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From the editor ..

Welcome to the July 2002 issue of *Learning Technology*. First time, we have started theme-based issue. This issue is guest edited by Dr. Paloma Díaz and Dr Ignacio Aedo, on the theme "Hypermedia and web as learning tools".

The IEEE International Conference on Advanced Learning Technologies, Kazan, Russia (September 9-12, 2002) is turning out to be an interesting conference. The website of the event is http://lttf.ieee.org/icalt2002/. You are most welcome to participate in the conference.

If you are involved in research and/or implementation of any aspect of advanced learning technologies, I invite you to contribute your own work in progress, project reports, case studies, and events announcements in this newsletter. For more details, please refer author guidelines at http://www.ieeetclt.org/content/authors-guidelines.

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From guest editors ..

"Hypermedia and web as learning tools"

In the last years, we are experiencing a rise in hypermedia and web-based applications aimed at supporting the learning and teaching processes. Much has been said about the utility of hypermedia as a learning tool, taking it for granted that both the associative structure of the hypertext and the navigation freedom offered to the students are two helpful learning resources. However, there is also evidence about the fact that free navigation is not always the best strategy to support learning efficiently. Moreover, when hypermedia systems move on to the web arena, new issues arise as the target users become an heterogeneous population whose specific needs have to be addressed. Indeed, many issues have to be considered in the development of a useful hypermedia or web-based learning system and, at the end, developers need to empirically evaluate their approaches in their domain of application to demonstrate their claims. Thus, hypermedia and web are not as mature learning tools as it could be supposed and there is much to explore yet. This special issue of the Learning Technology newsletter is devoted to provide a view of educational applications that use hypermedia, web and related technologies in order to improve the learning process in specific domains.

A first group of papers includes three contributions concerning with links, the most relevant feature of any hypermedia application and whose potential can be used to improve the learning process. In “Link Types as Enablers of Semantic Navigation in Standard-Based Web Learning Systems”, Miguel Angel Sicilia and Elena García describe how to integrate an ontology of links in the SCORM specification. In “Hypertext as a Tool for Building ESL Students’ Reading Skills: A Pilot Study ”, Loretta F. Kasper analysis how to use several types of links in learning environments. Finally, in “Information structure diagrams as link icons” of Lawrie Hunter, it is shown how different kinds of links can be used to represent a map of concepts.

The second group of papers deals with how to use hypermedia to improve the learning process, that is, which kind of structures can help students to reach their learning goals and how to use some hypermedia resources to meet specific pedagogical objectives. In this group, the reader can found the Nada Dabbagh’s paper, titled “The effects of hierarchical versus heterarchical Web-based hypermedia designs on exploration, collaboration, and problem solving in a case-based learning environment”, where the author studies the effects of hierarchical versus heterarchical hypermedia structures of Web-based case representations on four learning variables (comprehensiveness of exploration paths, collaboration, perceived authenticity and complexity of the learning task and case structure). In “Using hypermedia to build web mediated constructivist learning event” , Kathy Skinner gives some clues about how hypermedia events can be used to facilitate active exploration and the construction of knowledge.

An open question in the hypermedia learning environments is how evaluate the courseware. Álvaro Ortigosa and Rosa M. Carro propose a interesting evaluation process in the “Continuous Evaluation of Adaptive Web-based Courses” paper. In “A comparison of computer mediated training tools”, John Paynter evaluates two contrasting flexible learning sites through student surveys.

Finally, the rest of the issue consists of examples of application of hypermedia and web in three different learning scenarios. “Web-Based Resources for Teaching Discrete Mathematics to Students of Information Sciences and Technology” by David R. Mudgett et al. presents a system to teach logic and discrete mathematics to undergraduate students in information sciences and technology. Will Simpson, in “Online learning: a project to develop an innovative approach to control”, shows different business subjects to first year BSc undergraduates. In “Turning the Web into a learning tool”, Giovanni Fulantelli introduces the WBI authoring tool, the interaction mechanisms it provides to students and their benefits for educational processes.

We hope you enjoy this amalgam of different but complementary views about the same topic: how to make use of hypermedia and the web to meet learning needs.

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Turning the Web into a learning tool

Abstract

The Web does not support effective user interaction with information, which plays a key-role in learning process; the lack of efficient support to navigation, the basic state-less http protocol, the author-centered approach to information content and structure are important obstacles to the vision of the web as learning tool. Nevertheless, it is still possible to develop Web-based architectures that can overcome these limits. In this paper, the author reports on a specific web-based instruction system that provides for effective interaction mechanisms.

Introduction

In literature, many limits to the vision of the Web as learning tool have been highlighted. In this paper, the focus is on the obstacles to effective interaction with the information on-line, which is perceived by the author as a major limit to educational applications. With this in mind, one of the most critical aspect is that the Web is extremely author-centered: users can only follow the links established by others, but are not allowed modifying the existing links or adding new ones. A second important limit is that the information provided by the Web servers is usually in the form of web pages identical for all the students of on-line modules, rather than personalized pages. A further obstacle arises from two strictly related issues: reading on line is not a comfortable task and it is not possible underlining and making notes on a screen.

Specific design strategies have been adopted and tools have been developed to improve the interaction in a Web-Based Instruction (WBI) system, thus overtaking the above reported obstacles. Specifically, the developed system allows authorized users (students, teachers and expert guests) to extend the information network dynamically and to handle and re-elaborate the information published on the web pages through specific “working tools”.
To the aim of this paper, the developed WBI system [Corrao et al. 99] is not presented in details; rather, the focus is on the interaction mechanisms implemented on it and their benefits for educational processes.

Extending the Hypertext Network dynamically

Specific tools have been developed to allow authorised users to add new pages and new (internal and external) links to the network. The WBI system stores and provides authorized users with information on the author of each new node and link, as well as all the modifications to the network since their last access.

In order to guarantee a consistent growth of an on-line network, the extension mechanism requires a very precise model of the information domain in such a way that new nodes can be immediately classified in some pre-defined category. Furthermore, some limits to the extension mechanism have been imposed, both at information node and link levels; particular attention has been paid to the types of links users can add to the system.

From a methodological point of view the possibility of extending the information network is an important point towards a real and significant implementation of the Constructivist theory on the Web, by allowing for the development of personalized in-depth research sections [Schank 94]; the possibility of extending the information network allows teachers and expert guests to enrich the content of the system too. New added pages and links are public to all the system users, thus providing for learning activities based on cooperative production of knowledge. Finally, the privileges accorded to specific classes of users prevent guests from arbitrarily adding information to the system.

Manipulating the page content

The “working tools” enable the user to handle and manipulate the information in the web pages, sustain the user’s attention at high level and develop his/her critical sense and his/her abilities to search for, extract and synthesize information. Specifically, most of these tools allow users to mimic traditional activities usually performed through stationery items.

Changes to the page content are private to the user who makes the modification. The philosophy of these tools is, in fact, the provision of mechanism for individual study strategies. In addition, making private modifications available to all the users could produce a chaotic representation of the information.

The “Marker” tool allows parts of the text on the pages to be highlighted. The selected parts remain highlighted until the end of the on-line module; in addition, the user can decide whether and when to transform these selected parts into real informative documents by putting them into the “Kit bag”. The “ Foot-Note” tool allows the user to add notes, reference-marks and other information to the text of a page; the notes, which are for the private use of the user who created them, remain “attached” to the pages from one on-line work session to another. During first reading, the user can “mark” each page of the system s/he considers relevant to his/her studies by using the “Page-mark” tool; the user can navigate back to the marked pages through the “Iter” tool to study these pages in more detail. The “Note-book” tool works like a real note-book enabling the user to write down reflections, critical notes, and so on. The “Iter” tool highlights the presence of footnotes on the pages. The “Kit bag” tool represents a kind of catalogue that the users carry with them during navigation through the system, and where they store pieces of information collected on this way around. The pieces of information in the “Kit bag” retain the reference to their original web page; therefore, it is possible for the user to go back to the page, and choose links to other parts of the system. Finally, the “Iter” tool support users in navigating through the information: it shows the list of pages visited during each work session or since a date specified by the user; unlike the “history” tool available in most popular browsers, this tool keeps track of the operation performed on the pages through the tools described above. The teachers and the tutors of the on-line modules can access the same information, in order to control and assess the students’ activities in the system.

Conclusions

Accessing a rich information environment such as the Web -even if it is integrated with effective communication tools- is not a sufficient condition for expanding knowledge and stimulating learning. In fact learning requires “a deep understanding of the subject content” [Alexander 95] through a cognitive re-elaboration of the information [Colbourn 95]. The level of interaction allowed by the Web is a limit to effective study strategies on the Web. In this paper, some design and technical solutions to improve interaction in a WBI system have been proposed. Specifically, the design strategies that allow users to extend the information network, and some “working tools” which can maximize the learning and reading processes and facilitate the recognition of the phases of knowledge acquisition have been introduced.

