Enabling Technology for Asynchronous and Collaborative Learning

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Abstract

In this paper we describe our experience with asynchronous learning networks in a university environment. We pay particular attention to the enabling technologies that are needed to make collaboration over a network feasible. We combine high capacity wireless networks with off-the-shelf conference tools and streaming media to enhance our courses so that faculty spend more time on the social interaction so critical to effective teaching.

Introduction

The overwhelming evidence that the web has significantly influenced education makes saying so unnecessary. We can stop debating whether computers should be required in engineering schools and focus our attention on deploying them in the most effective ways. The purpose of this paper is to describe the fundamental enabling technology that allowed us to implement an asynchronous learning environment to leverage our academic program's resources. Asynchronous learning means that faculty and students are not working together at the same place or at the same time. Our goal has been to augment our existing course offerings and improve the quality of teaching. We have not pursued the "distance learning" model to eliminate class attendance. Certainly the enabling technologies that we used can be applied to remote locations, but this is not the objective. My hope is that deploying advanced technology would allow me more time in the classroom to interact with students to establish the relevancy of material while at the same time covering the ever growing syllabus of material.

The technology that we have found works well together is not particularly new. In fact, the use of the Socratic method dates from 400BC and its use in engineering is rather limited compared to law and medical schools. New and rapidly advancing technology such as wireless telecommunications, streamed media, and conferencing tools make the use of old tools like the Socratic method viable teaching alternatives for technical education.

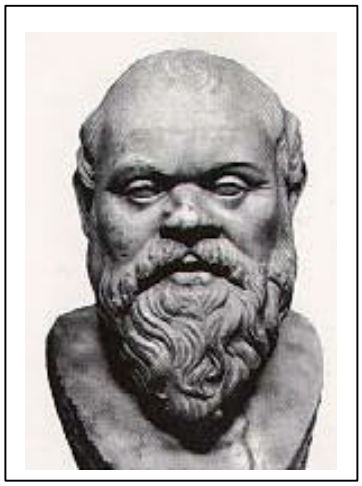

Figure 1. Could old tools like the Socratic Method find support with new web technology?

The Engineering Management Program at Florida Tech offers a MS degree that is highly interdisciplinary and combines technical study in all our engineering fields with management courses as well as courses focused on engineering and technology management. The students have technical backgrounds and generally are mature students who are moving into management roles in their careers. They are computer literate and highly motivated to participate in pedagogy that is innovative, collaborative, and focused. The program offers several "topics" courses that change quickly to meet the needs of a diverse and eclectic group. Three courses have been heavily tuned to make use of distributed media and web-based tools. These can be visited at http://www.fit.edu/~wshaw .

Asynchronous Tools

The use of asynchronous media to supplement traditional course delivery has proven to be exceptionally effective. Course lectures are archived in web media that students can access before, during and after the class where material is normally presented. Lucas [1998] and Gray [1998] report the rapidly growing set of software tools that allow distributed access to course materials. Preparing lecture materials for asynchronous delivery is much the same as traditional lecture preparation. In fact, we try to make sure that what we show in class is exactly what is placed on the web. Denton [1998] offers compelling evidence of changes in engineering education that can utilize asynchronous tools.

A technique that has worked well for me is to include three distinct types of course support. First, the slides are provided in compressed format. Second, narrated slide sets are compressed and placed on the web as a self-contained lecture. These presentations are essentially canned lectures and result from "practice" runs to rehearse classroom presentations. I use the PointPlus system from NetScene (http://www.netscene.com) to provide highly compressed and secure files. Finally, recordings of the actual classroom presentation are used to create streamed media that can be re-played on any desktop workstation. I use Microsoft's Netshow tools (http://www.microsoft.com/netshow) to produce and distribute these audio tracks. Figure 2 depicts an excerpt from a course support web table that follows a course syllabus in quality engineering. The columns correspond to the three media types noted above.

Clearly, the first time a course is offered with this type of support effort is expended to capture the media. But the materials have to constructed anyway and the reuse of materials make the second and following course offerings much less work. I find that I can cover more material when I know that the entire lecture is archived for the students and I know they can return to it for details. Each time the course is offered, new materials are added, audio tracks are updated, and the course grows to match the ever enlarging syllabus.

Placing media on the web is only a step in the right direction. I like Fraser's Rule which states "*the extent to which a student gains a comparable pedagogical benefit from a printout of your Web resources as from the resources themselves is the extent to which you have done nothing of pedagogical value by moving to the Web*" [Fraser, 1998]. So, the key is not more media on the web -- the key is media on the web that engages the learning process. Using slide sets and audio is a great resource where the value is intrinsic to the media – not the web page. This becomes evident when the follow-on courses use an identical web page but links go to improved media and updated materials created and edited by a faculty based on previous class experience and new knowledge. Simply placing extensive written documents on the web really provides the student with a distributed printing and viewing capability.

