Chapter 10
Robotics in Early Childhood Education: A Case Study for the Best Practices

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ABSTRACT
This study aimed to present best practices for robotics in early childhood education based on a case study. Positive Technological Development (PTD) framework was utilised as a theoretical framework suitable for robotics and children education studies. The developmentally appropriateness of the robotics resources for the children was also discovered to make recommendations for the educators. Since robotics in education is an emerging area, through evidence based findings, it is aimed to contribute to the effective use of robotics in education with presenting examples from the children's learning process with robotics.

INTRODUCTION
Today’s children are surrounded by a ubiquitous computing environment and they need to learn this human-made world along with natural world, numbers and letters (Bers, 2010). Early childhood education could be considered as a fundamental preparation stage for the real life and given all those robots which have the capability of walking, running, carrying goods with fuzzy calculations, it is an essential requirement to introduce the children with the logic and concrete version of computational thinking applications. Having suggested that, considering the children with their future while ignoring their today could bring about some problematic situations; therefore, robotics education in the pre-school education must be founded on robust pillars and this is what this chapter has sought for based on illustrative types of practice based implication.

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A further point that forms the motivation for our work here is that there is no particular technology that is developed for educational purposes. For instance, mobile phones, projectors, internet and tablets are not invented for education; whereas, they are used in education. However, since these technologies do not specifically serve the aim of improving education, some problems occur in the process of adapting and integrating them in education. In the case of robots, there are ongoing Research and Development projects by which specifically educational robots are produced. Therefore, robotics in education is a topic that is open for new discoveries and research is needed to further explore the best teaching and learning practices, choosing developmentally suitable robotics resources, human resources and so on.

Now, once essential parts of a robotics kit such as sensors and actuators are obtained, it is easy even for the children to build a basic robot; Lego Mind storm could be considered as a good example of this. Within this framework, assumingly, children in the near future can develop their own interactional robotic toys based on their interest and creativity. This points out a need of examining robotics in early childhood holistically.

Considering the text-based nature of computer programming languages which disables the children to learn computing as they are almost unable to read and write, it is evident that a new design followed by new pedagogical approach is needed. Due to the emergence of graphic based software merely requires children to drag and drop the icons so as to programme, robotics is now applicable in pre-school education and children could engage with robotics kits thanks to ‘removing cognitive demands on, for instance, reading ability’ (Manches & Plowman, 2015: np) in the kit.

Against this background, the remainder of this chapter will explore (a) developmentally appropriateness of the robotics resources for children and (b) learning experiences with robotics in early childhood education within a specific framework through a macro example in which robotics kits with different features are employed.

**LITERATURE REVIEW ON ROBOTICS IN EDUCATION**

In the literature, research findings generally support integration of robotics in early childhood education especially for STEM education. Briefly, researchers put forward that children who are engaged with robotics demonstrate ‘fewer gender-based stereotypes regarding Science, Technology, Engineering and Mathematics [STEM] careers’ (Sullivan & Bers, 2015) and their ability in mathematics at an early age such as 5 is a significant predictor of later ability (Manches & Plowman, 2015) thus, their engagement with a knowledge domain such as Robotics should be supported from an early age.

In some studies conducted by Bers (e.g. Bers, 2008, Bers, 2010; Sullivan & Bers, 2015), robotics is dealt with its potential to develop engineering skills of the children with stressing a need to change the existing curriculum attempting to address these skills by using ‘cardboard or recycled materials to build cities and bridges and become “little engineers”’ since the curriculum has concentrated on ‘literacy and numeracy, with some recent attention to science’. In these studies, rather than an occupation, engineering skills refer to creativity, designing ability, producing an outcome and finding solutions to the existing problems. In some articles, the engineering is replaced with a more comprehensive discipline, STEM. Given that the field of robotics is essentially composed of the knowledge domain in STEM, as aptly focused in robotics studies, it would help children if teachers decompose this knowledge domain through embedding robotics in curriculum. Please see Figure 1 showing The Cheetah Robot developed by Boston