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Information structure diagrams as link icons

For some years, the author has been requiring his Japanese beginner technical English writing students to embed their HyperCard navigation links in information structure diagrams, for two purposes:

1. To foster awareness of information structures, and
2. To challenge the students to create structured navigation routes in their documents.

This has direct application to hypermedia interfaces. Its success depends on the reader being familiar with information structures and their systematic graphical representation.

1. Information structures vs. language structures

Fauconnier (1997), working from the notion that mappings are central to meaning construction, notes that "...the domains that we need in order to understand language functioning are not in the combinatorial structure of language itself; they are in the cognitive constructions that language acts upon." (Fauconnier, 1997:13) If this is correct, then the syntactic structures of text do not serve particularly well in the representation of structured information.

Systemic functional linguists such as Mohan (1986) claim that there are certain irreducible information structures (Mohan's 'knowledge structures') which map onto SFL's 'text types' (AKA language function 'genres,' see Butt et al (2000)), which in turn are expressed by specific rhetorical devices (not language structures).

The author has modified Mohan's knowledge structures so as to represent most of the irreducible information structures which underly technical information by node-link-node iconic graphics. In this approach to information structures and introductory technical writing, the structures taught and iconified are:

1. Description	Link expression:	C is an attribute of X
2. Classification	Link expression:	X is a kind of A
3a. Comparison	Link expression:	X is A-er than Y
3b. Comparison	Link expression:	X has attribute A, but Y has attribute B
4. Sequence	Link expression:	A then B, After A, B etc.
5. Cause-effect	Link expression:	A so B, If A, then B, etc.
6. Contradiction	Link expression:	X has attribute A, but Y has attribute not A

The graphical representation of these structures can be accomplished through granularity in link representation, as seen in figure 1.

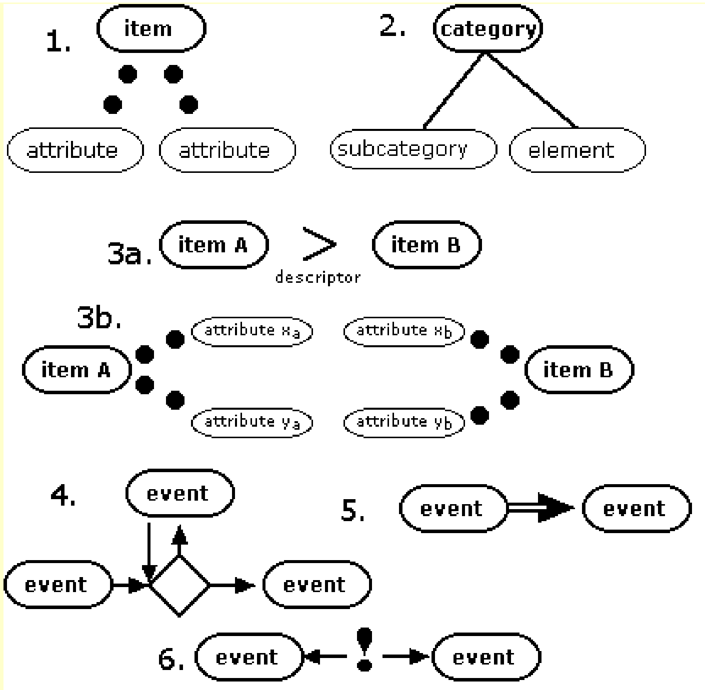

Figure 1. Hunter's knowledge structure icons.

2. Imposing structure on hypertext

In order to force the student to graphically articulate the information structure (not text structure) of her/his overall document, the instructor specifies one of a variety of structures in an assignment, these structures being signalled to the reader by means of a graphical directory on the opening card or page of the hypertext document. The graphical directory, reduced in size, reappears on every relevant page of the document, each element of the graphic being used as a link (see figures 2 and 3). This approach has proven highly motivating and supportive of the development of structure in student writing, and serves to highlight the issue of navigation within a hypertext. This has obvious transfer to the design of such hypertexts as web sites.

In this instructional approach, the students brainstorm a collection of information and then place their data in information structure maps (not 'concept maps,' which are merely associational, and not information-structured).

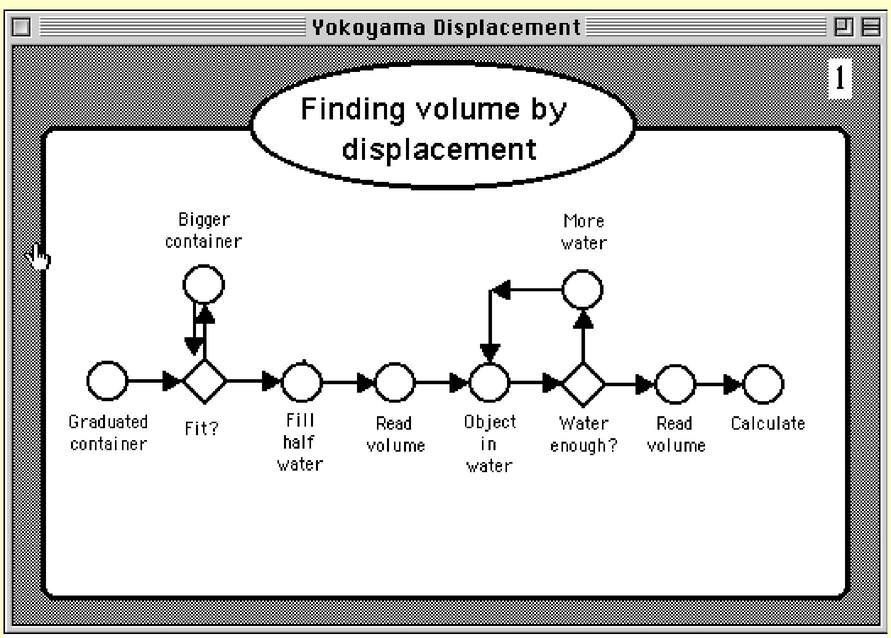

Figure 2: graphical directory: nodes are links to other cards.

Each node is an entity: an object, class, person, attribute, place, concept, etc. Each node-link-node graphical element in a map represents an irreducible information structure, one of the 6 text types listed above, and is the equivalent of a simple English sentence. Several elements within a local structure are the equivalent of a complex or compound sentence.

Templates are useful in the early stages of learning about how to structure information. The teacher can strongly control the structure of the students' work by providing them with templates, which may contain a skeleton directory card and corresponding content cards linked to each element in the directory, or may contain buttons which govern or restrict the pathways by which the reader can navigate the document. After working with a variety of templates, the student will have acquired a repertoire of structures for use in further work. It has been observed that some students soon independently develop new structures.

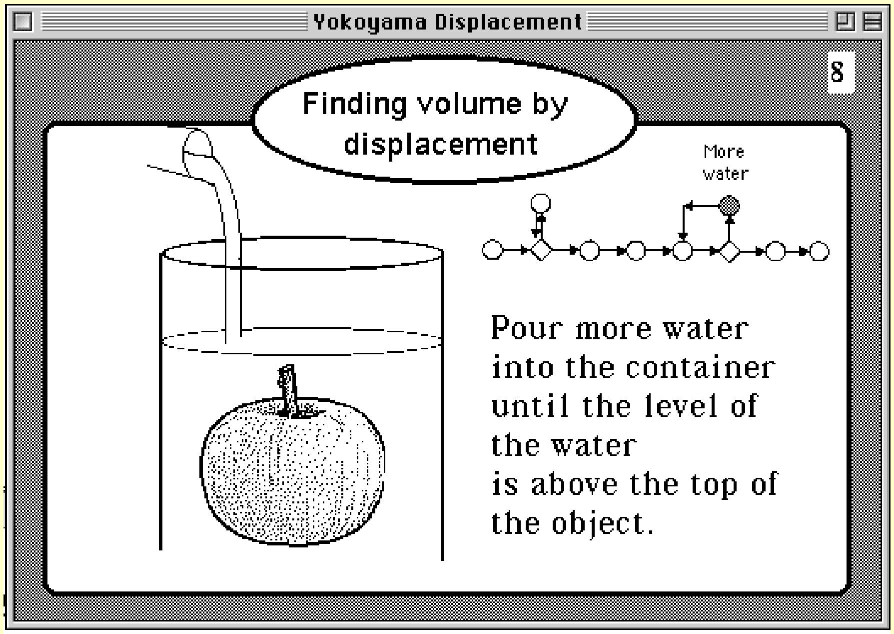

Figure3: graphical directory shrunk to locator icon with hot links.

