

Combining Synchronous and Asynchronous Learning Networks in Engineering

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Abstract

For the past year faculty at Christopher Newport University have been experimenting with Synchronous Learning Networks (SLNs) and Asynchronous Learning Networks (ALNs) throughout the computer engineering curriculum. Learning Networks are introduced in introductory physics courses and used in many courses throughout the four year program. A web-based software tool, Web-4M, is being used as a common thread to combine SLNs and ALNs at Christopher Newport University. Web-4M, which is now commercially available, was designed by CNU faculty to address the needs of science and engineering students in network-based learning. This software uniquely merges SLNs and ALNs by linking synchronous tools such as chats, white boards and slide shows with a common data repository that is also used by asynchronous tools such as email, news groups and a file manager. These communication tools are used in a variety of ways including: simple file transfer, virtual office hours, student project logs, posting review material, collaboration with other institutions, and student to student collaboration. This paper discusses the unique features of Web-4M and faculty experience in the application of this tool set to engineering instruction.

I. Introduction

Over the past year faculty in Engineering and Physics have been teaching with a tools suite called Web-4M. The collaboration and information sharing tools found in Web-4M can be applied to any discipline, but the rich nature of visualization tools found in Web-4M (an not found in many other collaboration products) made it especially useful in teaching engineering and science. Web-4M, a product developed by [JDH Technologies](#), is unique in that it is a hybrid tool suite containing both synchronous and asynchronous tools useful in both web-based and traditional classes. This mix allows greater flexibility in presentation of material in a learning environment. It also opens up a realm of possibilities not available solely through ALNs. For example, Web-4M is very effective in a hybrid class that not only meets in a traditional, time-bound classroom but also requires the students to take part in a given amount of on-line synchronous discussions, problem-solving sessions, group homework, or to view presentations. A key component of making these new teaching paradigms work effectively is a tightly integrated distance education delivery system that allows for storage and retrieval of materials presented in a synchronous forum, thus accommodating absenteeism and providing a means for student review. The following sections will discuss some of the features of Web-4M, explain how the synchronous and asynchronous tools are integrated and give an example of how these tools can be used effectively in an engineering curriculum.

II. The Web-4M Tool Suite

The Web-4M suite consists of eight communication and collaboration tools plus several utilities. We will not discuss all of these tools but will highlight some of the unique tools not found in other web-based distance learning software. Web-4M can be roughly divided into asynchronous and synchronous tools as shown in Table 1, although due to the tightly integrated nature of Web-4M this line between synchronous and asynchronous is not always clear (more on this later).

| Tools | Category | Common Function |
|-----------------------------|--------------|--------------------------------------|
| White Board | Synchronous | Shared Drawing |
| Interactive Slide Show | Synchronous | Synchronized presentation & browsing |
| Chat | Synchronous | Text-based real-time communications |
| Yo & Broadcast | Synchronous | 1-to-1 or 1-to-many direct messaging |
| Email | Asynchronous | Common email functional |
| News Groups | Asynchronous | Student logs |
| Browseable Document Library | Asynchronous | Documents sharing/posting |
| Calendar | Asynchronous | Posting important dates/events |

Table 1. Web-4M Tools

A. Multi-media Rooms

Another distinguishing feature of some of the tools is whether or not they are room-based. Web-4M has extended the concept of a Chat Room to that of a Multimedia Room. An instructor can go into a room with a group of students and Chat while presenting material in a Slide Show or while sketching on a White Board. It is also possible (although not recommended for the novice) to participate in multiple rooms. There are also different kinds of rooms, which can serve different purposes. An instructor or administrator sets up permanent rooms. An instructor may, for example, set up a permanent room called Engineering 101, where the introductory engineering class regularly meets, refer to Figure 1. Every time students log into the system, they can go to this room and interact with other on-line users. Another kind of room in Web-4M is called an Annex. Annexes are rooms anyone can create and they exist within the system until the last person exits the room. These are useful for student breakout discussions or problem-solving sessions. A third type of room is called a Hideout. Hideouts are private rooms, which only invited participants may enter. These rooms are useful for private discussions and/or advising.

