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Assessment and Comparison of Web-Based Educational Environments

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Abstract: *The World Wide Web (WWW) has considerable potential for delivering distance education programs. New software tools are being developed to facilitate the authoring, delivery and management of Web-based courses. In this paper, we perform a detailed assessment of five such Web-based educational environments, namely WebCT, TopClass, LearningSpace, Virtual-U and LearnLinc. We base our evaluation on experimentation and practice with these tools.*

1. Introduction

Tele-Education on the WWW can enhance the traditional way of teaching and offer new learning experiences to the students. However, there are many questions to be answered, for example how well a formal educational system can be delivered over the Web, will there be any human contact or communication, what are the benefits of Web-based education, etc. Recently, many Web-based educational environments have been developed. These software tools help in the development and authoring of courses, the delivery of the courses over the Web, the secure access of the course material by the students and the instructors, the automatic grading of exams, the student performance tracking and reporting, the statistical analysis of the student performance and the course material usage. Some popular software tools that facilitate the creation of sophisticated Web-based educational environments are the following: WebCT [WebCT], TopClass [TopClass], LearningSpace [LearningSpace], Virtual-U [Virtual-U] and LearnLinc [LearnLinc].

It is difficult to conclude about the best product because some are better in a particular feature area, while others in another feature area. Furthermore, every day new products and new versions of the already existing products appear. Bruce Landon [Landon 1998] compares many software tools such as WebCT, TopClass, LearningSpace, Virtual-U, Web Course in a Box, CourseInfo, FirstClass, PlaceWare. He concludes that WebCT, TopClass and LearningSpace are the best, with a slight superiority of TopClass. LearningSpace precedes the others in the synchronous collaboration features. It is important to mention that the synchronous communication abilities of LearningSpace are due to the DataBeam Learning Server, a Web-based educational product by Lotus Company. Sharon Gray [Gray 1998] surveys many software tools and concludes that LearningSpace is the best followed by WebCT and TopClass V2.0.2. Gray mainly focuses on the area of collaboration tools in which LearningSpace is a step ahead. Gray also points out the importance of WebCT for its feature of detailed student progress report and TopClass for its auto-testing feature. Herb Bethowey [Bethowey, 1997] concludes that TopClass is an easy to use software tool with extensive features for interaction between student-to-student and student-to-instructor. He also suggests LearningSpace as an excellent collaboration tool, with excellent course administration. Some other papers [Iowa 1997], [DBCC 1998], [Manitoba 1998] and [Uiterwijk & Seoane 1998] also analyze and compare Web-based educational tools, with LearningSpace, WebCT, TopClass and Virtual-U to be the most promising for Web-based education. University of Manitoba compares the three important software tools (LearningSpace, WebCT, TopClass) and the authoring tool ToolBook II. The survey concludes that WebCT has many capabilities for an integrated educational environment with TopClass and ToolBook II coming next.

In this paper, we analyze and compare WebCT, TopClass, LearningSpace, Virtual-U and LearnLinc. We evaluate the most recent versions of these products. Although LearnLinc has not many features, we evaluate it because it is a new powerful integrated program with superior characteristics for synchronous education. We provide a comprehensive table with all available features for the evaluated tools.

2. Web-Based Educational Environments Presentation

In this section, we present five popular Web-based educational environments to which we have ended up after extensive investigation: WebCT, TopClass, LearningSpace, Virtual-U and LearnLinc.

2.1 WebCT

WebCT [WebCT] is an easy to use environment for creating web-based courses without need to know programming. We have built online courses easily with the use of event-driven buttons. Only few times it was necessary to interfere with the course page's code in order to add advanced functions or modify slightly the existing features. WebCT was developed to support self-guided online courses. It supports high security as it is installed over the Apache Server. The Apache Server helps us to control the user's access and to secure the course material and framework from the hackers. We found out that the Internet Explorer is incorporated better than Netscape Navigator. WebCT also provides conferencing system, on-line chat, student progress tracking, group project organization, student self-evaluation, grade maintenance and distribution. Moreover, it provides access control, navigation tools, auto-marked quizzes, electronic mail, automatic index generation, course calendar, student homepages, course content searches and much more. WebCT gives the ability to the students to create their personal Web Pages allowing them to display their homework or any other information.