3. Converting structured hypertext to linear text

Technical report writing remains a linear form; non-linear forms such as hypertext have yet to invade the formal genre. Thus the students must be able to convert their hypertext documents into the linear format of English prose. Template type model sentences for each text type are provided to the students, whose task it is then is to use the models to frame sentences and paragraphs expressing their own information structures.

The approach outlined in this paper aims at providing the student with visual representations of information structure; this leads to awareness of information structure and to the foundation skill of choosing the appropriate graphical tools to represent that structure.

Resources

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Hypertext as a Tool for Building ESL Students' Reading Skills: A Pilot Study*

Recent research (Kasper, 2000; Lomicka, 1998; Soe et al., 2000; Warschauer, 1999) suggests that hypertext can provide an effective tool for developing reading skills. Because hypertext is a relatively new textual medium, and because it is likely to become more dominant in the future, research is needed so that both reading instructors and students may be empowered to use hypertext to its full advantage. This paper describes the pilot phase of a two-year controlled research study of the features, design, and effects of hypertext on the development of the reading skills of high intermediate level** college ESL students.

Mishra et al. (1996) note that well-designed hypertext systems can facilitate active interaction between readers and texts and can promote cognitive flexibility necessary for the integration and consolidation of knowledge gleaned from a variety of sources. Although nonlinear hypertext can offer students many benefits, Rouet and Levonen (1996) advise that without overt instruction in how to navigate hypertext effectively, students may become lost in a sea of information, potentially experiencing cognitive overload. Foltz (1996) further cautions that hypertext may present a problem for students with poor reading skills. Having to choose where to go next can take students' attention away from processing the text, with the possible result that they generate fewer hypotheses as they read, making it harder for them to integrate the information presented. Foltz' work pointed to two key factors in hypertext comprehension: (1) the coherence of the text and (2) how the reader's goals affected strategies used.

My two-year study seeks to investigate and assess the role of hypertext in developing ESL students' reading comprehension skills. The pilot study, conducted during the 2001-2002 academic year, focused on developing and testing different types of hypertexts with a total of 50 high intermediate students enrolled in two different sections of an integrated reading and writing course.

In keeping with the different experimental conditions to be tested in Phase 2 of the study, I constructed several types of hypertexts, each based upon topics studied in the course. The five types were: (1) glosses, in which links provide popup vocabulary definitions, (2) controlled hypertexts, in which links lead to a predetermined and limited number of texts on the topic, (3) free hypertexts, in which students are directed to freely explore the Internet for other texts related to the topic, (4) controlled hypertexts with glosses, and (5) free hypertexts with glosses.

The pilot study tested and compared these hypertexts. It measured the effects of each on students' performance on reading comprehension tasks. An online feedback questionnaire assessed students' reactions to the effectiveness and ease of use of each type of hypertext.

The majority of students reported that they found gloss hypertexts to be the most useful; of these gloss hypertexts, the controlled hypertexts with glosses were rated the easiest to use and the most effective. In contrast free hypertexts, with or without glosses, were rated the most difficult to use. Students' performance on reading comprehension exercises mirrored their preferences. Scores on gloss hypertexts, particularly controlled gloss hypertexts, were significantly higher than those on free hypertexts.

Students' said that gloss hypertexts enabled them to read with greater comprehension because these texts provided easy access to the definitions of new vocabulary words. They said that controlled hypertexts made the text clearer by providing links to specific relevant information. Students' preference for controlled hypertext supports Foltz' (1996) claims that text coherence plays a powerful role in students' comprehension of hypertext.

Overall students disliked free hypertext because they found it confusing. They complained that free hypertext led to too much information, making it easy to get lost in exploring the links and forget about the main topic. They also said sorting through and evaluating the usefulness of all the different definitions and opinions on the topic was time-consuming. In addition, free hypertext was intimidating to students who were less experienced with the computer. These results support the claims of both Foltz (1996) and Rouet & Levonen (1996), and are particularly interesting since students here received instruction both in how to navigate hypertext and in how to evaluate information found on the Web.

Overall the pilot study has provided student feedback and performance data that support the claims of previous researchers and has also helped to elucidate issues that need further attention in Phase 2 of the study. Student feedback and performance data indicate that glosses facilitate comprehension. Therefore hypertexts used in developmental reading courses should incorporate glosses. The results of the pilot study also suggest that students need more extensive training in how to navigate hypertexts. In addition, students' exploration of free hypertexts needs to be more carefully evaluated, with data collected on the number and content of the sites visited. It is possible that with increased instruction and practice, students will experience less information overload with free hypertexts, and they may become more proficient at finding and pursuing links that lead them to more coherent, and more useful, free hypertexts.

Endnotes:
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** High intermediate here refers to an entry-level TOEFL score of approximately 425.

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Web-Based Resources for Teaching Discrete Mathematics to Students of Information Sciences and Technology*

Abstract

This paper reviews the authors' experience in the design and use of web-based resources to help teach logic and discrete mathematics to undergraduate students in information sciences and technology. The resources discussed address two major issues in teaching such students:

1. Many students often lack the strong mathematical background of a typical physical science, engineering, computer science, or mathematics undergraduate.
2. The typical student has a distinctly applied, not theoretical, orientation and is frequently properly motivated only in the context of solving practical problems of real interest.

These resources include extensive course web pages, including lecture notes; text-based tutorials; tutorial Java applets; Java applets for application demonstration as well as for hands-on computation laboratory experiments; and links to mathematical resources on the web. Web page usage statistics and the results of anonymous student surveys and teacher-effectiveness ratings indicate that most students find the website useful, use it extensively, and prefer the more web-interactive course to a more traditional alternative.

1. Introduction

In recent years, many students in the information sciences and technology (IST) have evolved a different focus than many earlier students of the computing sciences, who frequently came from mathematics, physical sciences or engineering. However, proliferation of information systems in the last 20 years to all walks of life has lead students from many other areas to pursue in-depth studies of IST. Many of these students have found that their scientific and mathematical training is inadequate to learn traditional computer science.

For two years, the authors have taught a core curriculum course in logic and discrete mathematics to college sophomores with a wide range of backgrounds, who aspire to major in IST. Most students are academically able, but a significant number have difficulty with the level of mathematical abstraction required, and frequently don't understand why this level of mathematics is relevant to IST. Therefore, we have developed tutorial, application-demonstration, and computation-laboratory teaching resources.

2. Example Course Web Site

A course website, http://acs.ist.psu.edu/ist230/, was developed to provide a structure for both course administration and development of teaching resources. This site has a table of contents, linking to:

- An administrative page, with a course syllabus; a detailed explanation of class policies; instructor and teaching assistant contact information and office hours; and other administrative details such as exam schedules.
- A class announcements page, updated frequently.
- A course schedule, with direct links to relevant web resources.
- Lecture and computation-laboratory notes.
- Other on-line materials, such as tutorials, application-oriented Java applets, optional exercises, practice exams, and mathematical web links.
- Homework assignments and solutions (behind a secure directory, to reduce proliferation of solution sets).
- A feedback form, to encourage anonymous student feedback about the course. We believe this feedback is important, and have found that students will give constructive criticism if it is received gracefully.

In addition to this course website, we are also developing a topically-oriented discrete mathematics website, http://acs.ist.psu.edu/discrete-math/.

3. Results and Analysis

During the 2001-2002 academic year, a traditional lecture format was used in 2 out of 3 weekly classes, closely following web lecture notes. One weekly session was devoted to group-based computational exercises using applets developed in-house or web-based programs.

Approximately 96% of the students surveyed (during the regular teacher evaluation) found the website useful, and half of those reported daily use, consistent with an observed 200 hits per day for 75 enrolled students during Spring 2002.

Student feedback clearly indicates that the website and inclusion of extensive web-based resources has improved student satisfaction with the course. This is reflected in both written comments and numerical ratings of teacher effectiveness with respect to previous semesters.

Currently, the website is text-based and simple in structure for easy maintenance. Although IST students would appreciate a small nod to more sophisticated graphic design, student feedback shows that, at least, good web page usability criteria should be followed [1] to the extent of having a coherent, centralized interface and fast-loading navigation pages. It is our non-objective impression that our students value the clear, centralized information base the website provides, even though it is not a sophisticated website.

