USING SCREENCASTS IN ChE COURSES

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The expansion of distance learning has created new technologies that distribute educational content, and many online classes are taught using video technology. As schools began using video lectures, however, universities discovered distance learners rated teacher quality lower than traditional students who took the course by sitting in the classroom.[1] Toto[2-3] studied the use of screencasts, to supplement a first-semester, general chemistry class for distance learners. He identified topics from homework assignments on which students did poorly the year before and then created 60 screencasts that specifically addressed the difficult concepts. When he compared performance between the classes with and without the screencasts, he found that students with access to the screencasts scored 11% better in the course overall and 22% better on the concepts on which prior students scored poorly. Additionally, the students liked the screencasts. For one chapter of the text, Toto did not provide screencasts, and when he later polled students who had used screencasts, 90% said they would have liked to have had them for that chapter.

Screencasts of example problems can be superior to written solutions because students can listen to the instructors explain the problem-solving strategies that they use. Research has shown that when given just the final written solution to a problem, good students use the solutions differently than poor students.[4] The good students use the solutions to justify the individual steps in the solution to gain a deeper understanding, whereas the poor students tend to just follow the steps without

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connecting the solution to the concepts. With screencasts, all of the students are able to hear an expert's explanation and understand how each step in the solution relates to the underlying principles.

Research into science education has shown that the use of active learning and peer instruction improves student understanding.[6,7] One effective way to make lecture more interactive is to ask students multiple-choice conceptual questions called ConcepTests during class, have students first answer the questions on their own, and then have them discuss their answer with a group of students. The use of ConcepTests is effective because they allow students to formulate their own ideas, explain their thoughts to their classmates, and get immediate feedback from the instructor on difficult concepts or misconceptions they have during lecture. This method of teaching increases student understanding, but it reduces the amount of lecture time,[10] and students must learn material through reading assignments and problem sets. Students like this interactive approach,[7-9] but feedback on end-of-course assessments indicates that some students would still like to see the presentation of examples problems "worked all the way to the end." Screencasts are easily developed and integrated into a course to meet the different learning styles of students. Screencasts also create a different, more individualized, type of active learning experience: A student can work through an example problem at his/her own pace with the screencast paused, and then refer to the explanation when he/she becomes "stuck."

TYPES OF SCREENCASTS

Short screencasts were used in Fall 2008 and Spring 2009 to supplement five courses: graduate reaction engineering, junior-level thermodynamics, freshmen general chemistry for engineers, the sophomore-level material and energy balances, and creative technology (a freshman-level course for nonengineers). Screencasts were produced using a tablet PC, Microsoft PowerPoint or Windows Journal (software that is included with the tablet PC), and Camtasia Studio screencasting software. The screencasts were typically 5-15 minutes long, and included the following types of presentations:

- *Example problems worked out in detail: these are similar to example problems that might be worked through during class.*
- *Mini-lectures: explanations of important topics, similar to what could be presented in class.*
- *Clarification of ConcepTests from class: more-detailed explanations of conceptual problems posed during class or solutions to additional ConcepTests.*
- *Clarifications on homework problems: multiple students often come to office hours with the same question about a problem, and a screencast can be used to explain the issue instead of explaining it multiple times during office hours.*
- *Explanations on how to use new software: step-by-step use of menus, how to do certain types of calculations, and what settings are needed.*

Screencasts cannot be represented well on a printed page; they are a much more dynamic and visual way to present material than just text. To get a better idea of what screencasts for chemical engineering courses are like, links to some of our screencasts are available at <http://www.colorado.edu/che/undergrad/innovative_teaching.html>.

PREPARING AND USING SCREENCASTS

Screencasts have a number of potential advantages. Going through the details of a problem solution is probably not the most effective use of class time; more-active learning approaches better engage students in the material. The screencasts are often quite similar to what could be presented in class, but students can go through them at their own pace. This means that they can pause the video to work through calculations on their own, replay sections that were difficult to understand, or watch the video weeks later to review the material. The time it takes to create a screencast is short; producing an example problem essentially takes the same amount of time that it would to work through the solution. Additionally, screencasts of example problems or derivations have advantages over in-class presentations because a Tablet PC screen has much higher contrast than a blackboard, and students do not have to try to quickly copy down all the steps. Instead, they can focus on understanding the underlying concepts.