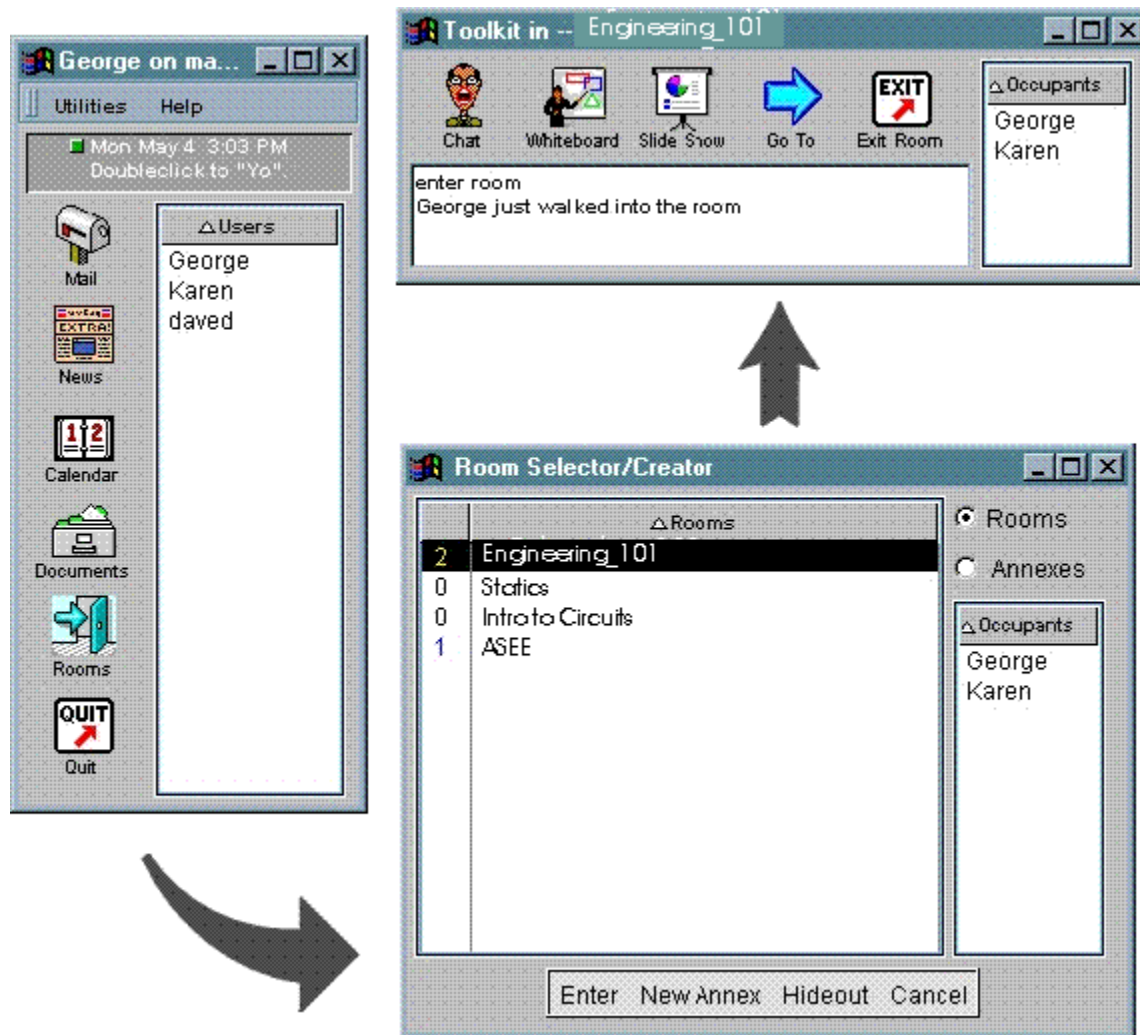


Figure 1. Web-4M Tools: Main Control Window, Room Selector and Room Toolkit.

