Chapter 11
Learning Computational Thinking Development in Young Children With Bee-Bot Educational Robotics

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ABSTRACT

It is widely known that when used intentionally and appropriately, technology and interactive media are effective tools to support learning and development. In recent years, there has been a push to introduce coding and computational thinking in early childhood education, and robotics is an excellent tool to achieve this. This chapter presents some results obtained in the development of a learning experience in computational thinking using Bee-Bot educational robotics. The experience involved 47 preschoolers of a kindergarten in Crete, Greece during the period 2019-2020. The study reports statistically significant learning gains between the initial and final assessment of children’s computational thinking skills. It was found that children in the treatment group who engaged in the robotic curricular intervention performed better on CT tests. This finding shows that an enhanced teaching experience using robots was beneficial for improving young children’s computational thinking skills. The implications for designing appropriate curricula using robots for kindergarteners are addressed.

DOI: 10.4018/978-1-7998-4576-8.ch011
INTRODUCTION

Over the last few years, increasing attention has been focused on the development of children’s acquisition of 21st-century skills and digital competences (Kalogiannakis & Papadakis, 2020). Consequently, many education scholars have argued that teaching technology – the “T” in STEM (Science, Technology, Engineering, and Mathematics) – to young children is vital in keeping up with 21st-century employment patterns (Lee, 2019). When used intentionally and appropriately, technology and interactive media are effective tools to support learning and development (NAEYC & Fred Rogers Center & Joint Position Statement, 2012). In early childhood, new interactive and smart screen technologies create opportunities to enhance young children’s growing, learning, and playing (Bers 2008). Technologies, such as those that involve robotics or coding apps, come at a time when the demand for computing jobs around the globe is at an all-time high while its supply is at an all-time low (European Commission, 2018; Papadakis, 2020; Servoz, 2018). At the same time, researchers and scholars have highlighted the vast cognitive benefits of introducing Computational Thinking (CT) skills to young children (Govindarajan, 2019; Orfanakis & Papadakis, 2016). For instance, Bers (2018a) highlights the fact that children as young as four years old can learn foundational computational thinking concepts and this kind of learning can support their language, mathematical, cognitive, and socio-emotional development.

The term ‘Computational Thinking’ can be defined as solving problems algorithmically and developing a sense of technological fluency (Bers, 2018b) which involves, but is not limited to, critical thinking, problem solving and creativity (Papavlasopoulou, Sharma, & Giannakos, 2019). Central to this approach is the notion of by taking part in coding activities, children, including preschoolers, are exposed to Computational Thinking skills (Wing, 2006). According to Herdzina (2019) this is a main reason that coding is seen as the new modern literacy for today’s young children. It is widely known that there is women underrepresentation in science, technology, engineering, and math (STEM) and as a result many young women have fewer opportunities to contribute to and benefit from careers in computer science and engineering (Papadakis, Tousia, & Polychronaki, 2018; Master, Cheryan, Moscatelli, & Meltzoff, 2017). Research suggests that coding experience enhances children’s interest in knowledge and skills include engineering-science, technology, engineering, and mathematics (STEM) areas, and reduces gender-biased stereotypes associated with STEM careers (Master et al., 2017; Sullivan, 2016).

Following technological advancements, international trends, and research developments, robotics and computer programming initiatives are growing in popularity amongst early childhood researchers and educators (Sullivan & Bers, 2016). Studies on the inclusion of concepts such as computational thinking and coding in the education system have had an important impact on the educational goal for many countries (Çiftci & Bildiren, 2019; Papadakis & Kalogiannakis, 2019; Sáez-López et al., 2016). In an effort to improve current educational programs, national educational programs and private initiatives such as the ‘Hour of code’ (https://hourofcode.com) and the ‘Code week’ (https://codeweek.eu) are focusing on STEM literacy and making coding and computational thinking a priority for education (Bers, González-González, & Armas–Torres, 2019; Papavlasopoulou et al., 2019).

Scholars have long recognized that preschool children can engage in and complete basic programming and robotics tasks (Sullivan & Bers 2016). Today, there is a newfound abundance of technological tools aimed at young children on the commercial landscape (Sullivan, 2016). A number of mobile applications (apps) that are designed to teach young children coding skills in a fun, game-like way has become popular in recent years (Papadakis, Zaranis, & Kalogiannakis, 2019). For instance, apps such as the Daisy the Dinosaur, the Kodable, and Scratch Jr., have been found that when used intentionally.