AC 2011-460: USING SCREENCASTS TO ENHANCE INTRODUCTORY ENVIRONMENTAL ENGINEERING EDUCATION

Philip J. Parker, University of Wisconsin, Platteville

Philip Parker is a Professor of Environmental Engineering at the University of Wisconsin-Platteville. He received his B.S., M.S., and Ph.D. from Clarkson University in Potsdam, NY.

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Overview

Active learning is widely accepted as a best practice in higher education. Many students however, despite enjoying the interesting and interactive classroom environment associated with active learning, lament the fact that active learning does not provide as many opportunities for the faculty member to work out example problems in class. For students who have found success in the many courses in which the focus of in-class activities is on presenting derivations and then working out a few example problems, this lack of examples can be especially troubling. In my view however, having students transcribe an example problem from the board is not the most valuable use of class time. Yet I also recognize that the working out of problems in class does present some valuable "teachable moments."

A potential compromise is the use of screencasts to present example problems. Screencasts are recordings of computer screen activity with supporting audio narrative. I have created several screencasts using a PC, microphone, and Camtasia software. I have used this software to create a series of screencasts for my Introduction to Environmental Engineering course. Students can download and view the screencasts outside of class whenever they wish and wherever they have internet access.

Background

Screencasts are recordings of on-screen activity and associated voice instructions. They have most commonly been used as tutorials to teach computer software[1] as they record mouse movements and clicks. For this project, I used Camtasia software and a headset with microphone.

The screencasts were created in the Fall 2010 semester and made available to 37 students enrolled in CE3340 (Introduction to Environmental Engineering). Students were encouraged to view the screencasts, especially before an exam. The intent was to keep screencasts less than 5 minutes in length, as personal experience and research[2] has shown that students lose interest in lengthy screencasts. A total of seven screencasts were created. The original intent was to create screencasts of worked examples for every lecture period, but this was not possible given other commitments. Therefore, I targeted topics that students find the most difficult.

Goal

The goal of implementing screencasts was to provide students with worked-out examples without using class time. I recognize the value in working example problems in class as they

allow the instructor to show how theory is applied and to point out common places for students to make errors. But, I do not view this as the most beneficial use of class time. From my experience, working out example problems often involve using class time for lower level yet essential steps such as unit conversions, algebraic rearrangement, and calculations; and of course, they introduce the inevitable time-wasting calculation error. I would rather use class time to present and discuss the fundamental concepts and discuss how to apply them.

Evolution of a screencast recording method

The recording of screencasts was a completely new field of study for me at the beginning of the Fall 2010 semester. However, the learning curve was not particularly steep, and spending less than 1 hour watching tutorials from the Camtasia website was sufficient training.

My method for recording the screencasts evolved over time. The first method was in essence to create a PowerPoint presentation and record the delivery of this presentation. The PowerPoint slides contained a number of equations, with various algebraic manipulations and inserting of given values. The details of unit conversions and numeric calculations were not included explicitly. I set the custom animations in PowerPoint such that each equation appeared one at a time on a mouse click. I continuously recorded my narration of these equations. This method worked acceptably, although typing equations into PowerPoint was found to be cumbersome and time consuming.

My next effort was to bypass the clumsy equation editing available in PowerPoint and write out the equations by hand, scan this document, use a screen capture program to copy each handwritten equation, and paste these equations in order into PowerPoint. The final result certainly did not have a very polished look, especially given my poor handwriting skills. But the scanned handwritten method was equally effective in terms of covering the material.

The third and final step in the evolution, and one with which I am quite happy, is the use of a Tablet PC. This allows me to write directly on the Tablet, using Microsoft Journal, while being recorded. Thus, it skips the step of needing to scan handwritten notes and to screen-capture the notes. It also allows me to talk as I write out the equations, making it feel a bit more natural to me. My poor handwriting is definitely a handicap, but I do not feel that it inhibits the learning effectiveness of the screencast.

In all delivery methods, I was not handicapped by any perfectionist inclinations. I told the class that the screencasts were not intended to look like they were professionally recorded, and that I was not going to record multiple trials until I got it perfect. Although I created an outline before recording myself, I did not write out a word-for-word script, but rather ad-libbed based on the outline. Only when I made an egregious error would I stop the screencast and re-record it. As it was, I spent less than 30 minutes in creating each screencast, whereas seeking for perfection in diction, handwriting, etc., would have taken several hours.

The resulting files were quite large (around 20 MB). To deliver the screencasts to the students, the UW-Platteville TV Services office uploaded them to a server, and I provided a link to each screencast from within the course management system (Desire2Learn).

Assessment

The screencasts met the goal of allowing me to prevent worked example problems without using valuable class time to do so. In addition, I evaluated student use of the screencasts; assessed whether the screencasts affected student learning; and measured student attitudes toward the screencasts.