B. Interactive Slide Show

The Interactive Slide Show shown in Figure 2 is an especially powerful tool for presenting material. A series of images can be synchronously controlled by an instructor, allowing a multi-user distributed PowerPoint-like presentation. In fact a PowerPoint presentation can be easily converted into a Web-4M slide show. The images in a slide show are presented with the White Board, allowing them to be annotated. In addition to images, URLs and audio files can be attached to each slide. The URL feature allows an instructor to synchronously browse the web with a class and also to launch documents supported by the browser such as movies. A slide show may be used in conjunction with Chat to discuss the presentation and to query student for responses.

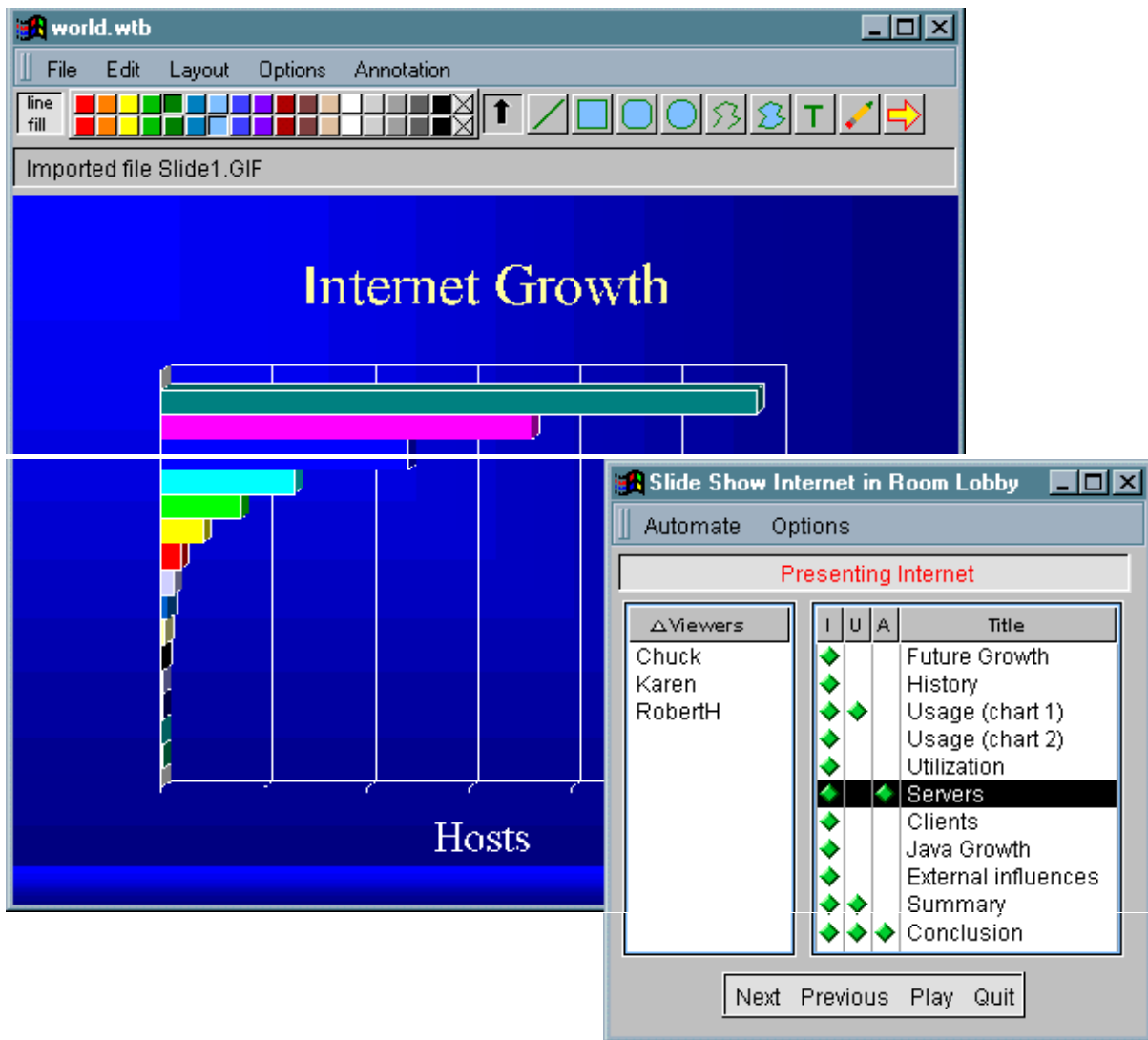


Figure 2. Interactive Slide Show presented in the White Board tool.