The next most effective technology that we have experienced is the use of distributed conferencing tools. Dutta-Roy [1998], Jamison [1998], and Gray [1998] discuss a variety of techniques and evolving tools ranging from threaded email to video conferencing. We experimented with several types of conferencing tools and found them very effective when targeted to the proper course objectives. For example, chat rooms work well for discussing assignments but not for presenting new material to large groups. Video-

Course Item Description	Slides	Slides w/Audio	Audio Track	Item Notes or References
Introduction to Quality Systems Engineering	**	--	**	Course welcome, introduction to quality, definitions, and historical contributors
The Experience of Quality	**	**	**	The experience of quality as a human process
Robust Design: Part 1	**	**	**	Concepts in Robust Design and a Stress/Strength Product Model Demo
Robust Design: Part 2	--	--	**	Class Registration Example, introduce SPCEx software tool (see Software download area)
The Seven Basic Quality Tools: Part 1	**	--	**	Overview of the Basic Tools

Figure 2. Web-Based Course Support

conferencing tools like NetMeeting (http://www.microsoft.com/netmeeting) work well with shared whiteboards and software sharing. A particularly useful tool is web-based collaboration tools like WebBoard (http://webboard.oreilly.com). Figure 3 shows a conference board set up to support a course in Project Engineering. This course used web conferencing and streamed media to allow class time to be reduced 50% during a summer school offering in 1998. The conference is still active and can be sampled at http://engmgt.fit.edu:8080/~pe.

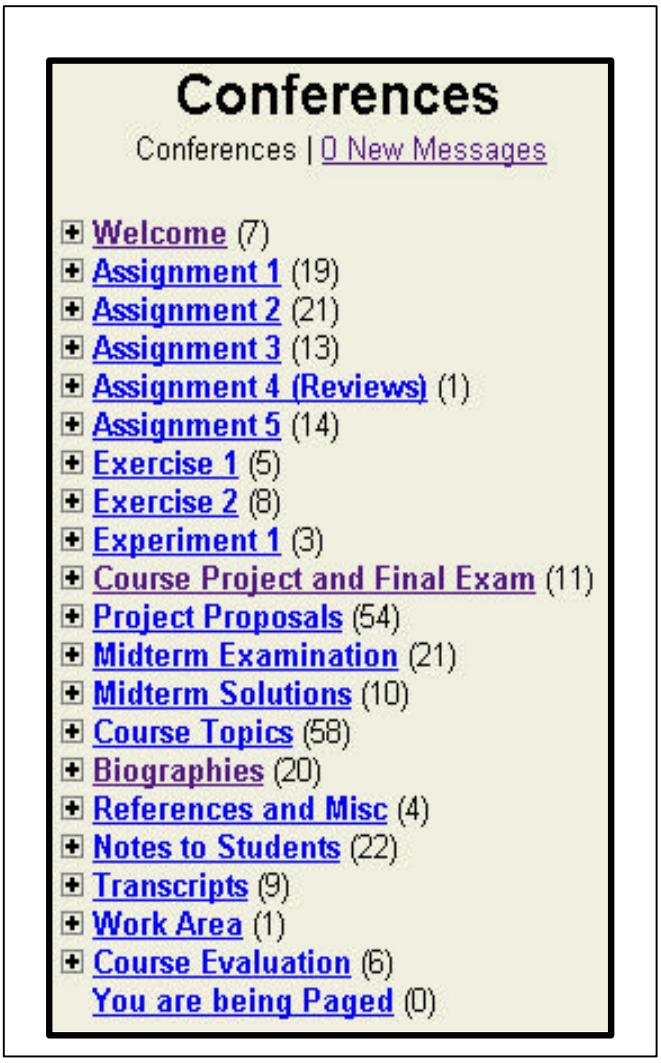

Figure 3. WebBoard Conference Board

Each conference board is composed of topics that can be expanded to reveal threaded discussions. Each discussion item includes uploaded files, html, and web links. Figure 4 shows a sample of an expanded discussion topic.

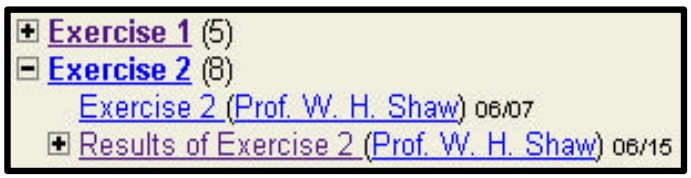

Figure 4. Expanded Conference Topic

Figure 5 shows a typical conference item with an embedded document.

