

Chapter 47

Teaching Basic Programming Concepts to Young Primary School Students Using Tablets: Results of a Pilot Project

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ABSTRACT

The study presents the results of a project in which tablets and a ready-made application were used for teaching basic programming concepts to young primary school students (ages 7-9). A total of 135 students participated in the study, attending primary schools in Athens, Greece, divided into three groups. The first was taught conventionally. The second was taught using a board game, while the third was taught using tablets and an application. Students' performance was assessed using evaluation sheets. Data analyses revealed that students in the tablets/application group outperformed students in the other two groups in three out of four tests. No age differences were noted. Students' views regarding the application were highly positive. The learning outcomes can be attributed to the combination of the application's game-like features and to the tablets' ease of use. On the basis of the results, educators, as well as policy makers, can consider the use of tablets and mobile applications for teaching basic programming concepts to young primary school students.

INTRODUCTION

Constant technological developments have brought significant changes in all aspects of our lives, education included. This fact puts educational systems under pressure; they have to change in order to meet the needs for instruction and training in the Information era. However, we are past the stage in which the goal - with regard to ICT- was students to become adept users of devices and applications. Nowadays, the goal is for students to be able to design and create content using technology (OECD, 2015). In a way, this need is related to the acquisition of computer programming skills (Resnick et al., 2009).

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The benefits students have when they learn how to program were noted since the early days of the integration of computers in education (Papert, 1980). It helps them to develop their analytical and synthetic thinking, fosters their skills in designing and solving algorithms, and has a positive impact on their creativity and imagination (Fessakis, Gouli, & Mavroudi, 2013; Liu, Cheng, & Huang, 2011). The teaching of basic programming concepts is included into the Greek primary school's curriculum, in the last two grades. Alas, the content is poor, outdated, not well organized, and students face problems (Papadakis, Orfanakis, Kalogiannakis, & Zaranis, 2014). On the other hand, researchers suggest that the teaching of programming should have game-like characteristics, so that the whole process becomes an enjoyable experience (e.g., Margulieux, Guzdial, & Catrambone, 2012) and that it should start as early as possible (Kalelioğlu, 2015).

In recent years, the use of smartphones and tablets and their applications has exponentially increased; people of all ages (adolescents included) routinely use them. These mobile devices, because of their specific characteristics (e.g., low cost, portability, and connectivity), can become a valuable educational tool. Consequently, their educational uses are the subject of an increasing number of studies and the relevant literature is becoming more and more extensive (e.g., Goodwin, 2012; Henderson, 2012).

About a year ago, a team at the Department of Primary School Education, at the University of the Aegean, laid the groundwork for the research initiative Emerging Technologies in Education (ETiE). Its main purpose is to study the educational potential of a variety of emerging technologies (e.g., tablets, virtual and augmented reality, 3D printers, and drones) in as many as possible primary and junior high school's grades and subjects. Taking into account that: (a) there is the need for more innovative methods for teaching programming concepts and (b) that mobile devices have an interesting educational potential, it was quite logical to wonder whether tablets - or other mobile devices for that matter - can be used for teaching programming concepts to primary school students. In the context of ETiE, a pilot project was designed and implemented in order to study exactly this. The main research objective was to examine what the learning outcomes might be after teaching programming concepts in a playful way using tablets. Moreover, it was considered as an interesting endeavor to have as a target group very young students (7-9-year-olds), deviating from the directives of the Greek curriculum. The rationale, methodology, and the results of this intervention are presented and analyzed in the coming sections.

PROGRAMMING AS A TEACHING SUBJECT IN PRIMARY SCHOOL

While there is no common consensus regarding the definition of programming, it can be viewed as the creative process of instructing a computer on how to perform a task (Blackwell, 2002). The instructions/commands for executing this task have to be written in a (programming) language that can be understood by the computer. The existing literature suggests multiple benefits for students when they learn how to program. Besides learning fundamental programming concepts (Zhang, Liu, Ordóñez de Pablos, & She, 2014), they develop a positive attitude toward learning computing in general (Fessakis et al., 2013; Keren & Fridin, 2014). A better understanding of mathematical concepts and improvement of their social skills (Fessakis et al., 2013), improvement of their problem-solving skills (Akcaoglu & Koehler, 2014), as well as an impact on their creativity and imagination (Liu et al., 2011), were also noted. Likewise, when students perform well in programming, they tend to use more meta-cognitive management strategies (Bergin, Reilly, & Traynor, 2005). On the other hand, the teaching of this subject is not an easy task and students do face problems. Their poor understanding of how programs are executed (Pea, 1986), and of

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