4. Conclusions and Future Work

This paper reviews the design and use of web-based resources for teaching logic and discrete mathematics to IST students, many of whom do not have strong background or interest in mathematics. Without claiming the authority of a controlled scientific study, we observed significantly improved student satisfaction with the course and instructors, when using a reasonably well-organized website with useful administrative information, lecture supplements, and hands-on web resources.

Another viable approach to using web resources is Problem-Based Learning (PBL). Using PBL, application problems umbrella the theoretical concepts, and all theoretical work is done in the context of solving an application. Finding suitable case studies which can truly utilize a reasonable range of the theoretical ideas is a significant challenge. PBL is under investigation for future versions of this course.

It is good that students appear to prefer a more interactive approach to learning, but even more important that this translates to improved learning and the ability to use this increased understanding. It is widely accepted that being engaged by the subject matter and practicing the skills to be learned lead to better learning. An interesting article by Hake [2] claims that students of introductory physics learn fundamental physics concepts better using "interactive engagement" methods, such as hands-on demonstrations or experiments, as opposed to using "traditional" lecture-based methods. We have not yet directly measured whether or not our approach improves students' "knowledge gain" [2], however this is an important question for future research.

* This work was supported by the Penn State Fund for Excellence in Learning and Teaching, through the project "Java-Based Teaching of Mathematics in Information Sciences and Technology".

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The effects of hierarchical versus heterarchical Web-based hypermedia designs on exploration, collaboration, and problem solving in a case-based learning environment

Abstract

This case study examined the effects of hierarchical versus heterarchical hypermedia structures of Web-based case representations on four learning variables: (1) comprehensiveness of exploration paths; (2) collaboration; (3) perceived authenticity and complexity of the learning task and (4) case structure. Two groups of students were assigned to work through an ill-structured problem represented hierarchically and heterarchically in a Web-based format. A Web-based tracking program was deployed to track students' journeys through the hypermedia case designs. Students were observed while interacting with the problem and were interviewed after submitting their case solutions. Results from the tracking program, observations, case solutions, and interview questions are discussed. Implications for future research are provided.

Research Problem

Several research projects and studies (Booth-Sweeney, 2001; Herreid & Schiller, 2001; Siegel, et al.; Rogers & Erickson, 1998; Gerdes, 1998; Sutyak, et al., 1998; Fitzgerald & Semrau, 1996; Jacobson, et al., 1996) have investigated the use of cases or problems in instruction particularly in relation to case structure (e.g. linear versus hypertext, narrative versus conceptual) and problem complexity (e.g. well-defined versus ill-structured), and the impact of such variables on advanced knowledge acquisition. However to date, there is no explicit framework or instructional model to guide the design of Web-based hypermedia cases particularly for ill-structured problems or learning tasks that require students to engage in authentic activity and complex problem-solving.

Hierarchical versus Heterarchical Case Designs

This case study focused on hierarchical versus heterarchical Web-based hypermedia designs of ill-structured problems in order to explore the interaction between hypermedia linking structures and student learning and performance. Hierarchical hypermedia designs are linking structures that organize content into logical sections often by major topic area, resulting in several navigation levels with a top-down or tree-like structure (Oliver, 1996; Last, O'Donnell, & Kelly, 2001). On the other hand, network-like or heterarchical structures are "more chaotic with random links jumping from one topic to another in a more referential fashion" (Oliver, 1996, p. 15). Typically, embedded links are sprawled throughout the content representing associations similar to knowledge representation in a memory model or network structure (i.e. rhizome-like). Hierarchical versus heterarchical hypermedia designs can also be viewed as a "depth versus breadth" topology of linking structures (Larson & Czerwinski, 1998).

Research Questions

The following research questions were addressed in this study:

1. How does exploration in a heterarchical hypermedia case design compare to exploration in a hierarchical hypermedia case design?
2. How does collaboration between group members in a heterarchical hypermedia case design compare to collaboration in a hierarchical hypermedia case design?
3. How do students perceive the learning task in each of these case designs? Do they perceive it as authentic, challenging, complex, ill-structured, meaningful, relevant, and engaging? Were these perceptions different in each of the case designs?
4. How do students perceive the case structure in each of the case designs? Do they find it difficult to navigate through the case? Why or why not? Do they find it difficult to locate specific information?

Method of Investigation

Two groups of volunteer students in their last semester of study in a graduate program in Instructional Design (ID) at a large comprehensive university were assigned to explore and solve an ill-structured problem represented hierarchically and heterarchically in a Web-based format. Students in each group were instructed to use only one computer and select an operator amongst them (person sitting at the keyboard) who will be in charge of accessing the case online and clicking the mouse. The procedure for accessing the Web-based case required students to enter their group name, their individual names, and the operator's name. Each group was observed by the researcher while interacting with the case and their journeys through the hypermedia structures were tracked to a database (through a JAVA program) using a pop-up menu that automatically displayed when students used any navigation tool to move through the pages and links of the case and/or interact with the case content (e.g. clicked on a hyperlink, highlighted text, copied or pasted text, printed text, used browser navigation tools to move backward and forward, etc.). The pop-up menu requested short answers to embedded elaboration-seeking questions and required students to make selections from a list of choices to help determine: (1) whose decision was it to initiate the interaction with case content (group versus individual), and (2) why was that interaction selected (relevancy to problem-solving process) (see figure 1).

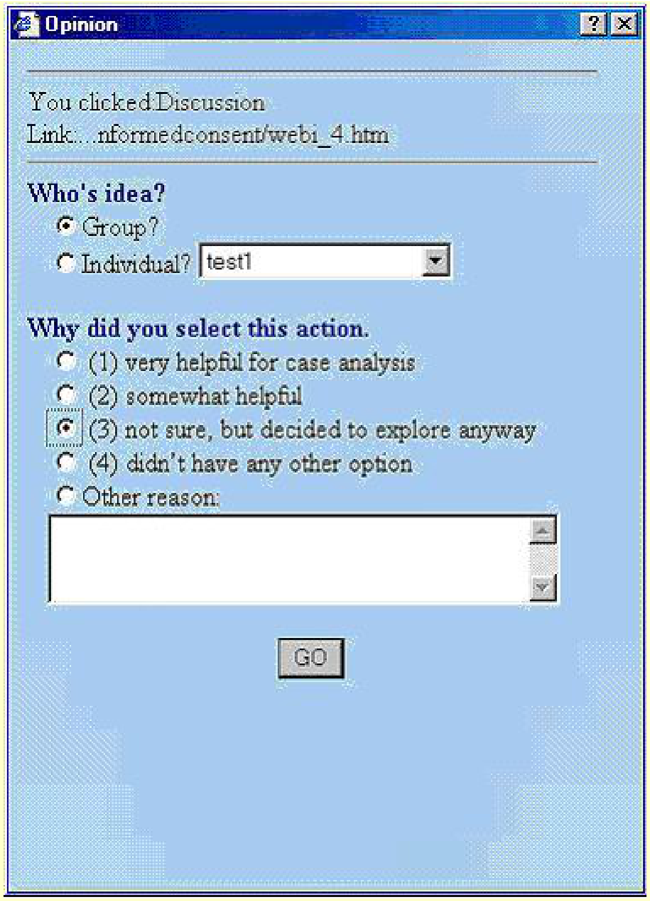

Figure 1: Pop-up menu displayed when interaction is initiated

A slightly different pop-up menu containing the same options for question 2 was displayed when students exited the page that was visited or completed the action that was selected, in order to determine whether students' initial perception about the usefulness or relevancy of the link/action to problem-solving was confirmed. This pre-post tracking technique was necessary to determine what students perceived as relevant and irrelevant case information (see figure 2).

