

# Adaptive Hypermedia Research at the Department of Informatics, University of Piraeus

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## DESCRIPTION OF THE RESEARCH GROUP

Dr. Maria Virvou (<http://www.unipi.gr/faculty/dep.php?dep=mvirvou>) is an Assistant Professor at the Department of Informatics, University of Piraeus. She is an active researcher in the area of adaptive educational systems and she has established a relevant research group at the same department. The research group consists of three research fellows, Dr. Maria Moundridou (<http://thalis.cs.unipi.gr/~mariam>), Dr. Victoria Tsiriga (<http://thalis.cs.unipi.gr/~vtsir>) and Dr. Katerina Kabassi (<http://rainbow.cs.unipi.gr/~kkabassi>), and five Ph.D. students, George Katsionis, Konstantinos Manos, Kalliopi Tourtoglou, Eythymios Alepis and Leondios Perdicaris.

## RESEARCH AREAS

Adaptivity is a very important feature for the educational effectiveness of educational software. This challenging goal has motivated in the recent years a number of research groups to engage in research on adaptive educational systems. As a result, quite a lot of adaptive educational systems have been created that propose the use of various methods and techniques. In this paper, we present the approaches that our research group has taken to deliver adaptive software that is educationally beneficial to students. The main research areas where our work has focused include adaptive authoring tools and learning environments, student modeling, the software engineering process of adaptive educational software and evaluations of adaptive systems.

### Adaptive authoring tools and learning environments

Authoring tools provide authoring environments where human instructors may be given a combination of facilities to produce courses for multiple domains. The main problem is that the methods used in the authoring tools have to be as domain-independent as possible and at the same time the resulting educational applications should support the individual learners' needs in every particular domain. In view of the above, a domain-independent student modelling approach is presented within the context of an authoring tool (Virvou, 2003). As a result, adaptive tutoring may be provided automatically based on either the student's missing pieces of domain-specific knowledge or his/her incorrect reasoning. In (Virvou & Alepis 2004a) the problem of mobile authoring of adaptive mobile educational applications is explored through a mobile authoring tool.

In (Moundridou and Virvou, 2001) we have presented a domain-independent component that focuses on authoring and delivering web-based textbooks using a tool called WEAR. These textbooks offer navigation support to students, adapted to their individual needs and knowledge. Using WEAR as an example, we have proposed a novel architecture for adaptive authoring tools

that incorporates an instructor modelling component, which is used to model the needs, preferences and knowledge of instructors and provide individualised support.

In (Virvou et al. 2002), authoring of adaptive educational applications focuses on virtual reality educational games. In (Virvou & Katsionis, 2003) error diagnosis is combined with affective characteristics of users' behaviour so that adaptive support may be offered. In this way the content of the tutoring may be adapted to the cognitive and emotional needs of individual students. In (Virvou & Manos, 2003), principles of cognitive psychology have been adapted for the modelling of the memory capabilities of student-players so that the system may adapt its decisions about which part of the theory should be presented to students for repetition and revision.

### **Student modelling**

Student modelling is of vital importance for the adaptivity of the educational systems because it guarantees personalisation of tutoring. In (Kabassi & Virvou, 2003) we have provided a novel architecture for student modelling over the web that is based on the very recent technology of Web Services. In this architecture, we address the problem of updating the individual long term models of students using networked PCs without losing any important piece of information. In (Kabassi & Virvou, 2004) we use a Multiple Attribute Decision Making (MADM) technique that takes into account several criteria concerning the student's cognitive state in order to produce advice adapted to the student's needs that are implied by the criteria. MADM techniques have not been used in student modelling despite the fact that the problem of adaptivity is of a multi-criteria nature.

Another contribution of the research group in this field involves the initialization of the student models. More specifically, we have introduced a framework for the initialization of the student model in Web-based AHES, which is called Initializing Student Models (ISM) framework (Tsiriga & Virvou 2004b). The ISM framework is a methodology that uses an innovative combination of stereotypes and the distance weighted k-nearest neighbour (k-NN) algorithm (Dudani, 1976) to set initial values of all aspects of the student model.

### **Software engineering process of adaptive educational systems**

To design a successful and effective authoring tool for adaptive educational applications, one must perform a careful and extensive requirements analysis in which both instructors and students should be involved. In (Moundridou & Virvou, 2003) we reported on an empirical study that we conducted in order to design and develop WEAR. In the three phases of the study we investigated several aspects concerning the attitude and behaviour of both classes of prospective users.

In (Virvou & Kabassi, 2003) we present and discuss the development process of an adaptive learning environment throughout its life-cycle. Special emphasis has been put on presenting the experimental studies that were conducted and used for the requirements analysis, design specifications and empirical evaluation of the user model and the system. (Virvou & Tsiriga, 2002) describes the application of an object-oriented model of life cycle in the development of an adaptive tutoring system and highlights the important role that teachers and students may play in it.

### **Evaluation of adaptive systems**

The evaluation of adaptive educational systems is a very important phase of their construction. Therefore, all the above mentioned applications were evaluated in terms of their effectiveness. More specifically, the evaluation of the generic framework of the initialisation of the student models is described in (Tsiriga & Virvou 2004a) and the likeability of games for educational purposes was tested in (Virvou, Katsionis & Manos, 2004).

A study was conducted in order to examine the necessity and added value of the existence of an instructor modelling component in WEAR's architecture (Moundridou & Virvou, 2002) whereas a different experiment focused on the user interface of the educational applications that result from

WEAR. Finally, the degree of usefulness of mobile facilities both for students and teachers who wish to manage their courses is tested in (Virvou & Alepis 2004b).

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