Chapter 2
5 Phases of Educational Robotics (5PER): The Scientific Method Applied to Educational Robotics

Mauricio P. Galvez-Legua
https://orcid.org/0000-0002-4845-4218
Universidad Nacional de Ingeniería, Peru

Diego E. Galvez-Aranda
Texas A&M University, USA

ABSTRACT

This chapter presents a methodology for the development of activities based on educational robotics: five phases of educational robotics (5PER). First, the authors describe how technology and science have evolved to this day, recognizing their importance, and how they have impacted the schools with approaches such as STEM. Then, the main theories and learning approaches that have driven to the use of educational robotics in schools are reviewed, as well as concepts of robotics, educational robotics, and the difference between them. Finally, each of the five phases are explained, and two practical examples of how to implement them in the development of learning activities are shown.

INTRODUCTION

In recent years, the use of Information and Communication Technologies (ICT) in education has intensified, framed in what we currently call the knowledge society. (Välimaa & Hoffman, 2008) Initially, many of these applications were aimed to provide better tools for teachers in their classrooms: computers, multimedia projectors, electronic whiteboards, etc. Subsequently, the ICT began to be used as means of learning: the internet generated information and interpretation skills and the simulators developed capacities in the management of virtual environments.(Boud & Prosser, 2002) The problem with these types of technological applications is that relativized the real world. Theories such as Seymurt Papert's

DOI: 10.4018/978-1-7998-7443-0.ch002

constructionism,(Harel & Papert, 1991) gave us a more active and natural approach to learning, his Learning by doing theory promoted the creation of Educational Robotics (ER) as a means of learning, which privileges creativity and experimentation through the design and construction of prototypes.(S. Papert, 1987, 1993; S. A. Papert, 1973, 2020), allowing students to experiment in the real world. Later, with the appearance of STEM as a new interdisciplinary educational approach, different disciplines such as science, technology, engineering, and mathematics, were encouraged in the classroom. Nowadays, the teaching of these disciplines are currently considered essential for the integral development of people.(Bybee, 2013; Xie, Fang, & Shauman, 2015) In this context, ER allows a more natural approach of students with these areas, initially as a game and then through experimentation, it allows the student to interact with physical phenomena and later propose possible solutions to observed problems and formulate conclusions in a way very similar to the scientific method.(Benitti, 2012; Mikropoulos & Bellou, 2013; S. A. Papert, 2020)

ER has great potential in education, and it is necessary to define a framework that standardizes its use and its relationship with research through experimentation. In the present work, the main objective of the authors is to propose an ER model based on the traditional scientific method called "5 Phases of educational robotics (5PER)" and an example of its implementation in educational environments.

BACKGROUND

Technology and Science

Technology appears as a result of understanding the world in which we, humans, live. Experimentation was the primary tool that man used, initially to survive, and later to dominate his environment.(Fan, Yu, & Hunter, 2004) The method called: trial-and-error, was refined as the human race evolved. An example of the application of the trial-and-error method could be a primitive man using a hard stone to carve a soft stone as shown in Figure 1. Another example could be the opening scene: The dawn of man, from the 2001 movie: Space Odyssey from Stanley Kubrick

Figure 1. Primitive man learning to carve a stone.