Διεθνές Συνέδριο για την Ανοικτή & εξ Αποστάσεως Εκπαίδευση

Τόμ. 9, Αρ. 6Β (2017)

Ο Σχεδιασμός της Μάθησης

Μια Ακαδημία Προγραμματισμού Νέων για το Scratch και το Arduino

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doi: 10.12681/icodl.1384

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Abstract

The purpose of this paper is threefold: First, to bring up the necessity of long life learning for adults along with the development of programming skills for students, in order adults and children to be competitive in a rapidly changing market and business world. Second, to briefly state the educational activities and synergies of the Educational Content Methodology & Technology Laboratory (e-CoMeT Lab) of the Hellenic Open University (HOU) aiming on democratizing education and offering the chance for distance learning to students from rural areas, girls, refuges and migrants with fewer opportunities to learn. And last but not least, to present the aims and the implementation procedure of the project Junior Coding Academy, a project implemented by e-CoMeT and Intermedi@KT, a Non-Profit Organization in Greece, that is still active and available for teachers and their students in order to acquire and develop their programming skills.

Keywords: *Non-formal education; Programming Skills; Scratch; Arduino, Distance Learning, Moodle*

1. Introduction

The 21th century is characterized by an exponent change end emergence, driven by digital innovations. In the past three centuries, there was a relative stability with regard to social and cultural development. Technological systems were created and disseminated throughout the world, followed by a 50 year of stability. During this period, educational institutions were reinvented to help world to understand how to operate, teaching practices worked fine and skills were lasted a lifetime. Now, we are living in an era where everything rapidly changes. Past decades skills become irrelevant, often last no longer than 18 months Old knowledge and skills have to reinvented and new skills and practices have to be developed evolving with new technologies. These and other insights and arguments are given by Prof. John Seely Brown during his talk about learning in and for the 21th century (2012).

In a rapidly changing society and economy, with different opportunities and challenges, what children need to have to complete and succeed? In his book, The Industries of the Future

(2016), Alec Ross argues that in a business world that is growing more global, multicultural fluency is increasingly important and kids need to have foreign language skills, in order to communicate and engage directly with people. However, this is not enough. Future kids should also become fluent in a technical, programming, or scientific language. And this is because "…he way the human capital markets are changing, you need to have this solidity to be able to converse with people in different parts of the world, understand their cultures, understand their languages, as well as being able to converse technically.". Big data, genomics, cyber, and robotics are among the high-growth industries of the future, and people who will make their livings in those industries need to be fluent in the coding languages behind them.

The importance of learning programming languages goes beyond coding with fluency. The biggest issue is the development of analytical skills. It makes people to thing in a very different way, in an algorithmic manner, to use abstraction in order to understand complex systems and how these interconnect, to decompose them to smaller ones and next solve them to provide a solution to the bigger one. These are the skills that are used everywhere, in building a business, or running a business, or even working in a business.

2. Democratizing access to programming

Children growing up in environments of economic and social privilege always have great opportunities to access to schools, institutes and educational environments in general. But what about those who are growing up under lesser circumstances, living in rural areas, or are refuges' or immigrants' children? Or, what about a vast number of the students that are educated by old fashion public school systems? For these children there are several open resources on the internet that have arisen lately that democratize access to important programming skills. An example is the Codecademy, an educational company that offers free online lessons to more than 45M people around the world. It teaches them how to code (in Python, Java, JavaScript, Ruby, etc.) and create web sites and web applications (using html, css, etc.). Another important action is Scratch, a visual programming environment developed by the Lifelong Kindergarten Group at the MIT Media Lab, that helps young people learn to think creatively, reason systematically, and work collaboratively. Scratch teaches children to program their own interactive stories, games and animations. Applications (projects) are built by combining visual blocks. Each visual block facilitates a specific type of user-computer interaction and by thorough combination, powerful game like applications can be developed. During this process users are able to comprehend the basic programming concepts and develop transferable software design skills. Scratch has been used extensively in introductory programming courses and more than 26M projects are shared in the Scratch platform.