2.2 TopClass

Working in conjunction with web and media servers, TopClass ver. 3.0 [TopClass] provides scalability with sophisticated tracking and security. TopClass Server delivers courses and tests to any user connected through Intranets or the Internet. It also supports collaboration and discussion-group. It can use Oracle as a data store for training content, recording testing and tracking information. This option helps us to support more sophisticated reports and align management and backup procedures with other enterprise systems. It also supports the use of authorization information on Windows NT networks to identify users and eliminate additional login steps. It is certified to be Year 2000-compliant. Other utilities include the Player for off-line viewing and the Converter for automatic translation of MS Word documents or Web-based training content into complete TopClass courses. TopClass Player is a useful utility program, especially in remote locations where we can not afford the cost of online viewing. We only have to pay for the time being connected to the Internet in order to transfer the course content in our PCs. After finishing this transfer, we log off and continue our training in an offline viewing avoiding the connection's costs. The Creator lets us combine any web-compatible content into learning modules. The Assistants convert all documents and MS Office 97 presentations into complete courses. The Analyzer keeps track of usage, gathers feedback, and provides data for return-on-investment analysis. An advantage of TopClass Server from the other tested tools is the ability to convert instructor's material from a *.doc* or *.html* or even *.ppt* format into a customized course format to be displayed to the students. This function facilitates the instructors to build a course without the need to know programming.

2.3 LearningSpace

LearningSpace 2.5 [LearningSpace] is the latest release of Lotus solution for creating and delivering collaborative distributed education and training. LearningSpace runs on the industry-leading Domino Web Server, so it provides outstanding flexibility, advanced security and scalability. It does not require programming or technical skills. Templates help us to shape course content quickly and easily. LearningSpace transforms courses with cutting-edge video, audio and graphics, supports team learning and collaboration, manages courses and controls enrollments. It also provides private areas for discussions, assignments, grades, or confidential information. Furthermore, LearningSpace is becoming more powerful by collaborating with the DataBeam Learning Server. This results to a more integrated solution, enhancing the program's functions (Audio and VideoConference, Whiteboard and Application Sharing). An important function of this collaboration is the Application Sharing, which help us to share an application and to work in-groups effectively.

2.4 Virtual-U

Virtual-U [Virtual-U] is a server based software system that enables customized design, delivery, and enhancement of education and training courses. We can support group communication and collaboration in a secure newsgroup-style setting. Also we can easily set up collaborative groups online and define structures, tasks and objectives. A user can learn to moderate conferences and to create sub-conferences. Virtual-U enables us to organize course resources into a flexible online course syllabus without programming knowledge. These resources can include downloadable files, course texts, relevant Web links, assignments and any type of multimedia file. It automatically places the course syllabus on the Web for access by all students enrolled in that course. Virtual-U includes functions such as creating and maintaining student accounts, defining access privileges and establishing courses. Administrators can also perform batch imports of class lists from existing registration data.

2.5 LearnLinc

LearnLinc [LearnLinc] was the first live online learning classroom to support multimedia-authored courseware, allowing CBT quality synchronized content. It provides a simple user interface allowing us to configure features and presentation materials for students. It also supports full duplex audio and two-way videoconferencing with Intel ProShare 500. LearnLinc’s Floor Control lists student names alphabetically, or in hand raises order allowing us to choose students easily to call on. Also it enhances our communication using videostreaming for one-way delivery of live or pre-recorded audio and video. LearnLinc’s Synchronized Web Browser supports full functionality. LearnLinc supports Application Sharing for full interactivity. Moreover it contains a Question & Answer feature, to allow the instructor to write and launch questions before class or on the fly during a class and a Text Chat that allows private messages to be sent to the instructor by a student. Its Shared Whiteboard allows any file or image to be pasted-in as an object. LearnLinc is suitable for real time distance education. However, it does not include all the appropriate functions to simulate a traditional classroom.