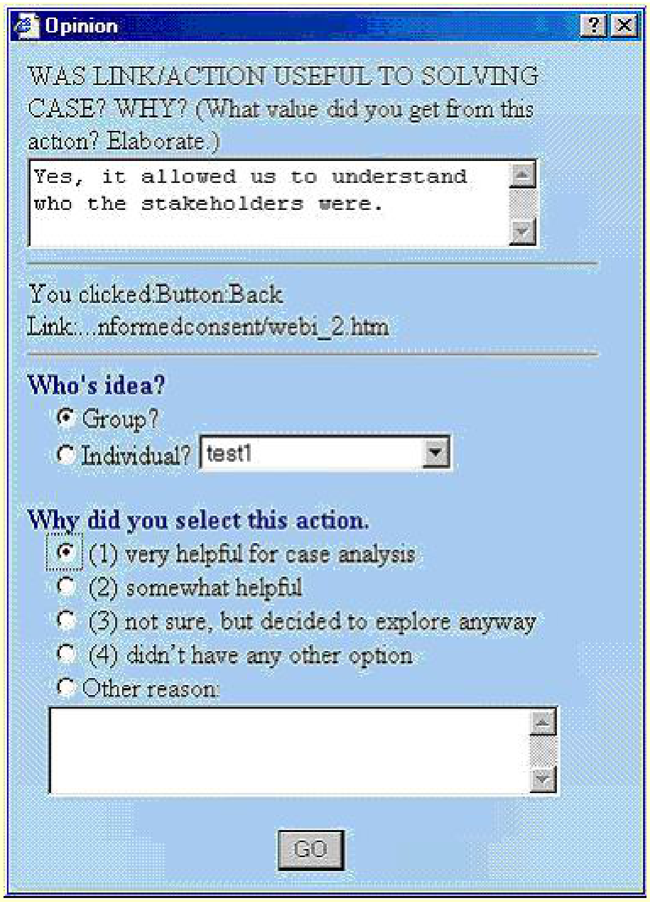

Figure 2: Pop-up menu displayed after visiting link or completing action

In addition to the above information, the JAVA program recorded the URL of every page visited, the URL of every page in which an interaction was initiated, the start time of an interaction, the type of interaction, the time spent on every page/interaction, and the total session time. During each group session the researcher silently observed and recorded the group processes and deliberations triggered while exploring the case content. At the end of the session, each group submitted their outline of the case issues and recommended solution(s) and the researcher interviewed each group using eight questions designed to identify additional information about students' perceptions of problem authenticity and complexity, case structure, navigation issues, and problem-solving strategies. The interviews were audio recorded and later transcribed for further analyses.

Results

The following is a summary of the results based on analyses of the primary data sources: the interview data and the tracking program.

1. 1. Exploration in the hierarchical case design was found to be more comprehensive in terms of the number of links visited/revisited, number of unique links visited, and the total number of interactions generated, however the average time spent on a page in the heterarchical case design was one and a half times more than the average time spent on a page in the hierarchical case design.
2. Both groups identified the same links/pages as most useful with respect to relevancy to problem solving. However, the group interacting with the heterarchical case perceived more links initially as useful and later determined that these links were not useful which may imply that discriminating between relevant and irrelevant case information in a heterarchical design could be more difficult than in a hierarchical design.
3. The heterarchical case design triggered more collaboration between group members than the hierarchical case design. The heterarchical group's strategy was clearly one of discussion and reasoning through the problem information.
4. Perceptions of the ill-structuredness, authenticity, meaningfulness, and real-world relevance of the learning task were equal in both groups.
5. Perceptions of case structure in terms of organization of links, resource information, and navigation were overall more positive for the heterarchical group.

Discussion

This exploratory case study revealed important information about Web-based hypermedia case structure and its impact on student learning in a case-based learning environment. Most importantly, it revealed that heterarchical case designs potentially increase student collaboration in a Web-based hypermedia design of an ill-structured problem and engage students in thinking critically about case content. More research however is needed to support these initial findings and to address some inconsistencies noted from the analyses of the secondary data sources (case solutions and researcher's observations of group processes). For example, the heterarchical versus hierarchical design needs to be further studied to ensure that depth versus breadth is the delineating factor and that irrelevant and relevant case content can be equally integrated in both case designs. Additionally, case analysis and solutions would need to be more comprehensive (i.e. not limited to a one page outline of case issues) and would need to be evaluated by experts in the field of study to determine their viability as a proposed solution. Future studies will also involve a more defined experimental research design that will test the effect of case structure of ill-structured problems on complex problem-solving skills and knowledge transfer using several learning variables as predictors (e.g. low versus high prior knowledge) and varying problem-contexts.

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Continuous Evaluation of Adaptive Web-based Courses

1. Introduction

Adaptive-course development is a complex activity, and it results more difficult as the number of adaptive features increases [1]. Particularly, it is difficult to evaluate whether a course fulfills the needs of every student [2]. This task, that should be continuously carried out since the course is available for old and new students, might be supported by help tools.

There exist some authoring tools [3] that incorporate syntactic analyzers to detect errors such as references to non-defined components. Our proposal consists of carrying out a continuous evaluation process consisting of observing the student's behaviors along with the course description in order to detect possible design errors, deficiencies and/or opportunities of improvement in a semi-automatically way, and to offer the corresponding suggestions to the course designers.

2. Adaptive Course Analysis

The starting point of this work was the analysis of the adaptive courses that are generated by the TANGOW system [4], in which the topics that constitute the course, their organization within the course structure, the navigational flexibility and the contents themselves are dynamically adapted to the user features and behaviors.

When analyzing an adaptive course, the course description can be examined statically, while the student interactions within the generated course require a dynamic analysis.

On the one hand, static analysis consists of detecting situations where the course does not satisfy some given criteria related to its organization and contents. There have been proposed several criteria of evaluation of hypermedia systems [5]. Some of the criteria considered during the static analysis are:

- Granularity: it is not convenient to include too much topics in a single page, but splitting the information in different sections.
- Number of internal and external links: in order to avoid the student confusion, this number should not be too large in every page.
- Presence of self-assessment exercises: these exercises should be included at the end of the sections so that students can test the knowledge they have acquired.
- Guidance flexibility/inflexibility: adaptive courses range from those where the order in which pages must be visited is totally enforced by the system to cases where all navigation possibilities are offered. The best situation is one in which the guidance strictness depends on each student's needs.

On the other hand, the dynamic analysis is based on observing the student behavior while interacting with the course. Some behaviors that, when repeated by a significant number of students, can suggest deficiencies in the course design are:

- Large number of failures while solving tests: it suggests lack of clarity or precision on the related contents, or need for further explanations, reviews and/or examples. When the topic being considered has prerequisite topics associated, the suggestions can also be applied to them, mainly when the results of the students while performing them have not been good (the pre-required knowledge may have not been consolidated).
- Too much visits to previous topics: it suggests the need of including summaries and reviews, or creating dependencies between the topics involved, so that a minimum score in the tests associated to the first topic are required in order to access the second one. This is especially important when the students that visited the previous topics got better results in the current one than those who did not.
- Erratic navigation paths through the pages of a section: it suggests the need of reorganizing the topics within the section.
- Early desertion: it is very likely that there exist serious deficiencies on the course designed.

The most interesting problems are detected through a combination of these sources of information with the student opinions about the course execution.

3. Continuous Evaluation in an Educational Environment

The analysis of adaptive courses has been implemented by means of a software agent [6] that has been integrated within the educational environment constituted by the TANGOW system and the BOLEROW authoring tool [3]. BOLEROW supports the creation and maintenance of adaptive courses, while TANGOW generates particular courses for each student dynamically. Figure 1 shows the relationships among the environment components (the shaded modules represent the new components and the rows represent the information flow).

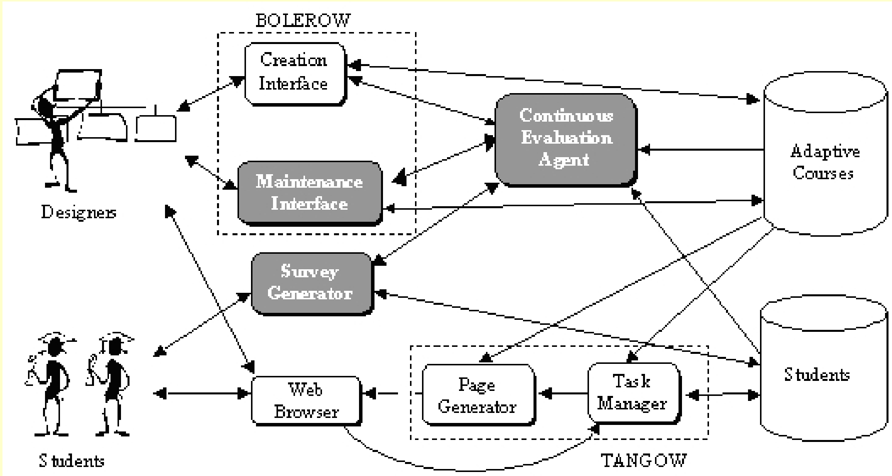

Figure 1. Incorporating evaluation in the teaching environment

A designer can create an adaptive course through the BOLEROW Web-based Creation Interface, being the course stored in the corresponding database. The Continuous Evaluation Agent analyzes the course testing whether it satisfies the static analysis criteria. If any criterion has not been followed, it generates a suggestion that will be shown to the course designer through the Creation Interface. The designer can check the course generation for every user profile by accessing to TANGOW, and modify it through BOLEROW. This process can be repeated as many times as desired. Once the designer considers the development phase as finished, the course is available for the users.