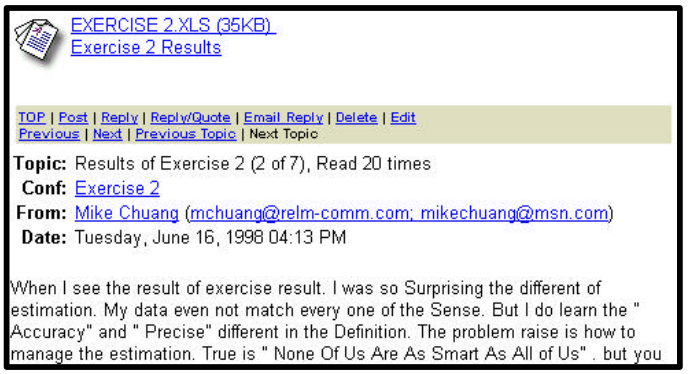

Figure 5. Discussion Item

Use of web conferencing tools greatly facilitates collaborative work where students work together with guidance from the instructor. Wallace and Weiner [1998] present challenging opportunities that arise when more time is available in the actual classroom due to moving “transmit mode” teaching to an offline environment. Chat rooms have been used to supplement “office hours” and much more flexibility is possible. I conducted office hours and group discussions even when I was traveling and far removed from campus.

Using a threaded discussion provided focus to course topics that were organized around the syllabus. Since the conference tools allow web links, the course support materials discussed earlier were simply linked into the discussion items to match the course timeline. Chat room discussions are archived as transcripts so that these synchronous events can be viewed by students at their convenience. Figure 6 shows an example transcript from a Sunday afternoon chat session.

Topic: Sunday, June 14 (1 of 1), Read 25 times
Conf: Transcripts
From: Prof. W. H. Shaw (wshaw@fit.edu)
Date: Sunday, June 14, 1998 04:01 PM

Sunday, 6/14 Office Hours:

6/14/98 15:01 Prof. W. H. Shaw: Hi Rusty ..
6/14/98 15:07 Nathaniel Tarbox: In regard to the history project, due next tuesday. Our project is related to the Citibank building with the stuctural problem. more to come
6/14/98 15:09 Prof. W. H. Shaw: OK - be sure to state any assumptions/intuition that you apply
6/14/98 15:09 Nathaniel Tarbox: I was wondering if you would prefer a complete history with the problem after competion as a footnote or focus on the repair project itself

Figure 6. Chat Room Transcript

Network Technology

The use of streamed media, conference rooms, and web-based media put a strain on the capacity of most university networks. Many projects are underway to improve network speed and connectivity around the world. A project to introduce a second phase of the internet is currently underway in the US. A particularly valuable technology that we have adopted is wireless internet connectivity. This rapidly evolving technology provides several notable services. Our initial deployment is to provide a custom T1 connection to the internet in order to deliver audio and video media without placing excessive loads on our campus backbone. Using devices and radios in the 2.4Ghz band we worked with a wireless provider (http://www.flwireless.com) to establish a 1.54Mbs pipe to the internet. A sample of video media that we provide under a project with the IEEE Foundation is available at http://engmgt.com/ess.

Wireless LANs provide more than low cost point-to-point connectivity. The use of local, peer-to-peer networks inside of buildings, labs, and classrooms have tremendous promise as web-based media is used in the classroom. A discussion of the various configurations of wireless data communications and the IEEE 802.11 standards is beyond the scope of this paper but Figure 7 depicts visually the range of options. We use our wireless T1 as the main access gateway to media developed to support the Engineering Management Program and we envision local wireless capability in the near future. The Wireless LAN Association, WLANA [1999] provides a valuable web resource for learning about wireless technology (http://www.wlana.com).

Some Perspectives and Forecasts

Our experience with new (and old but revisited) technology has motivated perspectives and insights. These include:

- The most effective projection tool is the workstation that the student already has in their dorm or living space. The use of projection systems in class is nice and useful but not nearly as valuable as making the projected material accessible before and after class.