3. Comparison Criteria

In this section, we analyze the criteria that we use in the comparison of the Web-based educational environments. The following criteria are the most important in order to make a comprehensive and extensive assessment of these educational environments. We can classify these criteria according to their related features [Mamoukaris & Economides 1999] in: technology features, administration features, student features, instructor features and communication features.

Criteria that are related to the technology of the tools include the required RAM, Platform Independence (operating system), Access from Internet or LAN, Web-Browsers, ability to refer to an Universal Resource Locator, Internal e-mail to registered users, External e-mail to non-registered users, Video, Audio and Database (internal database and external database cooperation).

Criteria that are related to students such as off-line Viewing (the ability to view a course without being connected to the Internet), Friendly User's Interface, Annotations (students keep notes near the course material), automated Index, Text-Search, Learning Goals.

Criteria related to administration features’ concern the Security levels and Crash recovery tools that restore the course content and related information without loss of data from communication or server hardware failure.

Communication and Collaboration related criteria include Discussion Area to support asynchronous threaded communication, Audioconferencing, Videoconferencing (broadcasting video to users without a video input device), Bulletin Board (downloading and uploading/posting files over the Web), Chat (exchange of text in real time), Whiteboard (shared text window that may also support shared drawing), Application sharing (run an application on one machine and share the window view across the Web).

Criteria related to assist the instructor include Remote authoring & administration of courses, Customization features for Welcome Page, Customization features for the courses, Building motivation (adapting the display of the course content to the user’s preferences), Syllabus (automatic creation of a page with the contents of the course), Creating Actions (provide the student with extra material depending on test's results), Language for advanced functions, Questions Pools (repositories for questions), Import/Export Courses, Import a course with a .doc format (from Word), Import a course with a .ppt format (from PowerPoint). Additional criteria concern the

Access Control to prevent unauthorized access to the courses or to the program, Restrictions for the course material or the access time, Testing, Number of question types, Submission and Auto-Correction of tests and Reports of user's progress. Also, criteria related to the friendliness and easy of use of the tool include the requirement for Knowledge of HTML, Friendly Designer's Interface, Glossary that will help the designer to automatically specify a list with keywords and their definitions.

Finally, Price comprises another critical factor to our comparison. However, there are many differences in the way every product is priced. For example, the cost of WebCT, LearningSpace and Virtual-U refers to 100 users per one course. On the other hand, TopClass and LearnLinc calculate the cost for 100 simultaneous users (there may be many more registered users than those participating at a specific moment) and for a large number of courses per user (not just one course).

4. Comparison Results

Based on our practice and experience with WebCT, TopClass, LearningSpace, Virtual-U, LearnLinc, we present the following Table:

