

# Redefining “Distance” Education Increasing Diversity, Accessibility, and/or Classroom Participation in Engineering Courses on a Time, Financial, and Technology Shoestring

*Tom Walker<sup>1</sup>*

**Abstract** – This paper presents four semesters of methodology and results, some expected, some unexpected, from using Tablet PC technology and appropriate software tools to teach an introductory problem solving programming course for second-year engineering majors. The methods used provide both real and virtual seats in the same course with real asynchronous student world-wide participation at very minimal personal, personnel, technology, and time costs for both students and instructors. The results are overwhelmingly positive and the methods can be applied to all or parts of multiple courses and curricula. There is definite applicability to K-12 outreach programs as well as community/junior college collaborative programs. Issues addressed include learning styles, under-represented minority participation, student peer support and collaboration, student classroom participation, budgetary and personnel resources, computer grading, and course management systems. All of the methods and technology involved will be demonstrated during the presentation.

*Keywords:* Distance education, Educational technologies, Diversity, Tablet PCs, Camtasia™

## BACKGROUND

The concept of “distance” or “online” courses is not only generally accepted by most engineering schools, appropriately and properly developed courses are demanded by students, administrators, and, in the case of publicly-funded institutions, state governments. Until very recently, courses were simply divided into two specific categories, “online/distance” or “in-class/traditional”, based solely on the method (or place) of delivery/receipt which was either over the “web” or in the classroom. The widespread availability of web-based “course management systems” (CMS) in the late 1990s provided a catalyst for foundational changes in course delivery. As CMS capabilities continue to expand and improve they have been adopted by faculty and students as an integral part of the undergraduate academic experience. Progressive instructors understand that “...CMS enables teachers to extend the classroom beyond its traditional boundaries of time and space.”<sup>[1]</sup> Of course, instructors might also take the time to replace “CMS” with “textbooks” and reread that sentence. The question is no longer one of “extending the classroom” with technology – it has become one of changing the teaching/learning paradigm with technology in a way that enhances “learning” without requiring significant additional financial, temporal, or physical resources.

Coincidentally, driven largely by a combination of decreasing resources and increasing demand, engineering instructors are being “encouraged” to develop “online” versions of their courses. The two greatest disincentives to offering engineering courses in “distance” mode have been the additional effort required for faculty to prepare and deliver the materials and the concurrent loss of the immediate feedback the instructor receives in a typical classroom environment. An “online” offering of a course has typically increased the faculty effort by a factor of four to six and, without costly broadband communications equipment and operating personnel, it has been difficult for students

---

<sup>1</sup> Associate Professor, Engineering Education Department, Virginia Polytechnic Institute and State University, Blacksburg, VA 24060, twalker@vt.edu

to ask questions of the instructor or the instructor to poll or quiz the students. Additionally, "...teachers usually don't have the time or inclination to explore some new technology."<sup>[2]</sup> Virginia Tech, as with many other higher education institutions, has been very proactive in addressing these problems with the joint efforts of its Institute for Distance and Distributed Learning<sup>[3]</sup> and its Faculty Development Institute<sup>[4]</sup> and the results have been very positive. The Virginia Tech College of Engineering has demonstrated an incredibly strong commitment to the positive use of "educational technologies" and computers in particular in and outside the college. All students were required to have "personal computers" in 1984, "laptops" in 2002<sup>[5]</sup>, and "tablet PCs" in 2006.<sup>[6]</sup>

## **ENGE 2314 – A WEB ENHANCED PROGRAMMING COURSE**

Engineering Problem Solving with C++ (ENGE 2314) is a 2-credit introductory programming course designed from the outset (1999) to take advantage of Internet and other computer technology to provide for asynchronous distance learning and automatic grading. It was developed within the framework of a custom web "front end" (now termed a CMS) developed "in house".<sup>[7]</sup> Different formats, applications, and technologies have been tested as they became available with the view of enhancing the students' learning experience and choice while not adding significantly to the instructor's out of class workload. For example, in 2003 MP3 lecture recordings were published simultaneously with the presentation slides.

