Chapter 5
Use of Robots to Help Students With Diverse Needs:
Concepts, Opportunities, and Challenges

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ABSTRACT

In most countries, the student population in schools continues to grow more diverse, and the unique learning needs of the students are recognized. In this respect, it is crucial to ensure that policies foster educational outcomes for all students, not just an average general education student. Since working on robots is very stimulating for especially young students, allowing them to develop key skills that will help them be successful during their school years and beyond in terms of problem-solving, creativity, scientific approach, and team spirit, robots are becoming more popular as an educational platform. For that reason, many types of robots are being involved in education. Robots with different features and capabilities, such as simple robots or socially interactive robots, are used in education, and usually, objectives and targets of a study and age group of students dictate the choices regarding robots. Considering the different roles of robots in education, in this chapter, the use of robots in the education of students with diverse needs is reviewed.

INTRODUCTION

Diversity can be considered as everything that makes people different from each other and includes various factors such as race, ethnicity, age, gender, personality, religious belief, political conviction, socioeconomic class, or ability (Shaw, 2005). Therefore, the fact that each student could bring unique ideas, experiences, and strengths to classrooms and the exploration, comprehension and incorporation of these to enrich learning in the classrooms is understood to be important (Shaw, 2005; Martinez-Acosta & Favero, 2018). It has been shown that diversity changes the way individuals think by fostering creativity and innovation, in addition to decision-making and problem-solving skills (Cox & Blake, 1991). It is expected that diversity both in and out of classrooms will possibly continue to increase; therefore, it is

indispensable to prepare students to embrace those differences from themselves. It has been shown that promoting inclusion and developing awareness around multicultural education and adopting a culturally responsive approach to teaching offers considerable benefits to all students (Durodoye, 1998).

It has been shown that the use of robots in education provides a number of critical benefits (Benitti, 2012; Chang et al., 2010; Lopez-Caudana, Ramirez-Montoya, Martínez-Pérez, & Rodríguez-Abitia, 2020; Young, Wang, & Jang, 2010). First, it helps to enable the students to develop co-operative skills and teamwork. Second, it helps to enable the students to create higher confidence and attitude to face the outer world. Third, it helps the students to communicate and learn different platforms provided by robot-supported curriculums. Finally, it helps the students to know their strengths and weaknesses, as well as their passion. However, even sophisticated socially interactive robots are still far from being autonomously used in schools because of their technological limitations (Senft *et al.*, 2019). Therefore, generally, the design goals of robots with educational goals are mainly to function as a stimulating and engaging companion instead of replacing human teachers (Serholt *et al.*, 2014; Sharkey, 2016). However, in order to successfully integrate robots in schools, easy-to-use and well-designed interfacing mechanisms must be provided so that the human teacher will be able to control the robot with little or no training.

In today's fast moving world and highly-competitive learning environment with new innovations and continuous improvements in technologies, it has become inevitable for both schools and parents to offer STEM education to children. STEM education helps children to compete with other children and be equipped with skills which help them to handle difficult situations in this competitive environment.

Although there is a lack of scientific studies on the topic, it is agreed that robots are a pedagogical tool for science, technology, engineering and mathematics (STEM) and a motivating, engagement tool for students to pursue STEM studies (Benitti, 2012; Üçgül, 2013). The practical usage of robots in STEM keeps the students engaged until they find a solution for a problem in hand. This way it both enhances the students' logical perception and improves their analytical and reasoning ability. However, in an educational context, robots are certainly effective beyond STEM. In particular, the key benefit of robots in education is that robots reinforce scientific and technological culture in schools (Jung & Won, 2018). In an educational context, robots provide other benefits. First, they are ideal tools for making abstract knowledge concrete. Second, through a number of specific activities, they are quite useful for applying scientific thinking (Barak & Zadok, 2009). Finally, through trans-disciplinary activity-based projects they enable the transfer of knowledge.

In general, different from standard, basic curriculums, the use of robotics in education helps students to get prepared for the future as confident and independent individuals with desired skills. Three major roles and one complementary role can be identified for robots in education. One of the major roles is educational subject. The robots can be used as an educational subject to teach basic algorithms with concrete object actions (Mubin *et al.*, 2013). The second major role is that they can be a learning support tool. The robots can be used to support educational activities, particularly in medical and healthcare education. The third major role is telepresence. The robots can be used to enable sick or even hospitalised children to attend classroom sessions virtually at school by taking control of the robot (Ahumada-Newhart & Olson, 2019). The complementary role is based on a collaborative robot-human approach. In this role, for example, robots can be aware of the presence or absence of students and then welcome them into the classroom by name if they are present, and this way they allow the teacher to focus more on their pedagogical objectives. Considering the various benefits of robots in education and the great potential they offer (Barker & Ansorge, 2007), in this study, the use of robots in the education of students with

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