual and collaborative learning activities and be aligned with different curriculum objectives and competencies (Unesco Report, 2017). Robotics in schools can help students turn their curiosity and apathy into creativity, innovation, and development of skills. Papadakis & Kalogiannakis (2017) notice that "there are concerns among researchers and education professionals that students in our classrooms are bored, unmotivated and disengaged from school". Eguchi (2012) notices that educational robotics introduce two goals as learning objectives. One goal is to use robots to make children interested in learning about the world of technology by incorporating classes and activities that focus on teaching children about robots. Another aim is the creation of new projects using robots as learning tools to engage children in activities while teaching concepts not easily taught with traditional approaches.

Eguchi (2017) also notices that learning with educational robotics provides students, who usually are the consumers of technology, with opportunities to stop question and think deeply about technology and that when designing, constructing, programming, and documenting the development of autonomous robots or robotics projects, students not only learn how the technology works, but they also apply the skills and content knowledge learned in school in a meaningful and exciting way. Educational robotics is widely spread at all grades of the primary and secondary education community, and in many cases is adapted as a gamification approach and as a mean of developing Computational Thinking (CT) skills, such as problem representation, abstraction, pattern recognition, decomposition, simulation, verification, and prediction. Although, many doubts and questions have arisen. What computational tools and computational methods are appropriate for the school education settings, how robotics and CT can be