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Electronic Notes in Theoretical Computer Science
ELSEVIER
Electronic Notes in Theoretical Computer Science 224 (2009) 151–158
www.elsevier.com/locate/entcs

PathFinder: A Visualization eMathTeacher for Actively Learning Dijkstra's Algorithm

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Abstract

PathFinder is a new eMathTeacher for actively learning Dijkstra's algorithm. In [12] the concept of eMathTeacher was defined and the minimum as well as some additional requirements were described. The tool presented here is an enhanced paradigm of this new concept on Computer Aided Instruction (CAI) resources: an application designed following the eMathTeacher philosophy for active eLearning. The highlighting new feature provided by this application is an animated algorithm visualization panel showing, on the code, the current step the student is executing and/or where there is a user's mistake within the algorithm running. PathFinder also includes another two interesting new features: an active framework area for the algorithm data and the capability of saving/retrieving the created graph.

Keywords: eMathTeacher, eLearning, Active learning, Constructive learning, Interactive Java applications, Computer Assisted Instruction (CAI).

1 Introduction and Preliminaries

Graphical and dynamic web based tools are more appealing for students than traditional learning materials. It has been confirmed that learners spend much more study time when visualization is involved; however, there has been some skepticism about the real value of visualizations as a pedagogical tool. Many educators think that visual tools enhance their lectures and significantly increase student's comprehension, but such tools are of little effectiveness when students are not actively engaged in the learning process [6]. Furthermore, when students are not required to wonder about the concepts, to provide answers and to predict what is happening

[1] This work has been partially supported by UPM (Spain) under Project No. IE07 1010-029.
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doi:10.1016/j.entcs.2008.12.059

next, they might adopt a passive attitude that is not beneficial at all, and may even be harmful for their training. The analysis presented by Hundhausen et al. [3] asserts that "*how* students use AV technology, rather than *what* students see, appears to have the greatest impact on educational effectiveness" and their study "suggests that the most successful educational uses of AV technology are those in which the technology is used as a vehicle for actively engaging students in the process of learning algorithms". They concluded that, those who are actively engaged with the visualization have consistently outperformed the other ones who passively viewed them. Thus, in order to avoid a passive attitude, during the execution, the program should interact continuously with the users, forcing them to predict the following step.

In [1], the authors state that a "consciously designed approach informed by a constructivist view holds the most potential for effective online learning designs"; and that "learners must construct their understanding through an active process building on past experiences and knowledge and that knowledge cannot be simply accepted from others". According to this opinion, we believe that active learning is the only effective way of acquiring knowledge and that students cannot only look how the processes evolves, but they must get involved in the process itself.

The challenge of discovering new ways to motivate students in active learning encouraged us to develop a new kind of web based tools. Our main goal has been to get students involved, as actively as possible, in their learning process. With this objective in mind, we have been developing several interactive Java applets, that allow visualized execution of algorithms ([13], [10] & [14]). Those applets have been designed under the eMathTeacher philosophy and are being used as complementary material for blended learning (bLearning) [13] both for teachers on classroom lectures and students when learning by themselves. This way, the power and effectiveness of face to face teaching are boosted with the flexibility and technical capabilities of eLearning, turning out the students into the protagonists of their own learning progression.

In the next sections, we review the definition of eMathTeacher as well as its main requirements. This kind of application introduces a new concept in computer aided education as they can act as genuine virtual trainers extending the teacher's hand through the Web.

1.1 eMathTeacher Definition

An eLearning tool is eMathTeacher compliant [12] if it works as a virtual maths trainer. In other words: if it is an on-line self-assessment tool that help users to actively learn math concepts or algorithms by themselves, correcting their mistakes and providing them with clues to find the right solution.

They can also be applied as bLearning complementary material for being used both by teachers on classroom lectures and by students when learning maths by themselves. However, the most important feature of these tools is the feasibility of being used for practicing with maths methods or algorithms while the system guides the user towards the right answer.