

Chapter 33

Educational Robotics as a Learning Tool for Promoting Rich Environments for Active Learning (REALs)

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ABSTRACT

In our ever-changing society where new technological tools are being introduced into daily life more rapidly than ever before, more and more innovative and creative people are needed for the work of advancing technology. However, current educational practice in schools seems to be moving away from helping to educate our future innovative and creative workforce. With the extensive focus on assessments through standardized testing, the concern is raised that more and more teachers are forced to teach to the test. In this chapter, educational robotics is introduced as a transformational tool for learning, which promotes learning of computational thinking, coding, and engineering, all increasingly being viewed as critical ingredients of STEM learning in K-12 education. The purpose of this chapter is to highlight the importance of integrating educational robotics as a technological learning tool into K-12 curriculum to promote Rich Environments for Active Learning (REALs) to prepare students for the technology-driven future.

INTRODUCTION

The rapid pace of technological advancements enhanced by the interconnectedness brought on by the power of the Internet and social media has resulted in the ‘flattening’ of the world (Friedman, 2005). New technological tools are being introduced into our daily life more rapidly than

ever before. The introduction of new iProducts in almost every six months is in turn accelerating the development of similar products including other smartphones and tablet technologies. Creative project crowd-funding platforms, such as Kickstarter (<http://www.kickstarter.com>), Indiegogo (<https://www.indiegogo.com/>), and Quirky (<https://www.quirky.com>) are contributing to

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the accelerated birth of innovative technological tools by providing essential funding directly from potential and/or interested consumers.

Among these various technological advancements, robotics technology has been highlighted in recent media reports. News headlines from major news sources, including the New York Times, CNN, Wall Street Journal, and BBC, featuring various robotic innovations, are a strong indication of how much popular attention robotics technology has garnered in recent years. When watching the *Jetsons* television program in the 1960s and 1980s, very few people might have believed that a humanoid robot, like Rosie, would become a reality in their lifetime. On June 5, 2014, Softbank Mobile, a Japanese company, in collaboration with Aldebaran Robotics, a French company, unveiled *Pepper*, the world's first personal humanoid robot. Costing less than US\$2,000, Pepper is able to assist humans by reading and responding to human emotions (SoftBank Mobile Corp. & Aldebaran Robotics SAS, 2014). Prior to the introduction of Pepper, Amazon announced its plans for a drone delivery system and, in July 2014, asked the Federal Aviation Administration for permission for the drone use (Amazon.com, 2014). Google revealed the drone that they are developing and announced that they would also start drone delivery in December 2014 (A. Barr, Nicas, & Bensinger, 2014). Prior to the drone delivery plan, Google announced its acquisition of eight robotics companies, including Boston Dynamics, a Boston-based robotics company that produces robotics creations supported by the Department of Defense, and Schaft Inc., a Japanese robot venture start-up company (Ackerman, 2013). The Defense Advanced Research Projects Agency (DARPA), an agency of the US Department of Defense, held DARPA Robotics Challenge trial in December 2013, followed by its final in December 2014¹. Aldebaran Robotics' *NAO*, an autonomous and programmable humanoid robot, has been used in various educational settings including RoboCup Soccer league for the development of

algorithms for humanoid soccer and for the research of children with Autism. Moreover, iRobot Corporation, an American advanced technology company, introduced the popular room-cleaning robot, *Roomba*, in 2002, which has been sold in the market more than a decade already.

The world and its economy are changing at such a rapid pace that it is impossible to predict what the economy will look like even at the end of next week (Robinson, 2010). Despite all the dramatic changes that have taken place in the world, public education has maintained almost the same system since its introduction in the 19th century (Robinson, 2010). The majority of schools persist in trying to prepare students for the future by continuing what was done in the past (Robinson, 2010). More than 40 years ago Paulo Freire introduced his view of education, leading to the development of the critical pedagogy approach to education. In his book, *Pedagogy of Oppressed*, Freire argued that existing educational practice expects teachers to be narrators of facts and requires students "to memorize mechanically the narrated content" (Freire, 1994). In essence, students are turned into containers to be filled by the teacher. When using this *banking* approach to education (Freire, 1994), students are required to receive, memorize, and repeat knowledge and/or facts that are provided by their teachers. Freire argues, "The teacher talks about reality as if it were motionless, static, compartmentalized, and predictable. Or else he expounds on a topic completely alien to the existential experience of the students" (Freire, 1994, p.52). He continues:

... it is the people themselves who are filed away through the lack of creativity, transformation, and knowledge in this (at best) misguided system. For apart from inquiry apart from the praxis, individuals cannot be truly human. Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry, human beings pursue in the world, with the world, and with each other. (p.53)

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