While a student is taking a course, the agent analyses the course structure and contents, along with the navigational paths followed by the student and the results obtained by him/her while performing the self-assessment tests included in the course, in order to detect behavior patterns or test results that lead it to infer conclusions about the course quality. During this phase, it combines all the information to obtain the best possible conclusions concerning the course design.
In order to complement these conclusions, the agent generates a survey, starting from standard questions and including information about the inferred problems and the student's interaction with the course, and sends it to the student. By considering the student comments, the agent can reinforce or weaken its conclusions. In any case, the agent stores the suggestions so that designers can access to them through the Maintenance Interface and, if they agree, perform the proposed changes.

The contributions of the continuous evaluation agent to the adaptive course improvement and maintenance processes are been currently evaluated.

Acknowledgments

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A comparison of computer mediated training tools

Abstract

Various factors are leading organisations to deliver flexible learning via the Internet. These pressures include the need to be seen to be using the latest technology, the demand from users away from traditional courses to ones that can deliver anytime, anywhere and lastly to escape from the need to provide expensive classrooms and laboratories. There are different proprietary and off-the-shelf solutions capable of delivering teaching material to the Internet and assessing students. Yet they has been little research on the effectiveness of these vehicles from the viewpoints of course content authors, instructors and students. The research evaluates two contrasting flexible learning sites through student surveys.

Instruction

In this paper we compare student perception of two contrasting sites that use different navigation methods. Griffith University opened a new campus in 1998 at Logan outside Brisbane, Australia. It has around 1700 students enrolled in business, education, science and nursing courses operating in a 'flexible learning' environment - all subjects are taught using face-to-face teaching and material presented on the Internet. Educational designers use the web-authoring tool Dreamweaver in conjunction with input from content specialists to create the flexible-learning material. The students involved in the current study were third year business students with two years of flexible learning experiences behind them all using a common user-friendly interface. The Franchising subject was delivered over a 14-week semester and involved six 2-hour face-to-face seminars, with the remainder of the learning experiences being provided on the subject website or through group project work.

With an enrolment of 25,000 students Auckland University has the capacity to handle more than 6,000 simultaneous Internet users. This provides a competitive advantage in terms of its technological base to deliver its knowledge resources. The challenge is to re-engineer these educational resources to suit the new medium. As one answer to this challenge, a computer-supported learning (Cecil) environment has been developed over the past seven years by the University's Management Science and Information Systems Department. Cecil is designed to support administrative, communication, instructional, resource management, and assessment modules and has become a platform for disseminating knowledge resources using multimedia technology.

Survey Results

The students in the 3rd year Software Engineering class used a 20-question survey to evaluate the existing Cecil application and the alternative site at Griffith University used to teach the Franchising course. The questionnaire for the students enrolled in the Griffith course was administered manually. 52 of the 56 students enrolled in the Software Engineering class answered the questions in the Cecil survey and 19 of the 20 students enrolled in the Griffith course. The questions explored the following dimensions: usability, navigability, consistency, learnability, intuitiveness, simplicity, aesthetics, direct access, link, understandability, feedback, bandwidth.

We will only address the navigability issues here in keeping with this journal issue's theme. The Griffith students tended to be more positive about the navigation aspects of their site than the Auckland students. In contrast, the software engineering respondents believed that they feel more in control, and navigability is better, when using Cecil compared with the Franchise site. Their preference for the tree approach used in Cecil is apparently at variance with the way that most information is accessed on the web. They agreed that it is easy to for them remember where they are in the Cecil. It is likely that the fact that the navigability of Cecil is considered to be better than that of the Franchise site is a reflection of the users' familiarity with the Cecil sites.

The Software Engineering students were asked to rank and comment on the sites during their weekly tutorial (the topic that week was User Interface design and evaluation) and in the web discussion forum pages for the course. They ranked the Cecil application higher. Although the Cecil organisation was easy to understand, due to its similarity to Windows Explorer, the messy layout and the difficulty of looking through different folders caused confusion – this could be improved with a search facility. It was difficult to find if there was any new material; documents should be sorted by date rather than name. A Help facility was available at the franchise site but not for Cecil. Cecil also lacked the facility to ‘undo’ or a confirmation message.

Conclusions

It was not feasible for the Griffith students to test the Cecil site as it has a bias towards use by Information System majors; nor was it possible to alter the order in which the Auckland students were presented with the different interfaces. Despite their non-technical background the Griffith students consistently scored their site higher than the Software Engineering students scored either alternative. Users tend to score familiar interfaces higher.

Computer supported learning, with easy Internet access, provides valuable assistance to the community. The approach exemplified by Cecil at Auckland University and Dreamweaver at Griffith, can be used as one of the components reinforcing instruction. Students are no longer passive learners but active participants, employing classroom knowledge to face an unstructured and imperfect world where there is no "book", information is not readily available, courses of action are unknown, and creative abilities are necessary for effective problem solving. We expect the Flexible Learning approach to become one of the means by which Universities reach out to their constituencies to fulfil their mission. Computer systems can be designed to intelligently deliver traditional educational services. Academics will not be replaced by such an approach; rather, their role as a guide and a resource will be emphasised. Organisations must adapt the way that courses and information are packaged and delivered. As part of this they need feedback from the participants to evaluate the tools and processes used.

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Link Types as Enablers of Semantic Navigation in Standard-Based Web Learning Systems

Introduction

The concept of link in hypermedia systems and models provides an abstract and generic mean to arbitrarily interconnect nodes and contents. As a consequence of the loose semantics of the general plain concept of link, different types of links have been proposed for different purposes [Kopak, 1999], including the definition of aggregation and generalization relationships [Garg, 1988] and the explicit modelling of the structure of scientific writing [Trigg & Weiser, 1986]. In addition, link types have been included in hypermedia modelling frameworks, e.g., in [Díaz, 1997].

Nonetheless, the current realization of the link concept in the Web, by itself, lacks any kind of semantic interpretation (beyond the mere fact of the navigational connection of two nodes), and learning technology standards do not address the possibility of arbitrary explicit linking between learning objects with “extended” semantics. In other words, the ability of the link to convey information about some aspects of the relationship between two nodes is underutilized both in the Web and in current Web-oriented educational technology specifications.

The technologies commonly referred to as the “Semantic Web” [Berners-Lee, 2001] aim at providing semantic contents in the Web, mainly by using knowledge representations in the form of ontologies, which are in turn, translated into Web-enabled representation languages like RDF [W3C, 1999] and its extensions. Basically, an ontology can be defined as a shared conceptualisation of a specific domain. It is based on the definition of a generalization/specialization hierarchy of types or terms with attributes, relationships and arbitrary predicates defined on them. These technologies appear as good candidates for the specification of link types.

In this article, we briefly sketch a proposal for the use of links with a explicit semantic interpretation in learning technology settings – that can enable richer interaction models (both for static or adaptive applications) –, and how these links can be seamlessly integrated in the SCORM specification [ADL, 2002] by using a link ontology.

Link Types in Educational Technology

In this section we describe how different link types could be used in learning object standards. We’ll restrict ourselves to the SCORM specification, due to its comprehensiveness. For clarity’s sake, we’ll consider SCORM assets as atomic contents and Sharable Content Objects (SCO) as a special kind of hyperdocument that can be traced by a LMS.

We have used as starting point the categories in the taxonomy in [Baron, 1996] – adding revision links –, since it provides a category of rhetorical links that explicitly addresses learning objectives. The following table summarizes the (explicit or implicit) occurrence of link types in SCORM.

Link Category	Description	Realization in SCORM 1.2
Organizational Links	Used to describe the surface structure of educational contents (courses, chapters, modules, etc.).	Implicitly defined in content packaging structures, under the <organizations> elements, in Content Aggregation packages.
Concept-related (semantic) links	Describe the relationship between concepts or words.	May be defined by the types in the vocabulary of the <relation> element, which includes, among others isPartOf, isFormatOf, References, isBasedOn and Requires.
Pragmatic links	Relationships concerned with practical results (e.g. warnings).	Some link properties could be derived from the <learningresourcetype> metadata element in the <educational> one, e.g. assets with Problem Statement type can be linked differently from the table of contents.
Rhetorical links	Used with the intent of leading a reader through a series of steps to achieve a learning goal.	The same as in organizational links.
Revision links	For version tracing and revision control purposes	The hasVersion/isVersionOf types in metadata item <relation> explicitly define links of this kind. In addition, links can be derived from the information in the <lifecycle> element.