As an attempt to empower and assist the forms of non-typical education of teachers and students of the Greek educational system, the Educational Content Methodology & Technology Laboratory (e-CoMeT Lab) of the Hellenic Open University (HOU) has organized, implemented and participated in a number of educational program during the past years. Staring with the Scratch for Teachers, a 5 weeks' distance learning course for primary and high school teachers, with about 6000 applicants, 3800 participants and finally 3000 trainees. The program aimed in learning teachers to use the Scratch programming environment. The project was founded by the Google Computer Science for High School (Google CS4HS). Next, e-CoMeT participated in the European Code Week 2015, by designing and implemented a blended learning course where approx. 100 trainees (high school teachers) attended 3-hour workshops on JavaScript, HTML, CSS, Scratch, Arduino microcontroller, Raspberry microprocessor, and Microsoft Kinect camera, and studying the educational material available on the website of the project. In the sequel, a 7 weeks' blended learning course has developed in Moodle for aiding teachers to acquire basic programming

skills. The course was divided into teaching cycles, one cycle for ca group of prefectures of Greece. There were approx. 2400 applicants, 860 of them finally participated and 560 of them completed the course with success, All the participants were teachers in schools of the primary and secondary education, or they could potentially work as teachers. Moreover, a number of active teachers transferred their knowledge to their students (about 270 students) in schools. The program was funded by the Stavros Niarchos Foundation (NSF).

3. The Junior Coding Academy project

Junior Coding Academy (JCA) is an initiative which running from February to December 2017 and offers scratch programming, scratch game development and scratch programming for the Arduino microcontroller, to school students. The project is running in Western Greece, in the widest region covering Northern and Western Peloponnese as also Aitoloakarnania. Based on their programming competences and their teacher's guidance, students follow a suitable course in order to develop their programming skills, combining programming on computer and electronic circuitry design.

The targets groups of the project are students aged 10-16, coming from various socioeconomic backgrounds, mainly from rural areas, girls (at least 60% of the students will be girls) and refugee/migrants children (at least 15% of the students will be refugees/migrants). The direct aims of the project are to help students acquire solid coding skills, to engage at least 600 students, to helping closing the gap between genders, to engage refugees/migrants children who are currently integrated in the Greek educational system, and to produce online teaching materials, that will be made available to the educational community (via Creative Commons License).

JCA is possible through a collaboration between InterMedi@KT Non-Profit Organization, and the e-CoMeT Lab of HOU. InterMedi@KT is a non-profit organization working as a broker for vocational education, training and innovation, aiming at supporting, inspiring and empowering actions of evolving business and entrepreneurship.

3.1 The design of the courses

The course is designed and implemented by following a blended learning methodology, where teachers enroll an e-learning platform (available at http://juniorcodingacademy.gr/), attend the courses and then transfer the lesson to their students. Based on their students' programming competences, teachers follow the most suitable course in order to develop their students' programming skills. The courses run during or after the school and each course can be completed in three or four weeks. Finally, a student contest will be established with various gifts for the teams with the most original ideas and creations.

The e-learning platform offers three courses which each one can be individually realized but they are also interconnected: (i) Introduction to Scratch. (ii) Games and Scratch, and (iii) Block and Arduino. Through these courses, students develop basic programming skills and apply their knowledge to create games making that way the learning process a fun experience. At the next step, they are able to combine programming on circuit design, robotics and STEM. Through these steps, the Scratch programming language acts only as a tool to introduce students to algorithmic notions and develop programming skills.

The structure of the course follows the topics format (3 to 5 topics, depending on the course). Each topic is a distinct educational part of a wider curriculum which is designed to introduce participants to the educational subject. In two of the three courses, each topic is further subdivided into sub topics for better understanding. Each sub-topic consists of a video presentation through which the various concepts are taught as well as multiple activities that the trainees should accomplish in order to evaluate the acquired knowledge. The third course follows the same flow with the exception that it is not divided into subsections.

