Chapter 14
Teaching Aids and Manipulative Teaching Means:
Educational Robotics and Mathematics Using the Planned Bee-Bot Floor Robot

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ABSTRACT

The subject matter of this essay concerns the use of manipulatives and teaching aids in the teaching of mathematics for the 1st and 2nd grade of primary school, combined with educational robotics applications. In particular, the use of the programmable bee-bot floor robot combines procedures that involve the use of manipulative means (creating a track as a cardboard model, painting, assembling), teaching aid tools (demonstration of the programmable bee-bot floor robot), and finally, the comprehension of simple programming and mathematical concepts. Through the implementation of an educational scenario aiming to familiarize students with the basic geometric concepts, mathematical operations (multiplication table), basic algorithmic structures (simple problems and step solving), there will be involvement with the cognitive areas of informatics (basic programming concepts)) and mathematics (geometry, calculations).

INTRODUCTION

The teaching of mathematics and the general principles of Programming, especially when it comes to primary school ages, are increasingly capturing the interest of the research community (Kalogiannakis & Papadakis, 2017a; 2017b; 2017c). The purpose of this essay is to present a teaching proposal for the teaching of the concept of process to 1st and 2nd grade students of Primary School. The proposed teaching intervention, in the context of a guided research project, utilizes the programmable Pro-Bot floor robot and tries to investigate the degree of students' familiarity with mathematics (counting, learning shapes,

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designing a route, complete circle) and computer science (the concept of process as a programming process) and detect any possible educational problems that may arise during its teaching.

After an introduction to the concept of robotics and the benefits that result from its inclusion in the learning process, the description of the objectives and methodology of the research are articulated while the educational scenario with the corresponding activities is presented in detail, accompanied by observations and photographic material from the teaching process. Finally, through the qualitative evaluation of the children's work and the rest of the material, useful conclusions are drawn.

BACKGROUND

Educational Robotics in Primary Education

Research conducted in recent years internationally, suggest different approaches to the teaching of Programming and Mathematics, especially in secondary education (Papadakis, 2018; Papadakis, Tousia, & Polychronaki, 2018). The directions regarding the teaching of Programming focus on relieving the student from learning an abstract programming language where commands and syntax dominate. Thus, students are asked to draw examples from the "real" world and consider the interests and meanings they give in an interdisciplinary environment. Nevertheless, the difficulties in teaching Programming in Secondary Education do not differ significantly from those encountered in Primary Education. According to Fesakis & Dimitrakopoulou (2006) who attempted an overview of educational programming environments, they argue that the appropriate programming languages for ages 8-15 are Logo Like environments, Educational Robotics applications, as well as game creation programs, such as Game Maker (Fesakis & Dimitrakopoulou, 2006).

The Pedagogical Framework of Educational Robotics

Educational robotics today is experiencing significant development through the pedagogical current of the Logo programming language (Kalogiannakis & Papadakis, 2017b; 2017c). This pedagogical approach is enshrined in the context of classical constructivism and in the context of constructionism, as developed by Papert (Papert, 1991; Resnick, 1994).

The main objectives of this approach are:

1. problem solving through the handling and construction of real and imaginary objects,
2. the formalization of thought (using commands in a programming language for automatic handling),
3. socialization (human cooperation, interaction and promotion of thought through cognitive and socio-cognitive conflicts) and
4. the acquisition of knowledge and skills related to many disciplines and thus the promotion of interdisciplinary and interdisciplinary approach (Kafai & Resnick, 1996).

However, the peculiarity in the programming of robotic constructions such as the Bee-bot creates a different working environment for students (Kalogiannakis, Ampartzaki, Papadakis, & Skaraki, 2018). Thus, this type of robotic construction programming works: a) motivating students, necessary element for the teaching practice, b) there is a connection with social reference practices, if one considers that the