Supporting students' construction of programming mental models with e-books: The case of Computer Science e-book

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Abstract

Teaching programming to lower secondary education students constitutes a very interesting task with particular difficulties in relation to the other subjects in the Curriculum. Students' difficulties in algorithmic thinking and using programming objects for problem solving are well-known and documented in the literature. The key point is that, in computer programming, students need to think about problems, algorithms and data in ways that are quite different from those in regular cognitive activities in the classroom. Constructivist learning approaches determine the prevalent paradigm when teaching computer programming to novices. A series of programming languages and environments have been created for educational purposes. They have been used to support constructionist approaches to students' learning and development in algorithmic thinking and programming skills, e.g. Logo-like languages, programming micro worlds, visualisation programming environments etc.

In addition, e-books are considered as a promising technology for education offering opportunities to extend learning spaces beyond the boarders of traditional classrooms. They are digital format textbooks, enriched with multimedia and digital material, simulations, various resources, interactive applications, learning scenarios etc.

This presentation concerns the Computer Science e-book for Greek lower secondary schools and the affordances offered, for both students and teachers, in introductory programming. The e-book was created in the framework of Digital School programme, a great national and EU funded project implemented by the Computer Technology Institute and Press "Diophantus", under the aegis of the Greek Ministry of Education. Following, indicative examples related to the unit of Algorithmic and Logo programming are given, which can be easily integrated in educational practice to support constructionist learning activities:

Algorithmic: This application is a simple programming environment for the construction of algorithms able to draw simple and complex geometric shapes. It is a Java applet aiming a) to familiarize students and novice programmers with algorithmic thinking and b) to build efficient mental models of the loop structure. The programming engine is implemented using a small set of simple drawing commands in a Cartesian coordinate system (line draw, colour, variable initialisation, calculation and loop commands).

Stepwise programming: This application is an educational game environment helping students to construct the notion of stepwise execution of a program using a small set of commands. The execution space consists of a 10x15 grid of squares which are placed in a way to receive the
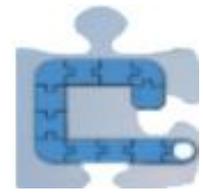
structural blocks, following the basic game rules of Tetris.

Drawing with Logo: This application incorporates features that help students to familiarize with a Logo-like programming environment and to develop algorithmic thinking skills. It offers enhanced opportunities for the teachers to design constructivist activities aiming a) to help students in introductory programming lessons and b) to support them to construct effectual representations and mental models regarding programming concepts and notions (e.g. loop command, procedures etc.)

Keywords

Constructionist learning, e-books, programming knowledge, algorithmic, mental models

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