Criteria	WebCT	TopClass	LearningSpace	Virtual-U	LearnLinc
RAM	32MB	32MB	64MB	24MB	32MB
Platform Independence	W, U	W, A, U	W, U	W, U	W
Access from Internet or LAN	Both	Both	Both	Both	Both
Web Browsers	Yes	Yes	Yes	Yes	Own Environment
Universal Resource Locator	Yes	Yes	Yes	Yes	Yes
Internal E-mail	Yes	Yes	Yes	Yes	Yes
External E-mail	*	Yes	Yes	No	Yes
Video	Yes	Yes	Yes	Yes	Yes
Audio	Yes	Yes	Yes	Yes	Yes
Database	Yes	Yes (Oracle)	Yes	Yes	Yes
Access Control	Yes	Yes	Yes	Yes	Yes
Restrictions for the courses	Yes	Yes	Yes	Yes	Yes
Testing	Yes	Yes	Yes	Yes	Yes
Number of questions types that supports	5	7	-	-	1
Submission and Correction of test	Yes	Yes	Yes	Yes	Yes
Report's of user's progress	Yes	Yes	Yes	Yes	Yes
Knowledge of HTML	No	No	No	Yes	Yes
Friendly User Interface	Yes	Yes	No	No	No
Friendly Designer's Interface	No	Yes	No	No	No
Glossary	Yes	No	No	Yes	No
Off-line Viewing	No	Yes	No	No	No
Annotations	Yes	No	Yes	Yes	Yes
Index	Yes	Yes	Yes	Yes	-
Text-Search	Yes	Yes	Yes	Yes	-
Learning Goals	Yes	No	Yes	Yes	No
Discussion Area	Yes	Yes	Yes	Yes	Yes
Audio-Conferencing	No	No	**	Yes	Yes
Video-Conferencing	No	No	**	Yes	Yes
Bulletin Board	Yes	Yes	Yes	Yes	Yes
Chat	*	No	No	No	Yes
Whiteboard	No	No	**	No	Yes
Application Sharing	No	No	**	No	Yes
Remote authoring & administration of courses	Yes	Yes	-	-	-
Customization features for Welcome Page	***	Yes	Yes	***	***
Building Motivations	No	Yes	No	No	No
Customization features for courses	Yes	Yes	Yes	No	No
Syllabus	Yes	No	Yes	Yes	Yes
Creating Actions	Yes	Yes	Yes	Yes	Yes
Language for advanced options	No	QML	No	No	No

Criteria	WebCT	TopClass	LearningSpace	Virtual-U	LearnLinc
Question Pools	No	Yes	Yes	No	No
Import/Export Courses	Yes	Yes	Yes	No	Yes
Import a course with a doc format (from Word)	No	Yes	No	No	No
Import a course with a ppt format (from PowerPoint)	No	Yes	No	No	Yes
Crash Recovery Tools	Yes	Yes	Yes	-	-
Price (see price criteria)	$500 for 100 users	$3,750$ for 100 users	$1,000 for 100 users	$3,500 for 100 users	$500 - $1,000

Table 1: Comparison of the educational environments

Price example: $500 for 100 users of WebCT, $3,750 for 100 users of TopClass, $1,000 for 100 users of LearningSpace, $3,500 for 100 users of Virtual-U and $500 - $1,000 for users of LearnLinc. In the table W means Windows, U - Unix and A - Apple. Also the symbol "*" means *Some Problems* appeared during experimentation. The symbol "**" means that LearningSpace provides Audio and VideoConference, Whiteboard and Application Sharing by combining its features with DataBeam Learning Server's features and "***" means that these products do not offer the ability to the designer to customize the Welcome Page according to his preferences. The graphics at the Welcome Page cannot been modified. Finally the symbol "-" means *Not enough information.*

5. Conclusion

There is a huge market for Tele-education over the Internet. Many software tools have been appeared that helps the delivery of courses over the Web. We evaluate five such popular Web-based educational environments and find out that each has some special features. The right choice depends on our preferences. LearningSpace is a powerful tool for collaboration and with the support of Lotus Domino Server provides a secure environment. LearnLinc is a very powerful software tool especially for conferences. In conjunction with DataBeam Learning Server it supports Video and Audio conferences and team-based conferences, but it is weak in supporting the online courses to the students. At present, we prefer TopClass and WebCT. TopClass provides a secure environment with different security levels and cooperates with the Oracle database. Its unique feature is that someone can download the course material, disconnect from the Internet and study the course offline with the help of utilities that accompany the program. In addition we can upgrade it by using tools such as IChat, and built a synchronous environment. Moreover, by incorporating the MS NetMeeting into it, TopClass can provide an integrated environment for Web-based education. WebCT has the advantage of an internal Chat environment, enhancing its functions with real time text communication. Additionally, WebCT's Chat offers a variety of forums for different thread discussions. An advantage of WebCT is the security due to the Apache Server. Apache Server is a powerful, widespread Web Server, which controls the access to the course content and prevents unauthorized access.

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