- The tools that are emerging will change the use of classroom time dramatically. More time can be devoted to discussion, interaction, coaching and mentoring. The fire-hose model of teaching can

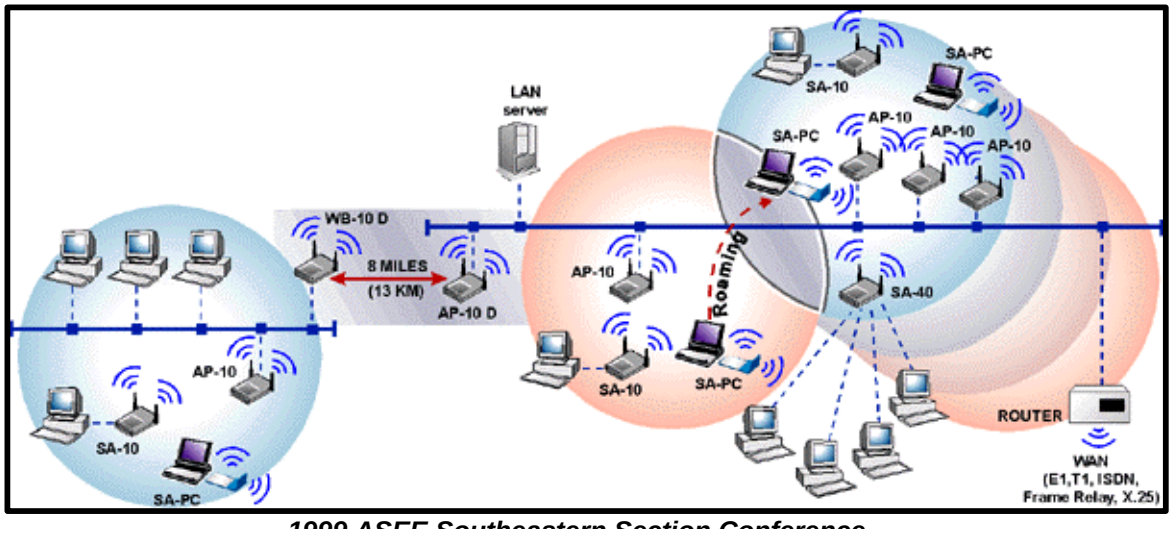

Figure 7. Wireless LANS - *Courtesy of BreezeCOM Inc. (http://www.breezecom.com)*

become less common.

- The trend to "just-in-time" media will allow faculty to use tools to quickly place media on the web for distribution. The economic cost to produce customized media will be justified only for high use, larger audiences where the media does not change frequently.

- It will not be good enough to be only a "subject matter expert" to teach effectively. More attention to learning styles, collaboration, and establishing relevancy of material will become part of teaching. Technology will be a part of this transition but teaching will remain a social process.

- The classroom environment will not disappear. Despite successful deployment of "distance learning", the classroom will survive as the same technology that enabled the "distance" will make class time more valuable. Our use of technology created more interaction and higher class enrollments.

- Evolving technology like conference rooms, streamed media, and wireless LANs will provide efficient use of faculty resources but will not replace them. It is a challenging and rewarding time to be part of academia.

Conclusion

Our experience with technology to support classroom instruction has been successful. Students report a high degree of satisfaction as well as appreciation for more personal attention. Web materials are accessed and used by students even when the course is completed.

Courses can be improved and faculty resources can be effectively leveraged using currently available and low cost technology. We have not spent more than $500 on any software tool. The startup time and cost can be minimized by focusing on simple and core technology that is portable and reusable.

I believe that the goal of technology enhanced instruction should be to improve the learning on the part of the student – not necessarily lower costs to the institution or the student. While lower cost is a worthwhile goal, students will find and attend those programs that add value by using tools and techniques that raise the quality of the learning experience.

A presentation of this paper is available at http://www.fit.edu/~wshaw/present.html .

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Professor Shaw is the Chair of the Engineering Management Program in the College of Engineering at Florida Tech. He serves as the Executive Vice President of the IEEE Engineering Management Society. He completed a BS in Electrical Engineering, a MS in Systems Engineering, and a PhD in Engineering Management all from Clemson University. He is an active member of ASEE, IEEE, ASEM, IIE, INFORMS, and SCS. His research interests include simulation systems, quality engineering and project management and his support includes the DoD, NSF, NIST and private industry. He has developed several asynchronous learning courses and supports a number of web-based technologies for media distribution. In 1997 he served as a Visiting Virtual Professor to the Georgian Technical University in Tblisi, Georgia. Currently he is working with a start-up company to design and install wireless internet services to deliver T1 class service at low cost to businesses, schools, and service organizations. Most of the media he has developed is available via wireless technology from his web page at http://www.fit.edu/~wshaw. Currently, Dr. Shaw is on sabbatical to complete a text to support collaborative learning in the area of project engineering to merge the concepts of project management with systems engineering. He consults with industry in the areas of quality, systems engineering, and project management. Prof. Shaw is a registered Professional Engineer in Ohio, Florida, and South Carolina. He lives with his wife Susan and three fine sons in Melbourne, Florida.