The conclusion is that the SCORM specification does include some fixed forms of explicit link typing, and it considers also implicit linking by defining content packaging and sequencing structures. But it precludes the inclusion of HTML links (except from the ones that link to elements defined in the same packaging structure), and therefore the granularity of the assets limits the granularity of the nodes linked. The problem lies in that common Web links are embedded inside assets, so that they’re out of the consideration of the specification (as a matter of fact, sharable content objects (SCOs) – which contains assets – are considered as the “lowest level of granularity of learning resources that can be tracked”). As a consequence, a more flexible linking approach that enables arbitrary link addresses and connection with externally defined ontologies would be desirable.

Integrating Semantic Links in SCORM

In the COHSE project [Carr et al., 2001], ontology terms were already used to annotate different learning objects to provide nodes some type of metainformation about their content. In this section, we summarize how to specify the type of a link between two learning objects using Link Types ontologies and the XLink extensions, in order to enable their specialized handling by the LMS.

Currently, the XLink and related specifications (XPath, XPointer) allow the definition of links between any XML structures [Carr, 1998] at fine-grained levels, overcoming HTML addressing limitations [DeRose, 1999]. An extended version of XLink can be used to specify annotated links between learning objects. These links can be stored separately as external “link-bases” of “extended” links (i.e. general links not constrained by HTML-style interpretation).

The following markup fragment shows an example of a link between two SCOs of type ArgumentAlternateLink, which can be defined on a “Learning Links” ontology.

```
<sco-ext:learning-link xlink:type="extended">
        <concept xlink:type="locator"
                     xlink:role="statement" xlink:href="..."/>
        <concept xlink:type="locator"
                     xlink:role="argument" xlink:href="..."/>
        <link-onto:ArgumentAlternateLink xlink:type="arc"
                    xlink:from="statement" xlink:to="argument" xlink:show="none" .../>
</sco-ext:learning-link>
```

Link-bases can be included in the metadata sections at the asset, SCO or package levels, and the choice would be a matter of the scope of the link-base. The benefits of this approach are those of XLink: multi-target, multidirectional and external links along with the definition of specific attributes and behaviours on links.

The LMS can use the meta-information defined on links to carry out link display adaptations – i.e. changing the appearance, in-screen arrangement of the links –, and also other forms of behaviours, like showing commentary links only to instructors, or providing adaptive linking behaviours (a review can be found in [Brusilovsky, 2001]), e.g. hiding analogy links if the destination location is about a concept that is currently not known by the student.

The main problem that introduces this approach is that LMS must be able to understand XLink, which would represent a major extension to the SCORM specification, difficult to become mainstream in the short run. As a consequence, restricted versions of the general-purpose approach that we have sketched –limited to extended the types in the <relation> elements – could be useful for practical reasons.

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Online learning: a project to develop an innovative approach to control

Introduction

This article describes a work in progress. My project is about the development of a personalised online learning control system, based upon web pages dynamically created from database data. It is an online system designed to encourage effective student learning through providing adaptive controls, while in the background student progress information is captured in the database to enable teachers to monitor and support the students' learning process. This work started as an attempt to enhance student motivation, skill building and effective learning by using the Internet in an adaptive way, to get away from the current 'one size fits all' philosophy. It has developed over the past four years, informed by a combination of research and student feedback, and is used for the teaching of business subjects to a group of over 200 students each year. These students are first year BSc undergraduates studying a range of technology-oriented degrees in the Engineering Faculty at the University of Central England in Birmingham, UK.

The Online Learning System

The system is designed to organise and present learning instructions and associated subject resources to the learner in a number of ways and levels. This information is initially presented in a tutor-set format, and the student can then explicitly adapt the way this module information is presented, by setting preference data or dynamically on the page.

The major elements of my online learning approach are:

- A blended approach, combining face-to-face teaching and independent online learning;
- An active learning and interactive style, allowing for text or graphic visualisations;
- Learning personalised to the individual through explicit adaptive controls;
- A tutor preferred task-oriented access to module resource materials;
- A topic-oriented alternative, linked to related tasks, for learner flexibility;
- Learner progress information dynamically updating views as feedback on tasks is input;
- Action sets to encourage social and collaborative learning, enabled through technology;
- Module resources loaded to the website in Office 2000 format, not converted to html;
- Adaptation enables use of different materials, rather than adapting materials;
- Online submission, marking and feedback on formative and summative assessment;
- Scaffolding of learners with support through embedded help, SMS and web messaging;
- The integration of a management information system to assist in management of students;
- Monitoring of online learner performance by teachers, with associated proactive support.

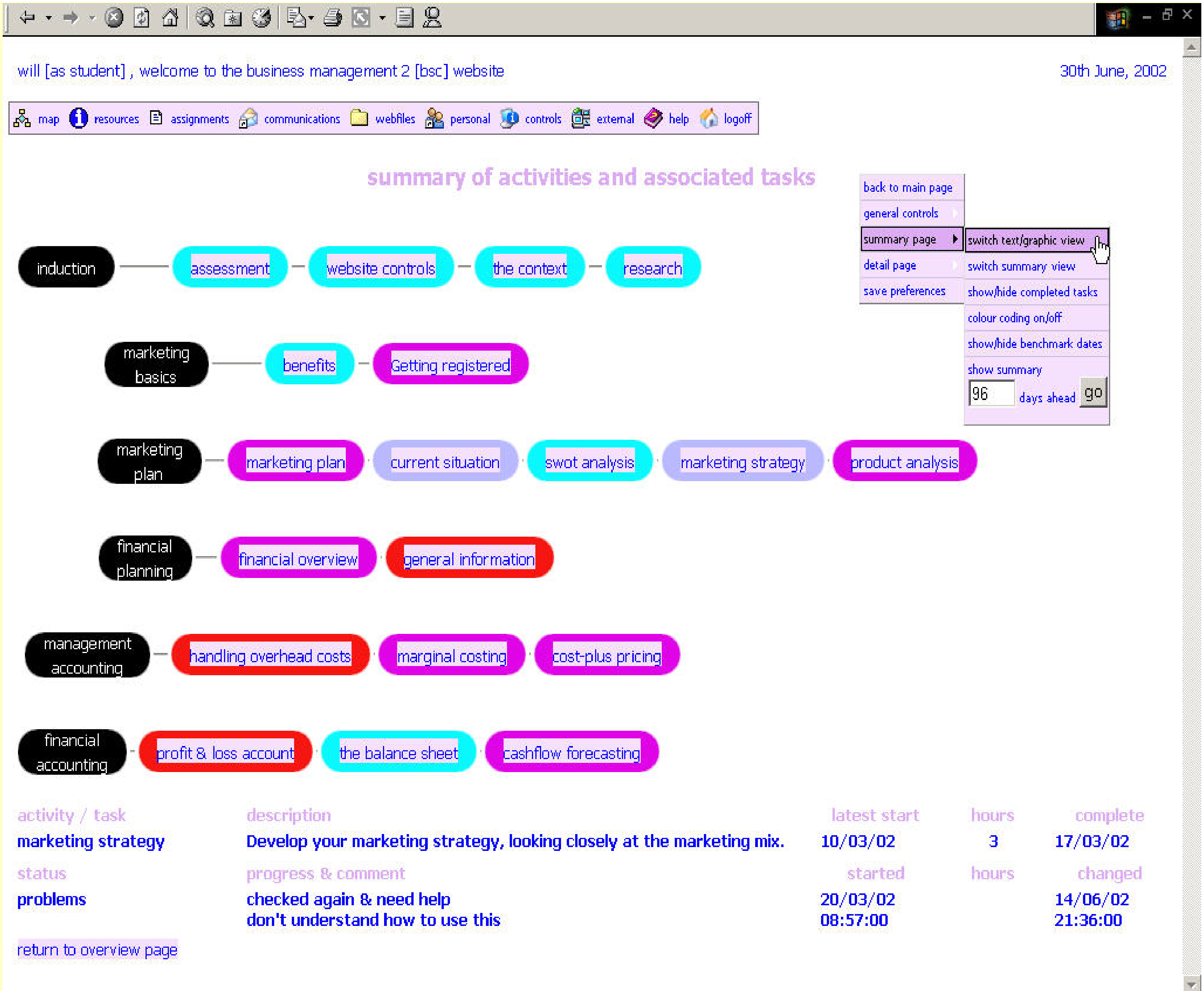

Figure 1. A screen shot showing one of the main control pages in my system

The technology underlying the online learning system – it is a system, not a website – is based upon SQL Server 2000 databases with web pages constructed using HTML, ASP, JavaScript and CSS. Pages are created dynamically from module and student databases to deliver module control information to the learner. This dynamic attribute then enables flexible and customisable views for each student, depending upon their preferences. The screen shot above gives a student view of the complete module structure, where images represent activities and associated tasks. Graphic images are created dynamically by combining module structure data and student progress data from the databases. Tasks are colour coded according to the student's task progress feedback and each task title is a hyperlink to task details, where access to task related resources is available. Tutor instruction and student feedback text for a task are shown using a mouseover technique. The menu bar is a drop-down menu facility for related views and facilities and the 'controls' menu, for adapting views, is a context menu initiated by the right mouse button function.

