

E-Questionnaire for Innovative Adaptive-Learning Scheme

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INTRODUCTION AND BACKGROUND

As broadband connectivity to the Internet becomes faster, Web-based learning systems have appeared and play an important role for self-learning, especially for working people. Most of the systems are not adapting to the learner, so the learner has to spend a lot of time before reaching the learning goal that is suitable for him or her (Solomos & Avouris, 1999). This procedure may discourage the learner from continuing his or her studies (Bixler & Spotts, 2000; Fitzelle & Trochim, 2000).

To overcome these difficulties, we have to design an e-learning system that will be adapted to the learner's ICT level and knowledge. In our proposal, we introduce an e-learning schema that has these characteristics. Specifically, we consider the IEEE reference model (WG) of the Learning Technology Standards Committee and use it to model the architecture of an e-learning system. Our approach is based on the usage of electronic questionnaires (e-questionnaires) that are designed by experts and aim to detect the learner's ICT level and learning preferences prior to the learning experience as well as after its completion. Through the analysis of learner responses to questionnaires, learners may be assigned to their corresponding learner profiles so that they are served with learning material that best matches their needs.

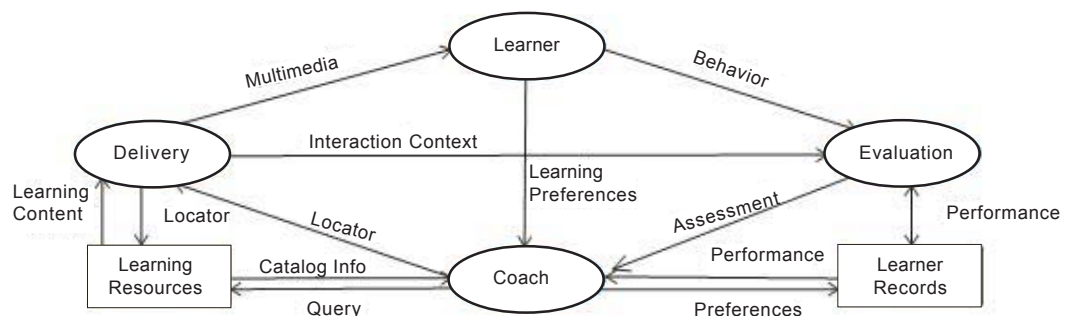
The structure of the article is the following. In the first section "Description of the E-Technology Application," we briefly present the generic structure of the e-learning system, as specified in the IEEE reference model (WG) of the Learning Technology Standards Committee, and then we present our approach to this model. Continuing, we outline the profile adaptation method that is used in our schema. Finally, in the section "Impact of the E-Technology Application," we refer to the SPERO project, in the framework in which the proposed system is being applied, and finally we list our concluding remarks.

DESCRIPTION OF THE E-TECHNOLOGY APPLICATION

Learning Technology Systems Architecture by IEEE

The proposed system is based on IEEE P1484.1/D9, the draft standard for a learning-technology system architecture (LTSA; IEEE P1484.1, n.d., <http://jtc1sc36.org>). This standard identifies a high-level architecture for e-learning systems that includes processes, stores, and flows as is depicted in Figure 1, and describes the interaction between these modules.

Figure 1. IEEE 1484.1 LTSA system components



This system, which could be adaptive for any educational course, contains two stores: learning resources and learner records. The learning resources store is invoked using a database that represents knowledge, information, and other resources that are used in the learning experiences. It may be represented as a collection of presentations, tutorials, experiments, or lessons. The other store of the IEEE LTSA system, the learner records, contains information about the learner as assessment information and certifications that the evaluation and coach processes have derived.

The learner entity, coach, evaluation, and delivery processes each have a main role in the system.

The main entity of the system is the learner entity, which represents a single learner or a group of learners with different needs. The learner process receives a multimedia presentation via the multimedia flow, which has been retrieved from the learning resources by the delivery process.

While the multimedia presentation is shown to the learner, his or her behavior and reactions are observed via the behavior flow, which provides information about the learner's activities. Information as keyboard clicks or mouse clicks is recorded in real time by the behavior flow and is used to evaluate the results of the learning.

The learning preferences flow is negotiated with the coach process based on language and cultural adaptation, as well as accessibility for people with physical limitations. The learner entity's observable behavior flow is an input to the evaluation process. The interaction context flow is a data flow from the delivery process to the evaluation process that may provide the necessary information for interpreting the information contained in the behavior data flow.

On the one hand, the evaluation process produces assessment information, which is sent to the coach process. On the other hand, the evaluation process creates performance information that is stored in the learner records. Performance information may come from both the evaluation process (e.g., grades on lessons) and the coach process (e.g., certifications). The coach may receive performance information from the learner records at any time. Performance information, such as assessment information and certifications, and preferences may be stored in the learner records by the coach process.

Based on this information, the coach process may generate queries and forward them to the learning resources store in order to request learning materials that are appropriate for each learner. The learning resources store replies to the coach process with catalog info flow, that is, with a list of locators that match the search query. The delivery process to retrieve learning content may use these.

Finally, the delivery process transforms information obtained, using the learning content store, into a presentation, which may be transferred to the learner entity, passing through the multimedia stream. The evaluation process that is described in the LTSA draft standard is not apparently adaptive to the learner as there is no mechanism that could provide this adaptation. In the proposed schema, we attempt to outline the procedure through which the LTSA draft standard may be applied with the direction of learner-centered content delivery. Our approach to understanding the learner's needs is outlined in the following section.

A NEW APPROACH TO LEARNING TECHNOLOGY SYSTEMS DESIGN

The presented procedure evolves around the notion of the e-questionnaire with the aim of the detection of the learner's learning preferences and ICT level, with respect to a specific learning topic. Through this procedure, learner adaptation to the proper learning topic and course can be achieved using an e-questionnaire. Our proposal could be considered as an extension of the IEEE LTSA draft, adding two stores, the questionnaire and learner profiles, and two processes, the e-survey and the experts' group, and enriching all modules that the IEEE LTSA contains with new functionalities with the purpose of effective collaboration between them (Figure 2).

In our case, the learner entity represents a teacher who works in the special educational needs sector (<http://www.image.ntua.gr/questspero>; Tzouveli, Tsapatsoulis, Kollias, & Michaelidou, 2003). The expert-group process is represented by a variety of people, such as teachers, teachers of the special-education sector, experts in e-learning, data analysts, psychologists, and software engineers. In our case study, the experts' group has designed and illustrated e-questionnaires, which are addressed to the teachers in the special educational needs sector and are intended to collect information for teachers' educational background, as well as their background in ICT. In addition, information concerning teachers' opinions about the pedagogical utilization of ICT and the amount of ICT they use in the teaching procedure are also extracted from these questionnaires.

It is noticeable that the experts' group is responsible for determining the learning issue that the e-learning schema can provide and for the learners' group in which this learning subject is addressed.

The questionnaire store is a database that contains various questionnaires designed for diverse educational needs and types of learners. Each of these questionnaires

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