

Chapter 2

Evaluating a Teaching Intervention for Teaching STEM and Programming Concepts Through the Creation of a Weather–Forecast App for Smart Mobile Devices

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ABSTRACT

The last two decades have necessitated the need for an interdisciplinary approach to mathematics, science, and technology (STEM) as contemporary problems are too multidimensional to be tackled by a single scientific discipline as was the case with classical school curricula. Teaching programming has the potential to contribute to this vision as it is effective in helping students develop critical thinking skills. This work presents an educational approach that combines STEM learning with the basic concepts of programming through the creation of a weather-forecast app for smart mobile devices with the programming environment MIT App Inventor. This approach was implemented with second grade high school students as a school project. The evaluation results are considered encouraging as the students engaged in authentic learning activities and research related to the STEM field while, at the same time, enhanced their interest and knowledge in pursuing careers involving programming, science, technology, engineering, and mathematics.

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INTRODUCTION

Equal digital citizenship is a presumptive value in the modern world. But to be digitally enough in the modern world requires not only access to and use of ICTs (Information and Communication Technologies) but also appropriate knowledge, skills and attitudes (Vuorikari, 2015). Besides, over the last decade there is an urgent need for an effective and interdisciplinary approach to Mathematics, Science and Technology (STEM) while modern problems are complex and multi-dimensional to be addressed by a single science discipline as was the case with classical school curricula for decades (Morrison & Bartlett, 2009). STEM seeks to transform the traditional teacher-centered teaching and learning approach to an alternative approach where problem-solving, creative thinking, discovery-exploration learning, and other high-level cognitive skills play a key role, while a direct and active learner involvement is required to obtain a subsequent behavior change (Dorouka, Papadakis & Kalogiannakis, 2019). This approach also avoids some of the common challenges to the use of creative programming (Wing, 2006). Within this approach of programming, which is not only focused on the techniques to code a program, different components which are related to the creative problem-solving process such as collaboration, creativity, communication, innovation, and critical thinking (Orfanakis & Papadakis, 2016) are utilized.

The development of STEM and programming skills to successfully negotiate the 21st-century information society, besides learning, has become a key competence that is addressed to all students. The reason is that they provide them with the necessary skills for their future profession (European Schoolnet, 2014). However, while one might expect students would be more likely to embrace programming courses in the context of formal education, evidence around the globe suggests that such a trend is not observed. Data from around the world, specifically in the United States and Europe, show that an increasing number of students are choosing not to pursue the programming disciplines in secondary schools and higher education (Papadakis & Kalogiannakis, 2017).

Computing has been introduced as a mandatory subject in primary and secondary school Greek curricula for decades. With the recent Computer Science curricula in Primary and Secondary Education (<http://ebooks.edu.gr/new/>), even the rigorous curriculum of the Greek school enables the teacher to plan and control his/her activities, to make use of readymade appropriate educational material and computer resources and to create his/her material as well. Teachers are also suggested to use real-world examples that demonstrate the interdisciplinary nature of modern disciplines and/or scenarios that enrich students' knowledge from previous classes and courses in math, physics, and electronics. This approach can be a very powerful way to engage students in STEM and coding activities and to help them appreciate why an understanding of STEM and coding matters to their lives. This science-based approach is not just logical; it engages students hands-on and inquiry-based activities to develop apps using developmentally appropriate learning programming environments for novices such as MIT App Inventor 2 (Papadakis et al., 2017).

This paper presents an educational intervention that combines the basic concepts of programming and STEM learning via the creation of a weather-forecast application (app) for smart mobile devices using the MIT App Inventor 2 programming environment. This paper is an extension of the author's paper presented at the 6th Panhellenic Scientific Conference 'Integration and Use of ICT in the Educational Process' in the Greek language. In this article, the author presents the rationale and design of the study, as well as the relevant result. The rest of the paper is organized as follows. The next section presents the current trends of empirical research in the necessity of programming, the difficulties that novice

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