1. How much did students use the provided screencasts?

The course management system (Desire2Learn) kept track of some rudimentary statistics about student usage of the screencasts (Table 1). 35 of the 37 students visited the site and watched at least one screencast during the semester. Such statistics are useful to a certain extent, but are limited. For example, just because a student visited the site doesn't mean they watched it. Or, a student may have been studying with a friend, and only that friend accessed it; in such a case, Desire2Learn would only tabulate that one student had watched the screencast.

Table 1: Screencast Viewing

Screencast Title	Number of Users Visited
1. Population Growth	27
2. Alkalinity and hardness calculations	24
3. Equilibrium constants – ICE charts	29
4. Henry's Law	22
5. PFR/CMFR combination	18
6. D.O. sag	26
7. Sludge Dewatering	22

2. How did their use correlate to their grade on exams?

Each marker in Figure 1 represents the number of screencasts viewed by a single student and that student's average score on the five hourly exams. There is no discernable trend to the data, a fact that is supported by fitting a linear regression to the data (not shown). Although students who watched all the screencasts did better on exams than some students who watched fewer screencasts, the two students who did not watch any screencasts performed better than three of the students who watched every screencast. Although disappointing, these results are not surprising for several reasons. The screencasts did not directly correlate to material on the exams. Some exceptional students learned all that they needed to learn from in-class activities

and by completing the homework and assigned reading. And, watching screencasts could not make up for deficiencies in academic ability for other students.
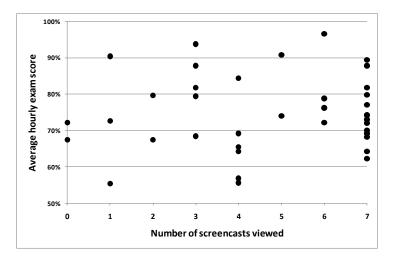

Figure 1: Effect of viewing screencasts on exam score

In an attempt to be more specific in the assessment, students' scores on a problem on the last hourly exam were compared based on whether the students had or had not watched a screencast related to that exam problem at least once. The topic of the problem was sludge dewatering and was worth a maximum of 20 points. The exam problem had some similarities to the screencast problem, but the exam problem approached the topic from a different angle. The average score for students who had watched the screencast at least once was *lower* (12.8) than it was for students who did not watch the screencast (13.5). The results were not statistically significant ($p = 0.606$).

3. What did students have to say about the screencasts?

On the last day of class, I administered a brief survey. Three of the questions on the survey pertained to the use of screencasts. Two Likert-scale questions and their responses are shown in Table 2. Clearly, the students found the screencasts helpful and would have liked additional screencasts. Note that the same (disgruntled perhaps?) student answered "Strongly Disagree" to both questions.

Table 2: Survey Response Summary

	Strongly Disagree	Disagree	Agree	Strongly Agree
I thought the screencasts were helpful	1	0	10	17
I wish there were more screencasts	1	1	13	12

The third question on the survey was more open-ended: "Please give me advice on how to make the screencasts more helpful." The most common response did not directly address the request, stating some variant of "I think they were great the way they were." The remainder of the comments did not follow a discernable pattern, although the following comments were suggested by two students each: enhance accessibility (not all students were able to view the screencasts on all computers); post the solutions earlier (the screencasts were not always available before the pertinent homework assignment); make handwriting neater. None of the students addressed the fact that the screencasts were not professionally recorded.

Discussion

Although the goal of creating and delivering the screencasts was not to positively affect student learning, the lack of an effect is nonetheless disappointing. Lee et al. reached the same conclusion after using screencasts to teach object-oriented programming.[3] Given that student learning depends on so many factors, this isn't surprising. Alternatively, perhaps the screencasts did affect learning for some students, but the methods used in this study were not able to measure them. Specifically, a controlled experiment study in which some participants had access to screencasts while other participants did not would be better able to assess this question.

Palaigeorgiou and Despotakis found that screencasts for computer science majors suffered because they did not afford students the opportunity to practice as they watched; rather, students had to sit back and simply watch, and alternating between the screencast and the software they were attempting to learn about became frustrating.[2] A similar effect may have been observed in the present study, as students watching a screencast were not actively engaged. A few survey responses suggested that I provide students with a printout of the worked-out example so they can follow along, and this would help to make the experience more active for the students who chose to print out the handout. I think this is an excellent suggestion, and it could easily be accommodated by the course management system.

One student asked on the survey that I "use problems more related to the actual homework and expected exam questions." This comment highlights the perceived "value" of worked examples to some students: the value is not in the learning that takes place, but in the fact that the worked examples are the same as the problems that appear on exams, thus allowing them to perform well on the exams. This view may also explain the number of students who want more screencasts – the more screencasts that are available, the better the chance that one of the homework or exam problems will be just like the screencast!

Future directions

Given the strong positive response from students, I will continue to create new screencasts for this course.

Bibliography

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