Issues

Feedback from the students about my style of online learning over the past four years has largely been positive, with favourable comments on the 'look and feel' of the technology, although reactions range from wildly enthusiastic to totally ambivalent. Motivation is generally higher than it was before using this approach on this subject area. Students initially find this approach to learning daunting and take some time to become comfortable with it. Academic results are in line with those produced using traditional teaching methods, but performance, particularly with the weaker students could be better. Sending text messages to student's mobiles directly from the system has been particularly effective in getting students to react to problems, for example late submission of coursework. Students do use the controls provided to adapt the views in different ways to suit their preferences and like the instant feedback that they get on their progress, particularly through the task colour scheme. Problems exist where students struggle with independent learning and I am attempting to develop the management information aspects of my system to recognise these students and then deal with them both online and face-to-face. Issues around students' understanding of what to do are common in the early stage, and it is apparent that a number of students have difficulties in reading technical instructions online. A comprehensive induction programme, covering use of the technology, development of learning skills and changing the learning culture, is still a major requirement and work is underway to implement this for the next academic year. Current improvements are being designed to identify problems in learner understanding and then to automatically adapt the form and style of instruction used and also to adapt the presentation depending upon student prior knowledge and progress. Exception reporting to assist in the management of the student group is being developed in the MIS aspects of the system. This is a key part of the move from 'sage on the stage' to 'guide on the side' and reflects the change from the teacher being the subject expert to being a learning facilitator.

Conclusions

Online learning is different. This is as true for staff as it is for students. Attempts at developing a web-based personalised learning system bring into play a complex array of characteristics. Attaining effective online learning is still a motivating force, but there is still a long way to go. Students' reactions to the approach are mixed and variable, just as they are in traditional teaching, however this is much more visible when using this approach. Difficulties with reading and understanding through computer screens need to be dealt with. Development of effective student and staff use of this technology is still in its infancy and our understanding still has some way to go. Finding the right balance between adaptive technology and human support is my quest.

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Using hypermedia to build web mediated constructivist learning events

When building a web mediated learning event, it is important to ask, "How will the pedagogy used support a best practice in education?" Web mediated learning events may be used to deliver instruction at a distance, or they may be used to extend the classroom experience. Either way, the hypermedia nature of the web makes it possible to simulate most of the best practices that are used daily in classrooms in the "real world".

One of those best practices is to facilitate a constructivist learning event. The constructivist learning movement is a natural outgrowth of a refinement of two models of learning that have long been considered to be best practices in education. And, the hypermedia nature of the Internet provides a way to facilitate virtual learning events that are consistent with both of these models.

Jean Piaget observed that children naturally explore their worlds and learn from their experiences. He noted that children manipulate things in their environment much as a scientist will, for the simple sake of observation. And, from those observations, these "little scientists" make discoveries about their worlds (http://www.piaget.org/). Agreeing with this theory and seeing the child as having the potential "to be revealed" through experience and discovery, Maria Montessori developed the first Discovery Learning model (http://www.montessori.edu/maria.html).

Operating from his own theoretical perspective, John Dewey helped developed the Experiential Learning model in which the learner uses a specific process to confront a problem, isolate data, form an hypothesis based on the isolated data, and then test the hypothesis (http://www.utm.edu/research/iep/d/dewey.htm#Theory of Knowledge). This model also requires that the learner take an active role in which he or she interacts with things in the environment both while isolating data and while testing the hypothesis. In other words, in both these models, the learner "constructs" understanding through active exploration and hypothesis testing. So, the key to understanding how hypermedia can be used to support constructivist learning is to understand the nature of constructivist learning itself (http://www.exploratorium.edu/IFI/resources/constructivistlearning.html). The following conditions must be present for a learning event to be considered "constructivist":

The learner must actively seek to understand a new set of knowledge or skills.

- The learner must have a way to formulate his or her own understanding through manipulating things or thoughts in the environment and observing the results of those manipulations.
- The learner must have a way to test the hypotheses that he or she is forming through feedback and/or consequences in the environment.

Much time has been devoted to the discussion of this educational practice. It has been confirmed in many position papers and research documents that the constructivist approach does lead to life-long learning behaviors. It has also been confirmed that the approach does result in more positive outcomes for learners at most ages than does the more tradition transmission model of learning in which the learner passively acquires knowledge that is being imparted by an expert (http://www.ed.gov/databases/ERIC_Digests/ed345929.html; http://www.ed.gov/databases/ERIC_Digests/ed443597.html; http://www.ed.gov/databases/ERIC_Digests/ed253468.html). And, yet, far too many web mediated learning events are built on the more traditional transmission model with the learner simply taking in information from the web page (or the class instructor via the web) as the expert.

So, how can hypermedia events be used to facilitate active exploration and the construction of knowledge? Here are just a few suggestions:

WebQuests that include a Directed Thinking Activity - The concept of a WebQuest was developed by Bernie Dodge (http://edweb.sdsu.edu/courses/edtec596/about_webquests.html). It is a term that is well known to many elementary teachers. However, WebQuests are less often used by those who teach older aged students and adults. The concept has become a bit "watered down" over time, as often happens in the field. But, the basic idea is to have students inquire for information by visiting web sites in order to complete an activity or a project. One of the keys to making a WebQuest constructivist is to include a Directed Thinking Activity in which the facilitator of learning provides prompts or questions that learners use to help direct their searches for understanding. An example of a WebQuest for adult learners can be found at http://www.lspe.com/store/wqintro.htm.

Simulations - The value of computer mediated simulations for the purposes of constructivist learning has long been recognized (http://phoenix.sce.fct.unl.pt/simposio/Ton_de_Jong.htm). Most simulations require that the program be able to branch into a particular outcome based on input from the learner. Hypermedia provides an excellent way to facilitate such branching. In the hypermedia environment, the learner comes to a decision point, makes a selection, and experiences the results or the outcomes of that decision. A good example of use of hypermedia to develop a simulation can be found at http://imedia.ksc.nasa.gov/index1.html.

Educational Games - There are a variety of ways to use games to facilitate constructivist learning. One of the most useful ways to use a game is to provide natural consequences or trial and error feedback. In this type of game, the "player" (learner) makes a selection. If the selection is correct the player is rewarded. However, if the player is incorrect, the consequence is a negative one. The combinations of positive and negative consequences are then used by the learner in the formation of or the confirmation of the hypothesis that is being tested. The following web site uses hypermedia in a game that can be used in this way: http://www.multiplechoicescec.com/courses/mehwork/tes.htm.

Virtual tours - Sometimes, it is important for the learner to simply be set free to "explore the environment" in order to learn what is there. Hypermedia makes it possible for the learner to set the pace and control the order of events. This web site is a good example of a hypermedia mediated virtual tour: http://www.nationalgeographic.com/features/97/castles/enter.html.

In its earliest form, the Internet of hypertext pages provided only limited possibilities for the design of constructivist learning opportunities. But with a full range of hypermedia now available, the opportunities to create virtual experiences in which the learner actively explores, gains feedback, and tests hypotheses are almost limitless.

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Announcement

Book Launch

“The Experience Designer: Learning, Networks and the Cybersphere” explores a dramatic new vision for learning and the Internet.

> "This is simply the best book that I have read on the process of learning. Brian's vision is unique, risky, and compelling. This is essential reading for anyone interested in taking charge of the future of learning."
> - Jerome Durlak, Communication Arts Professor, York University and the Canadian Film Centre.
>
> “In The Experience Designer, Brian Alger goes beyond the conventional notion of e-learning to provide us with a comprehensive context for lifelong and personal evolution. Brian empowers us to take control of the learning process through his holistic, systematic and inventive approach.”
> - Robin G. King: President, Imagina Corp; Animation Program, Sheridan College, Canada.
>
> “Brian Alger has raised the bar significantly. These shifts in thinking and practice will unleash the largely untapped power of e-technologies to help design authentic, interactive learning experiences for students, teachers, trainers, trainees and learners everywhere.”
> - Bob Williams: Education Leader; Director of Education, Ontario, Canada

The Experience Designer is designed to stimulate and provoke new ideas, insights and strategies for the effective use of new technologies to enhance and extend our ability to learn in a lifelong and lifewide manner.

Please visit http://www.experiencedesigner.net/index.htm for more information.

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