C. Yo & Broadcast

These tools are effective for sending messages to one or all system users. When someone "Yo's" a user in the system, a dialog box pops up on the recipient's computer and an audio message alerts the user that a message has arrived. This is a simple and effective means of getting the attention of another user in the system and sending them a message. The Yo and Broadcast tools are not room-based and can therefore be used to communicate with any user logged in to the Web-4M systems. These tools are very useful for inviting users into a multi-media room for a presentation or discussion.

D. Browseable Document Library

The Browseable Document Library consists of a document browsing tool which allows students to select and view documents that have been posted or stored in the library. This is an asynchronous tool that students can use independently to review materials. Students can view documents supported by web browsers including HTML, GIF, JPEG and text. Additional formats, such as PDF, AVI, MPEG, MOV, DOC, XLS, AVI and others, are easily configurable via plug-ins or helper applications. The browsing tool can be used to control the reading of documents. By means of the browsing tool, students can easily navigate documents that are hierarchically organized in a

file/directory structure. A companion tool, the File Manager, allows the posting of documents with a Drag-and-Drop operation. For example, it is trivial to post a scanned image from a textbook to the document library; you simply select the image file, and drag it to the student-accessible destination directory with the File Manager. Students can then view this document by using the document-browsing tool to display the document.

E. Additional Features

In lieu of going into all of Web-4M's tools in detail, Table summarizes unique features of some of the other tools. Detailed information can be found on the Web-4M Reference Pages on the JDH Technologies web site.

| Tool(s) | Feature | Comment |
|--------------------|------------------------|--|
| Chat | Text formatting | Useful for equations with superscripts and subscripts. Bold, italics and different font sizes are available. |
| Chat | Whisper mode | Allows directing chat to specific users in a room. Students can whisper questions or answers to the instructor without anyone seeing them. |
| Chat | Stealth mode | Instructors can enter a Chat room as super-users and not appear in the participant's list. This provides a way to silently monitor chat discussions. |
| Email | Folders | Drag and drop messages into separate folders to keep email organized. |
| Email | Groups | Maintain mailing groups, keeps group consistency as groups are updated. |
| Email | On demand attachments | Email attachments are only downloaded when requested, very useful over slow network connections. |
| Email | Return receipt | Returns notification to the sender when email is opened by the recipient. |
| Email/Calendar | Mail-able appointments | You can email students due dates and exam dates that will be automatically posted to their calendars. |
| Slide Show Builder | Image import | Allows a presenter to easily build a presentation from images exported from software tools such as PowerPoint. |
| White Board | Image import | Allows users to import images into the White Board tool for distributed viewing and annotations. |
| White Board | Object-based | The White Board tool is object-based, making drawing and editing pictures easier. |

II. Merging ALNs and SLNs

What does an instructor do when a student cannot attend an on-line presentation and discussion? In a traditional "off-line" class in such a situation the student copies the instructor's or a fellow student's notes. In on-line classes that utilize synchronous tools with asynchronous tools, the trick is to provide the student access to information presented in the synchronous forum in an asynchronous manner. Web-4M provides several mechanisms for doing this. Synchronous tools like Chat, White Board, and the Interactive Slide Show all permit saving to the Browseable Document Library, thus creating a record of the synchronous forum. This is depicted in Figure 3