### **Silicon Chalk™**

Beginning in late fall 2004, Silicon Chalk™ (SC) software was piloted in the classroom.<sup>[8]</sup> SC is collaborative software designed to enhance the face-to-face experience, allow for and encourage participation of remote students, record the entire process, and make it available to students involved synchronously and asynchronously while eliminating, almost entirely, the additional staff and equipment overhead traditionally required. During this pilot, the primary SC feature implemented was the simultaneous recording (instructor's "desktop" and audio) of the classroom experience during regularly scheduled class meetings with subsequent upload of that recording to the course server. Although several students did bring their laptops, "join" the SC session, and thus record the session on their computers with their synchronized notes, this mode was not demonstrated or tested extensively.

Even with this minimal use of SC features, the in-class experience, and thus the course, was dramatically changed. In previous semesters lectures were focused on the presentation slide model with students taking notes on published PDF files of those slides and MP3 audio uploaded when that became available. Few actual programming demonstrations were done because students had difficulty following the demonstration and simultaneously attempting to take notes without losing some of the steps. Therefore, during demonstrations, class participation was very minimal. Early in the spring 2005 semester, demonstrations became the focus for the entire class period because SC allowed the author to switch between software applications without concern that the students could not follow. As the students also realized that they did not have to take detailed notes, they began to actively contribute to the class. The author first noticed this when the students would instantly correct his inadvertent syntactical errors. [In the past, students had been so busy taking notes that they were not really watching the demonstration and did not see the error.] Shortly after this, the students began contributing with spontaneous questions such as:

- "What happens if you do this...?"
- "Why can't you do it this way...?"
- "Isn't it easier to do it this way...?"

Unfortunately, SC was acquired by Horizon Wimba<sup>[9]</sup> in summer 2005 and was taken out of production.

### **Camtasia™**

Shortly after discovering the demise of SC, during a short course administered by the VT Faculty Development Institute, the author was introduced to Camtasia™, a product of TechSmith<sup>[10]</sup>. Camtasia™ does not have all the synchronous collaboration tools available in SC, however, it does have the key component of simultaneous recording of the instructor's desktop with audio. Additionally, it is much less expensive and does not require the students to purchase or install any additional software as it is capable of producing standard multimedia files in several different formats, all of which are easily played by multiple computer operating systems. Beginning fall

2005, the author began using Camtasia™ in conjunction with a Tablet PC, recording all class sessions and posting them to the course website immediately after class.

## RESULTS

Both the author and the students required time to adjust to the new classroom dynamics. For the students, the primary adjustment involved understanding that they would not miss anything if they did not take notes and followed the instructor attentively, asking questions when appropriate. When this understanding was established, most of the students attending class began bringing their laptops to class and following along with the demonstrations. For the author, the primary adjustment involved taking advantage of the features of the Tablet PC and Camtasia™ combination, allowing and encouraging active student participation to drive the class forward.

### Diversity

Contemporary introductory computer programming courses are unique in that different students have widely differing computer skills and experience when they start the course. Those with fewer skills and less experience are often discouraged as they observe their opposites answer all the instructor’s questions and talk in “computer-eze”. The instructor also loses touch with those students who should be driving the course, getting a false view of what is really understood by the majority of students. Unfortunately, many students from under-represented minorities tend to be in the less experienced group. This particular course has another “handicap” – it is a service course for non-programming-intensive degree programs. In the new course format, attendance was recorded but not required and, because all students were provided with the video recordings of the lectures and the other information on the course website, many of the more experienced students and those who found the material easy to learn did not attend class. Therefore, the overwhelming majority of class attendees were those students who found the material difficult for various reasons and needed face-to-face contact with the instructor. Once they realized that their classmates were at their level, they were more participatory and began vocalizing their questions and taking “ownership” of course direction. Evidence of this is provided in Table 1 which is a compilation of anonymous survey results.