Screencasts can be integrated into class in several ways. Faculty can refer students to specific screencasts that explain, perhaps in a different way, the same concept discussed in class. Screencasts made by someone other than the instructor can be useful for demonstrating how other experts approach the same problem. The setup of example problems or derivations can be discussed in class, and screencasts can show the complete solutions.

Screencast use can be monitored on a classroom management system like Blackboard. This system records the total number of views, the number of different students who have viewed a file, and the amount of time students spent watching a screencast. Additionally, verbal feedback solicited at the beginning of class or feedback collected via Blackboard can provide feedback on the value of a specific screencast, and can also motivate other students to watch the screencasts.

The investment in money and time to purchase and learn to use the equipment and software is modest: $1,500 or less for a Tablet PC, ~$300 for Camtasia Studio, less than $50 for a microphone, and perhaps an hour to learn the software. TechSmith's Camtasia Studio was the best of several types of screen capture programs that we evaluated. Editing is straightforward and the screencasts created by Camtasia can be stored

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in a number of formats. We created screencasts in the Shockwave flash format (.swf suffix) for use on screencast.com or on the University of Colorado's version of Blackboard because these files seem to work the best with Internet Explorer. We also created files in the Quicktime format (.mp4) so that the videos can eventually be integrated into Apple's iTunesU. The files are not too large (less than 9 Mb for 10 minutes) and can be played from a Web browser. A PDF version of the file created by Windows Journal software or PowerPoint can also be created and posted along with the screencast so that students can have a printout of what appears on the screen.

It is important to note that the screencasts do not have to be professional quality; they can be the same quality as an in-class presentation of the same material. They can also be generated by graduate students or senior undergraduates. To keep screencasts to a reasonable length, the screen capture program can be paused as information is written on the Tablet screen and then started again to explain what was written. Videos between 5 and 15 minutes seem to be a good length.

STUDENT FEEDBACK

The screencasts in Fall 2008 and Spring 2009 were initial efforts to determine whether students would use them or like them and to establish how to make them. Anonymous feedback and data on screencast use were collected at the end of the semester from the students in these classes. Table 1 summarizes data on the use of screencasts In the graduate kinetics course, screencasts mainly covered material in the first half of the class, and in the thermodynamics class screencasts were only used in the last third of the class.

In anonymous, open-ended feedback about the course collected at the end of the semester, many students freely mentioned how helpful the videos were. Some student comments about the screencasts follow.

- *"Screencasts are fantastic. I watched some of them twice."*
- *"I learned a lot from the videos. It's hard learning at such a rapid pace in class, so it's really nice to be able to rewind and replay the videos as many times as needed."*
- *"I liked how the lectures were loaded full of clicker questions. That is really the best way for me to study . . . . The other thing that I really learn best from is videos. I wish you would have made a video for the harder clicker questions for each week."*
- *"I like the screencasts; it helps to have the solutions walked through step-by-step with explanation. They are also a great study tool in my opinion."*
- *"I love screencasts! I am able to work out the problem at my own pace, and watch the screencast whenever I get stuck."*
- *"I didn't learn as much when we stopped using screencasts."*
- *"It would have been valuable to have more example problems worked out."*

SUMMARY

Screencasts are easy to prepare on a Tablet PC and are valuable additions to graduate courses, core undergraduate courses, and a general science course. They are effective supplements to in-class active learning techniques such as ConcepTests. They are relatively inexpensive to create, and production time is minimal. They can be used in various ways, including example problems worked out in detail, mini-lectures, clarification of ConcepTests from class, clarifications of homework problems, and instructions on how to use new software. The feedback from students in the five courses where the screencasts were piloted was overwhelmingly positive, with a significant number of the students freely mentioning how valuable they were to their learning process.

TABLE 1
Student Feedback On Usefulness Of Screencasts In Five Courses

		Number of students		
	Course Enrollment	Useful/ Very Useful	Not Useful	Did Not Use
Graduate Reaction Kinetics	47	43	2	2
Junior Thermodynamics	73	29	1	43
General Chemistry	390	369	2	19
Sophomore Material and Energy Balances	52	43	0	9
Creative Technology	360	331	16	13

ACKNOWLEDGMENTS

We gratefully acknowledge assistance by Kimberly Edwards at the University of Colorado.

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