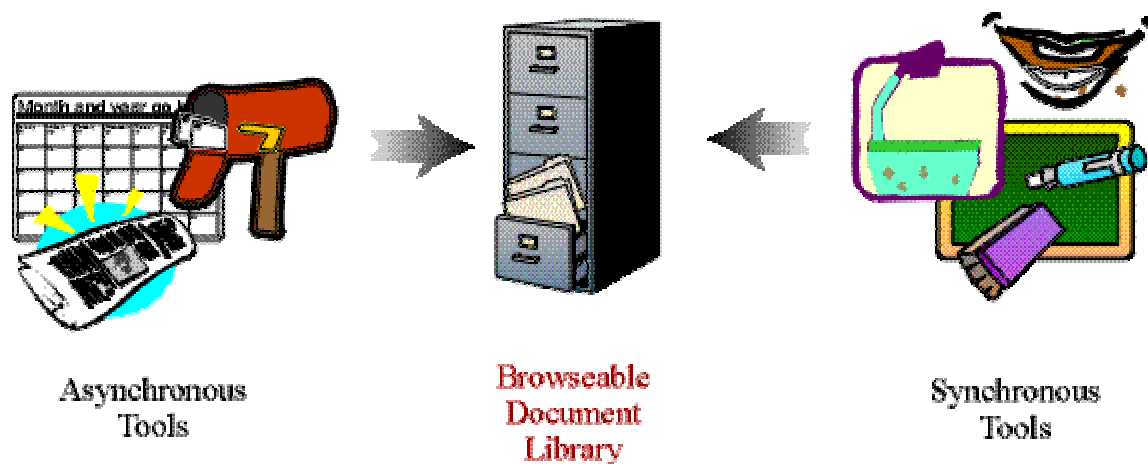


Figure 3. Combining Asynchronous and Synchronous Tools

Consequently, it is possible to simply tell the student to review the presentation, associated White Boards, and the Chat transcript that are in the document library.

The Document Library is a central repository for all of the tools in Web-4M. Email and News Group attachments can be stored in this area along with Chat discussions, White boards and Slide Shows. This also makes it possible to email (or post to a news group) a transcript of a Chat (or an annotated White Board) to an individual or class members. It is like having a court stenographer in the virtual classroom. It therefore becomes possible to ask on-line students to collaboratively work in groups using synchronous tools and then send by email copies of their group discussions as progress reports to the instructor. There is a great deal of flexibility in having combined synchronous and asynchronous tools. The next section gives one example of how an instructor might use this combination.

III. Virtual Class Flow

Dietz [1] outlines the basic instructor/student interactions in the traditional learning process which include pre-, post- and in-class materials, instructor and students asking questions, gauging student reactions and evaluating student comprehension. These interactions should occur in a distance

learning environment as well as in the traditional classroom. The delivery of pre-class material is easy. Pre-class material can range from reading web pages with related materials, assigning textbook problems, to writing assignments. The type and format of materials is often class dependent. In problem-solving classes like those found in Engineering, it is desirable to give sample problems of the type an instructor plans to cover in an on-line presentation and/or Chat session. While a wide range of document types can be easily posted to the Browseable Document Library for student review, other effective mechanisms for pre-class material delivery include sending email directly to students or posting materials to news groups.

The in-class instructor/student interactions can occur using the synchronous tools. The Chat tool combined with a previously prepared Interactive Slide Show can be used to step through new material. Problems or questions (similar to those given in the pre-class materials) can be included in the Slide Show. Students can be asked to respond via the Chat tool. If students whisper their responses to the instructor, only the instructor will see the student answers, thus eliminating copycat solutions or possible student embarrassment. Since the instructor controls the Slide Show, a “hint slide”, or “solution slide” can be presented after the instructor receives student responses. Student themselves can also ask questions of the teacher or of each other. In an Engineering Ethics class, an instructor might present an ethical dilemma and allow free discussion among the students to encourage them to express various interpretations. In a large class it is possible to have students break out into small groups and have group discussion in an Annex (temporary room). Remember also that the slides (images) in a presentation are presented in the White Board, making it easy to annotate, edit or emphasize a particular portion of the slide.

