

Towards a framework for effective web-based distributed learning.

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ABSTRACT

Developing web-based learning materials gives rise to a number of pedagogic problems. Learners are highly diverse in respect to their pedagogical requirements, and the implementation of an effective web-based learning strategy must avoid placing a heavy technological burden on IT-naïve academics.

A solution to both of these issues may be provided by software systems known as Integrated Learning Environments (ILE). WHURLE (Web-based Hierarchical Universal Reactive Learning Environment) is an XML-based ILE that is designed to adapt to individual learner profiles, thus redressing some of these major problems with most web-based learning.

Keywords

Integrated learning environments, education, distributed learning, adaptive hypermedia, XML.

1. INTRODUCTION

Ever since its early days the WWW has been used as a vehicle for distance and distributed learning. In recent years a number of generic software solutions known as Integrated Learning Environments (ILEs), have emerged to facilitate this. ILEs are usually designed to be discipline-independent, and thus hold out the prospect of greatly simplifying the process of implementation by partly automating the delivery of content and (to a greater or lesser extent) the burden of pedagogical design.

There is no doubt that the WWW is extremely good at delivering both information resources and declarative exposition. However these forms of delivery constitute only one component of an effective learning process. Laurillard [1] has suggested that learning is best modelled by “conversational” interactions between students and their teachers. At the heart of this model is an iterative process of dialogue in which both student and teacher describe their conceptions of the focal issue or topic, and the teacher responds to the student’s input “adaptively” in accordance with perceived

need. Although this adaptive model can, in principle, be implemented on the WWW, in practice such sophistication is rare.

One of the principal pedagogic weaknesses of the vast majority of ILEs is their “static content” – i.e. the system subjects all students to much the same pedagogical experience, regardless of their personal abilities and learning requirements.

2. THE NEED FOR ADAPTATION

In any given group of students there is inevitably a substantial variation between individual abilities, motivations and goals. More subtly there are also large differences between their methods of learning and their preferred learning styles [2]. Not only are these preferences diverse, they are also highly changeable [3]. This is especially important in the light of a detailed quantitative evaluation of web-based learning [4], which showed that a static WWW can have a polarising effect upon students of different abilities. Although some students undoubtedly benefit from this type of learning, others were found to be systematically disadvantaged.

These problems may be addressed by the use of adaptive hypermedia technologies. Systems that embody adaptability employ user modelling as the basis for adjusting either content or navigation to individual pedagogical requirements. A number of adaptive hypermedia systems have been developed for the WWW, and these have been extensively reviewed by Brusilovsky [5].

The major pedagogic limitation of most ILEs is their inability to ‘adapt’ to the learning style preferences, or abilities, of individual students. The content is usually ‘learner centred’ in its design, and so students are expected to study it in their own way and at their own optimal pace until the learning objectives for each study unit have been achieved. Frequently there are tools to assist them in making a judgement about whether or not specific learning objectives have been fulfilled (for example they may well be provided with continuous access to an online library of multiple-choice questions related to the material under study). However, while alternative interactive pathways

are available to different learners, the organisational structure and presentational style of the pedagogical content remain static, regardless of the personal abilities and learning preferences of the student.

3. THE WHURLE FRAMEWORK

We are currently involved in an adaptive ILE development program that uses XML technology to implement the key requirements outlined above. This environment models the teacher-learner dialogue described by Laurillard [1] and is capable of adapting to learner needs. The content is structurally predisposed to mass-production, reusability and global dissemination. We have currently developed a prototype XSLT (eXtensible Stylesheet Language Transformations) implementation of this framework called WHURLE (Web-based Hierarchical Universal Reactive Learning Environment).

WHURLE is completely independent of both the content it is delivering, and the context of its use, and will ultimately provide a complete suite of learning support tools that are general enough to allow for a very wide range of pedagogies. Content will be specified by non-technical domain experts using easy-to-use writing/editing tools, and every effort will be made to ensure that the system is easy to use by both teachers and learners.

Most current web-based ILEs require the use of HTML, with authoring tools that are either simplistic (which severely limits the pedagogic design), or very demanding in terms of the technical expertise they require, making them impractical for many non-IT-literate authors. Also some of them produce complex HTML that is difficult to maintain or repurpose. These problems are compounded by the fact that HTML freely mixes style and content, which frequently makes it difficult to mine, maintain or reuse this material. XML addresses these problems, by cleanly separating style from content.

The adaptive components of the WHURLE architecture are dependent upon the concept of conditional transclusion. Transclusion is a component of Nelson's original vision of hypertext that he has recently described as the "heart of connection" [6]. However, despite the fundamental importance of transclusion in his vision, it is still one of the more rarely implemented aspects of hypertext. Transclusion consists of the dynamic inclusion of an arbitrary component of one document inside another. In WHURLE the content is adapted to the needs of users by the use of a simplified model of transclusion to create "virtual documents" visible only to the learner. Conditionality in this context is dependent on information stored in user profiles, which is used transparently to create these "virtual documents". This allows the dynamic construction of both content and user interface to match the needs of the particular learner, in direct contrast to the imposition of inflexible systems, which is the case with most ILEs.

Information in the user profile can be gained from both explicit and inferred sources. Examples of the former are filling out a registration questionnaire, or the scores achieved in domain-

specific multiple choice quizzes. Examples of inferred sources are the use of click-through rates, page dwell time, and the kind of information requested by the user (as defined by both content domain and pedagogic style). The aim of WHURLE profiling is to store information about a user's domain preferences (including their abilities within these domains) and their learning style preferences, of which they may well not be consciously aware.

4. ACKNOWLEDGMENTS

We are most grateful to Peter Murray-Rust, and Helen Ashman for many useful discussions. We should also like to thank Will Trehwella and Kevin Caley for all of their help and support during this work.

We are also grateful to the staff of the Department of Ecology and Biodiversity of the University of Hong Kong for their enthusiasm and support in the development of pilots for this project.

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