At first, in all the courses, the teacher has to be familiar with the weekly objectives of the course. In a next level he can use the educational materials in the classroom with his students either through the predefined learning path that the instructors of the e-learning platform suggest or in a free manner, adapting them to the needs and the understanding of the class. Regarding the management of the topics from the participants, there is no time restriction or any kind of restriction in carrying out the activities. Each topic starts with a one-week delay in specific dates. When participants gain access to a topic they can go through the material without any limitation. This means that a participant can go through the material of a previous week countless times.

Each course requires specific tools (mainly online) in order to be accessed. In courses 'Introduction to Scratch' and 'Games with Scratch', the participants have to use the scratch.mit.edu platform (the online tool) as the main tool for supporting the learning process. They can develop their work in this platform and just submit it to the e-learning platform. If someone prefers, he can download the offline tool for Scratch programming and use it as well. In course 'Block and Arduino', the participants have to use the tinkercad.com platform (the online tool) and Arduino IDE (offline tool) as the main tools for completing the virtual part of the labs. After that, they have to use Arduino UNO for the hands-on part of the lab. Each lab consists of a 'studying educational content' part where participants should go through the educational material (usually video and pdf) and a hands-on part where they have to simulate a circuit and programming it and after that they have to construct it with real material like switches, cables and resistors. In this part they can experiment by changing electric components and programming parameters.

Courses were developed using Moodle, a popular open source Learning Management System suitable to manage its training content and allow for communication and interaction among students and teachers. Moodle can be used as a focal point for online collaboration or a repository on self-study courses and materials. It can contain collaborative and synchronous courses or independent and self-paced courses. It is an open-source platform and distributed under the GPL General Public License, while numerous plugins are available by the Moodle community and extend the standard version. The Hellenic Open University (HOU), uses Moodle to offer services to the entire population of students and tutors since the academic year 2013-14.

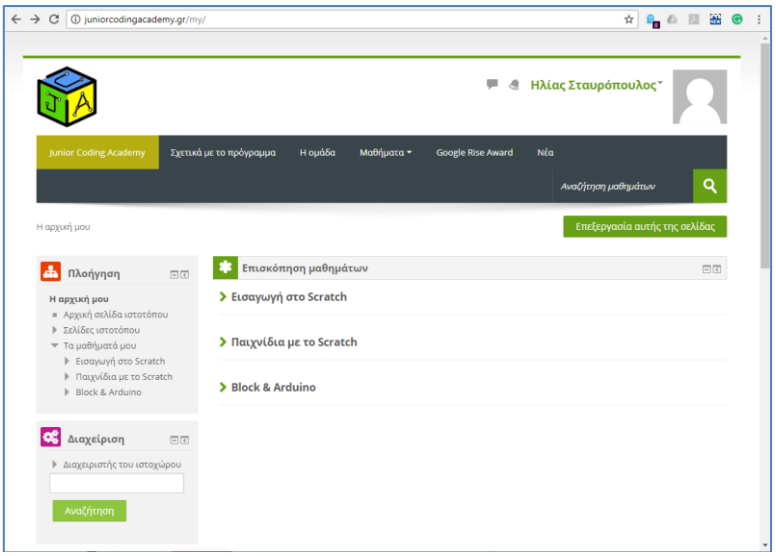

Figure 1 The Junior Coding Academy e-learning platform

To support the courses, modern technologies and tools were used on top of the Moodle platform as part of a constant research for supporting online courses and offering new learning experiences to learners. The built-in quiz module and the interactive content h5p tools were used in order to create the quizzes of the platform. The h5p tools extend the capabilities of the quizzes in a more playful and interactive way. The YouTube platform was also selected for supporting the video sharing part of the courses. Finally, JavaScript, html and css technologies were used for supporting the built-in components of the Moodle platform in order to increase the degree of interaction of the participants with the content. A snapshot of the platform is given in Figure 1.

Acknowledgment
JCA is funded by Google Rise Award 2016. The Google RISE Award is a program for non-formal education organizations around the world that promote computer science (CS) for K-12/pre-university age youth that are traditionally underrepresented in Computer Science.

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