Post-class material can be delivered to students using the same methods as the pre-class material. Chats transcripts, Slide Shows and White Boards can be easily archived to the Document Library for student review. Emailing calendar events with homework due dates is an easy way to ensure students know when material is due. Calendar events will be posted to the student’s calendar as a reminder. Using the Return Receipt feature in email lets the instructor know the student has opened the email message. A homework News Group is also useful. Both problems and solutions can be posted to this News Group for student access and review. News Groups are also useful for student logging. In project classes students can submit periodic logs to individual New Group to track their activities during the project. Joint group logs submitted by a design teams are also effective.

Another post (or pre-) class interaction is virtual office hours. An instructor can have scheduled office hours or just stay logged in to the Web-4M system while working in his/her office. Students can see that the instructor is in and communicate questions to their instructor in a variety of ways using Web-4M. The most effective method for virtual office hours is through a Chat, but if graphics are also required the White Board is very effective.

Evaluation of comprehension can be achieved through synchronous interactions. Instructors can review Chat transcripts to see who is not participating and comprehending (or maybe not reviewing pre-class material). If students know in advance that an instructor will review and grade answers presented during a Chat session they will have added incentive to be ready for an instructor's questions. Of course, most classes use some form of testing. It is easy to present an exam on-line via email (with return receipt) or by posting to the Document Library. Submission is best performed via email. Web-4M's email has extensive sorting features (time/date, sender, subject, ...)

which make it easy to group emails together and move them into folders. Since all email is time stamped, is also possible to give timed exams.

V. New Paradigms

Technology is rapidly changing requiring faculty to respond quickly with new teaching paradigms to effectively utilize new technology in the traditional classroom as well as in distance education. Next semester we are planning a hybrid class with the upcoming release of Web-4M. This new version of the software will change the face of distance education yet again. The new release contains a broadcast audio feature which works in conjunction with slide shows, chats and whiteboards in a room. With this new capability, an instructor will be able to talk through a lecture or presentation with a class on-line. The audio control can be requested and passed to individuals allowing students to participate by asking questions. The audio capability is designed to work on low bandwidth networks (as low as 28.8k modems).

Additionally synchronous and asynchronous assessment tools will be included in the upcoming release. The synchronous feature will allow for histogram responses to questions that are embedded in slide shows. Asynchronous exams can also be created with many question types (T/F, Multiple Choice, Numerical, Essay and Survey). Timed examinations and auto-grading of questions is also supported. Finally a full duplex phoning capability is supported. This feature is sure to be extremely useful for 1-on-1 instructor/student conferencing.

With enhancements like the ones discussed above, the distance learning environment will begin to more closely mimic the traditional classroom. Video capability, of course, is on the horizon but due to the bandwidth requirements may still be several years away from reaching the desktops of students connected to the Internet. With every new capability, will come more possibilities and more problems. Keeping current with technology is a must in sorting through the possibilities and developing effective teaching paradigms.

IV. Java Technology

When students use Web-4M their computers are actually running Java applets. We mention this because of some of the practical benefits associated with the Java technology. First, students only require an Internet connection and a computer with one of the latest web browsers (typically Microsoft Internet Explorer or Netscape Communicator). There is no other software installation required of the students. This feature should please administrators of distance education programs because there is no software distribution required on system upgrades. Another important feature of the Java technology is that Java runs on the JVM (Java Virtual Machine). As a consequence, Web-4M is platform independent. Currently, Web-4M runs on Windows 95/98/NT, Mac OS, Linux, Solaris and Java OS machines. Finally, the rapid growth of Java and its close ties to Internet and web browser technology ensure early adoption of the latest advances.

V. Summary

There is room in asynchronous learning networks for the use of synchronous tools. Web-4M with its common document database (Browseable Document Library) in an excellent example of how

these two methodologies can be merged into a single software system. It is now up to educators to experiment with the proper balance of synchronous and asynchronous tools to meet the needs of instructors and students. We have outline a basic approach for the presentation of material using a hybrid tools set and techniques we have found useful in instruction. We encourage more educators to use these web-based tools in both distance and traditional classroom environments.

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