Adaptive Web-based Textbooks

(panel)

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Discussion Topic

Hypermedia systems have enabled authors to break free from the linear presentation structure enforced by the world of physical (paper) books. The Web has further enabled authors to bring hypermedia documents on-line, so that they can reach a much wider audience. As a consequence, documents also reach an audience with widely varying interests, background, (hypermedia) experience, etc. In order to provide the most appropriate information to all users, and present it in the most suitable way, documents must be *adapted* to target user groups or even individual users. Adaptive hypermedia provides the methods and techniques to perform this adaptation automatically (instead of purely based on a questionnaire to be completed by every user).

Adaptive hypermedia has been applied in many application areas, but a large majority of all adaptive hypermedia applications is used in education. While it is not often named as such, most learning material that is available on-line can be viewed as an extension of the concept of a textbook. (Extensions may include search facilities, automatic evaluation of exercises or assignments, progress feedback, etc.) The panelists have all been involved in the creation and use of *adaptive* on-line textbooks. The panel discussion focuses on the experience with different adaptive methods and techniques used in these applications. Experience with a single specific adaptive application cannot lead to conclusions that are guaranteed to carry over to a different application area or the use by a different type of audience. Therefore the aim of this panel discussion is to find common experiences that suggest a more generally applicable pattern (that should be verified through future research) as well as contradicting experiences that suggest that the perceived influence of adaptation might actually be something that was specific to the application area, the audience, or the course topic. Although the four panelists together will present different angles of adaptive textbook creation and application, active participation of the panel attendees is needed to collect and discuss more different experiences with adaptive educational course material. Because the WebNet conference proceedings are produced in advance, the outcome of the panel discussion, including the expected participation of the audience, cannot be included here.

Background: Methods and Techniques for Adaptive Web-based Textbooks

Most textbooks have a structure that appears to be hierarchical (with chapters, sections, subsections, etc.) but that also provides one clearly suggested reading order. Of course it is possible to dive right into chapter 4, but most readers will not be surprised when this chapter uses terms and concepts they are not familiar with. The reader will automatically assume that the difficulty in understanding chapter 4 is caused by not having read chapters 1 through 3 and that it is really the reader's fault. Very few people expect a textbook to be clear for readers who ignore the suggested reading order. Learners have very different expectations from a hypermedia or Web-based textbook. When the reader sees a table of contents in which chapter and section titles are links, he or she expects that the author has intentionally made these links available to enable users to start (or continue) the reading process in any desired chapter or section. This not only sounds but actually is too good to be true. It is virtually impossible to write a textbook in which the chapters and/or sections can be studied in any arbitrary order. And in a rare case where it would be possible, it is certainly a lot of work to write the textbook with many different reading orders in mind. Adaptive methods and techniques come to the rescue. An Adaptive Web-based textbook can monitor what the learner reads, possibly also which tests or assignments the learner completes, and can adapt the presentation accordingly. This adaptation is generally done in two ways:

- **Adaptive presentation:** the information and/or the way it is presented is adapted to the user. When the system notices that the user visits a page in which a concept is used that the user does not yet know about, it may insert a (short) explanation to compensate for the missing foreknowledge. This adaptation method is sometimes referred to as adding a *prerequisite explanation*. Likewise, it is possible to provide an *additional explanation* of certain details to advanced users, or to show a *comparison* with other concepts, for users who are already familiar with these other concepts. Different techniques are used to create adaptive presentations. A simple technique is to use variants of information pages. Unfortunately this leads to duplication of the information that is common to each variant. An alternative technique is to use conditionally included fragments. For the inclusion of additional details one may also opt to always include the material but "shade" it for users who should probably skip these details. Techniques are plentiful, but it remains to be seen how useful they are, and whether the help they provide outweighs the potential problem that different users receive a different presentation of the same page, or even that the same user gets different presentations of a page at different times.
- **Adaptive navigation:** the links and/or the way links are shown is adapted to the user. When the system detects a link on the "current" page, leading to a page that requires prior knowledge the learner does not yet possess, it may alter the link or its presentation so as to warn the user that the link's destination is not (yet) desirable. By suggesting which are "good" links to follow and which are "bad" links, the system offers *guidance* to the learner. Different techniques have been tried to offer such guidance. A commonly used technique is *link annotation*, which means that good and bad links are presented in a different way. The "traffic light metaphor" uses a green link anchor or icon to indicate that a link is recommended, red to indicate that the user is not well-prepared for visiting the link, and yellow to indicate that the link does not lead to new information. Another technique uses *link hiding*. It is similar to annotation, but "bad" links are presented without a visible link anchor. The link may still work, but because it does not look different from normal text the user will not notice it. Yet another technique, mostly used with lists of link anchors, is to sort the links from most to least relevant. Web users know very well that a list is a suggestion to first follow the topmost link and work your way down. More techniques exist, but here also it remains to be seen how useful they are in general. (Research has shown they usefulness in specific cases already.)