Table 1

	Female	Male
Programming Experience	35% None	29% None
	48% Beginning	44% Beginning
	13% Intermediate	23% Intermediate
		4% Extensive
Class Attendance	25% Don't attend	60% Don't attend
Bring Laptop to Class	78%	63%
Follow Instructor's Demo	100%	90%
Believe They are More Attentive	72%	72%
Believe There is More Participation	83%	78%
“Attending class is more fun, less stressful”	78% agree	71% agree
“I would not succeed in this course without the recordings”	70% agree	55% agree
“The recordings make this course less difficult”	87% agree	75% agree

## Accessibility

Many students struggle to gain access to courses they need when they need them or when it is best for them to take them. Students are working an increasing number of hours to help pay for higher education costs. Resource issues are driving course offerings into larger classrooms and fewer time slots so there is less flexibility to deal with conflicts with other required courses and work schedules. Students with disabilities often find it difficult to attend class, or if they can attend, often find it difficult to both take notes and follow the lecture. Students often should not or cannot attend classes for medical reasons. Finally, students are often geographically remote from the campus. These cases are easily dealt with in ENGE 2314 using the combination of the course custom web site, the VT CMS, and the Camtasia™ recordings and “distance” students often take the course semi-synchronously with their on-campus peers.

## Required resources

1. Camtasia™ software (< \$200)
2. Tablet PC (standard computer will suffice but tablet markup capability is very useful and effective)
3. Computer microphone (Sony WCS 999 wireless with adapter is handy, approximately \$100)
4. Server for serving video recordings (TechSmith now offers this service very reasonably if there is not one easily available)
5. Course Management System (custom or licensed)

There is virtually no “learning curve” with respect to the use of the recording software – an instructor can be producing good videos less than an hour after software installation. Once installed and operating, there is virtually no additional time required of the instructor during the class presentation and the time uploading the file after class is negligible for high speed internet connections.

## CONCLUSIONS

Educational technology tools such as those described, when properly used in appropriate courses, are beneficial for various reasons including those mentioned herein. The startup and subsequent cost of these tools and their use is very small, both in real dollars and time. Engineering instructors can experiment with these technologies with very little training, if any, and no risk.

## REFERENCES

- [1] Ullman, Craig ; Rabinowitz, Mitchell, “Course Management Systems and the Reinvention of Instruction”, *T.H.E. Journal*, October, 2004, [http://thejournal.com/articles/17014\\_3](http://thejournal.com/articles/17014_3)
- [2] Ibid.
- [3] <http://www.iddl.vt.edu/about/mission.php>
- [4] [http://www.fdi.vt.edu/our\\_mission.html](http://www.fdi.vt.edu/our_mission.html)
- [5] Griffin, O. Hayden; Walker, Thomas D. L., “Faculty and Student Response to a Laptop Computer Requirement for Engineering Freshmen”, *Proceedings of the 2005 ASEE Annual Conference and Exposition, Portland, Oregon, June 2005*
- [6] <http://www.vtnews.vt.edu/story.php?relyear=2006&itemno=300>

- [7] Walker, Thomas D. L.; Goodman, Joseph K, "OMEN: An Online Grader for Engineering Programming Courses", *Proceedings of the 2004 ASEE Annual Conference and Exposition, Salt Lake City, Utah, June 2004*
- [8] Walker, Thomas; Moore, John, "Work in Progress – Instant Distance Learning Course Development Using Silicon Chalk™", *Proceedings of the 2005 Frontiers in Education Conference, Indianapolis, Indiana, October 2005*
- [9] <http://www.horizonwimba.com/>
- [10] <http://www.techsmith.com/>

**Thomas D. L. Walker**

Associate Professor of Engineering Education at Virginia Polytechnic Institute & State University (Virginia Tech). He earned his BSEE degree from Purdue University and his MSME from the Naval Postgraduate School. His primary academic and pedagogical interests are in the areas of distance/asynchronous learning technologies and methods, object-oriented programming, and object-oriented modeling. He is a licensed Professional Engineer.