Chapter 12
Introducing STEAM Through Tinkercad and Arduino

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ABSTRACT

During the last years, educators were challenged to move their lessons from the physical classroom to online classrooms due to the COVID-19 pandemic. Due to this situation, they had to come up with new teaching methods and applications and even use ICT to implement hands-on activities. Teaching robotics, a significant subject to promote STEAM education and computational thinking, had to be continued under these circumstances. In this chapter, the work and the results of teaching robotics in online classes are presented. Tinkercad simulation platform was used to teach robotics and plan projects that later were implemented using the Arduino platform robotic system in the physical classroom as hands-on activities.

INTRODUCTION

Our new digital age imposes a life where Information and Communication Technologies (ICTs) dominate and have changed our communication habits, our relationships and our perception. A significant consequence is in the way we obtain information and as a result in the way we conquer knowledge and teach. (de Souza, & Elisiario, 2019). On the other hand, students of the new digital generation have to develop not only digital skills but also team working and collaborative skills, flexibility and adaptiveness to problem solving, creativity, critical thinking etc.

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A strong education in Science, Technology, Engineering, Mathematics and even Art (STEAM) is important in recent years (Thibaut et al., 2018), (Madden et al., 2016). STEM education aims to prepare students in multidimensional capabilities to use in modern life (Rifandi & Rahmi, 2019). It raises their competitiveness, increases critical thinking skills, creativity and their spirit of innovation and improves problem solving abilities necessary in everyday life and therefore their computational thinking (CT) skills (Eryilmaz & Deniz, 2021).

STEAM education aims to connect different learning areas and emerge the relationship among divergent subjects (Ah-Fur, Chien-Hung, & Horng-Yih, 2018, July). According to Madden (2016), Rifandi (2019) and Tsolakis et al. (2021) STEM education is important as it affects and impacts a variety of skills that educators need to improve in students: Problem-solving, innovation, self-esteem, logical thinking, technological literature, communication and team working skills. STEM teaching is supported by educational robotics (ER) through problem solving tasks and on-hands activities developing thus students' CT skills.

Therefore, introducing robotic activities in students' curriculum is essential. However, during the COVID-19 pandemic, teaching robotics seemed to be difficult or even impossible as traditional classes changed to on-line classes. In order to continue ER teaching, instructors should resort to solutions that could be supported by the on-line classes. Tsolakis et al. (2021) state that the Arduino platform is suitable for STEAM introduction, it's online simulation tool can be used interchangeably as an alternative solution for the ER on-line classes.

BACKGROUND

Teaching educational robotics (ER) in order to promote Computational thinking (CT) is a challenging and desired process for our era. Students are challenged to work in teams to develop artifacts in order to discover new knowledge while educators are their mentors, just like Papert indicates in his constructivist theory (Papert, 1980).

A well-formed educational procedure must be held along with the project-based methodology so students are driven to conquer knowledge through an experimental process. The problem arises when no physical equipment is available, so computer simulation programs should be used. That problem may arise not only due to lack of equipment but also due to a situation similar to the one faced during the Covid-19 era. In this case, when classes were transferred to online, nobody knew how much this would last. The need of teaching ER even online emerged the need of looking for appropriate solutions. Thus a simulation program, which could be used in the online classes and would allow students to catch up with hands-on projects when back to school, seemed ideal

This chapter presents a simulation program which was used in replacement of the physical equipment due to difficulties that was arisen from the Covid-19 pandemic and the consequent lock down, as well as the way this effort evolved when students were back to physical classrooms and could therefore work with the available equipment. Thus, a hybrid (mixed) intervention is presented, which consists of a 3 on-line and 4 in-class sessions, along with the results of this transition.