The interested reader can find more information on adaptive hypermedia and adaptive web-based systems in the two references below.

References

Brusilovsky, P. (2001) Adaptive hypermedia. User Modeling and User Adapted Interaction 11 (1/2), 87-110, http://www.wkap.nl/oasis.htm/270983.

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About the Panelists

Prof. dr. Paul De Bra received his Masters degree in mathematics (1981) and Doctorate in computer science (1987) from the University of Antwerp. He is full professor in Databases and Hypermedia at the Eindhoven University of Technology. He has been researching database theory, hypermedia models, browsing semantics, and adaptive hypermedia principles and systems. He is author of an adaptive course on hypermedia that is offered (through the Web) to students of different universities in the Netherlands and Belgium. He is currently investigating a model for "general-purpose" adaptive hypermedia, and developing the "general-purpose" AHA! (adaptive hypermedia architecture) system. He also hosts the (global) Adaptive Hypertext and Hypermedia Homepage (at http://wwwis.win.tue.nl/ah/) and the Adaptive Hypermedia mailing list. He is program chair of the second International Conference on Adaptive Hypermedia and Adaptive Web-based Systems (AH2002, Malaga, Spain).

Dr. Peter Brusilovsky graduated (with honour) in applied mathematics (1983) from the Moscow State University, where he later obtained a phd in computer science (1987). He is now an assistant professor at the University of Pittsburgh (School of Information Sciences) and an adjunct research scientist at the Human-Computer Interaction Institute of Carnegie Mellon University. His research interest include adaptive web-based systems, intelligent tutoring systems and shells, student and user modelling, human-computer interaction and artificial intelligence. He is author of the (adaptive educational) Interbook system and the influential overview article "Methods and techniques of adaptive hypermedia" (User Modeling and User-Adapted Interaction, vol. 6, nr 2-3, pp. 87-129). He was program chair of the first International Conference on Adaptive Hypermedia and Adaptive Web-based Systems (AH2000, Trento, Italy), and is considered one of the leading experts in the field of adaptive hypermedia.

Dr. Tom Murray has degrees in education (EdD, MEd), computer science (MS), and physics (BS). He has been researching, publishing, consulting, and leading workshops on the subjects of authoring tools, knowledge acquisition, and knowledge representation for advanced technology instructional systems since 1985. He is currently visiting professor of instructional technology at Hampshire College, and director of the Hampshire College Digital Design Center. His research interests include adaptive hyperbooks (the MetaLinks project), Intelligent Tutoring Systems (ITS) authoring tools (the Eon project), and glass box simulation based learning environments for inquiry learning (the SimForest project). In general his research has focussed on designing systems that allow practicing educators and instructional designers to participate more completely in the design of advanced technology instructional systems. He has also published papers in the areas of ITS ontologies, ITS interoperability and reusability, distributed models of curriculum, exploratory evaluation of software, example-based strategies for teaching concepts, and the representation of instructional strategies.

Dr. Marcus Specht received his Diploma in Psychology in 1995 and a Dissertation from the University of Trier in 1998 on adaptive learning technology. Marcus Specht currently works as a senior scientist at the GMD German National Research Center for Information Technology. His main background is in the field of cognitive science, intelligent tutoring systems and the integration of ITS and Web-based tutoring. He was involved in the design, the implementation, and the evaluation of personalized eLearning technologies and adaptive hyperbooks in several projects in the last years (ELM-ART, Interbook, ACE). Currently he coordinates the group on personalized eLearning in the department on Information in Context (ICON) in GMD-FIT. The group develops a highly scalable eLearning platform for design and architecture in the European WINDS (http://winds-university.org) project of the IST program of the 5th framework. Furthermore he is involved in the concertation activity on learner modelling for personalized instruction in the 5th framework of the European commission and contributes to the developments in the Learner Technology Standardization Committee of the IEEE (IEEE-LTSC). Recently he co-founded bureau42™, a spinoff company of GMD providing personalized eLearning and education brokerage solutions (http://www.bureau42.de). His main research interests are adaptive learning and training systems, knowledge management, contextualized computing, and intelligent interfaces.