120th ASEE Annual Conference & Exposition
FRANKLY, WE DO GIVE A D*MN
June 23-26, 2013

Paper ID #6491

Getting Started With Screencasting: A Tool to Supplement Classes, Answer Student Questions, and Provide Guided Analysis Practice.

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Introduction

Learning how to effectively use technological tools in the classroom can present a steep learning curve to some instructors[12], especially those who are new to engineering education. Screencasting, the capture of a computer screen in video form, is such a technological tool that is becoming increasingly popular among educators[1, 4, 8, 11, 13-15]. One of the advantages of providing video resources for students is that they tap in to student's comfort with information presented in short, visual bursts[6] and provide a resource that can be accessed at any time. This availability is likely to be appreciated not only by the current generation of students, but also by non-traditional students who may not be able to come to office hours due to their school-life balance. The excellent literature review by Green et. al. covers work showing that students think screencasts are effective and that screencasts actually do improve student outcomes[8].

While screencasting videos hold much promise, finding the time to learn any new technique can be a struggle[3]. This paper reports on one educator's initial experiences with screencasting software and hardware tools (Camtasia, Jing, Wacom tablets, and PDF Annotator) and provides some tips and lessons learned for those interested in getting started in this area. Suggested strategies to use screencasts to support and reinforce (but not replace) regular classroom instruction are given. Feedback from the author's own experiences is used to support the utility of these types of screencasts.

A range of software and hardware tools exist

At its most basic form, Figure 1, screencasting requires only two steps—recording the screen and encoding the recording in a standard format. A great way to get your feet wet with screencasting is to start with this very simple process and see if it works for you.

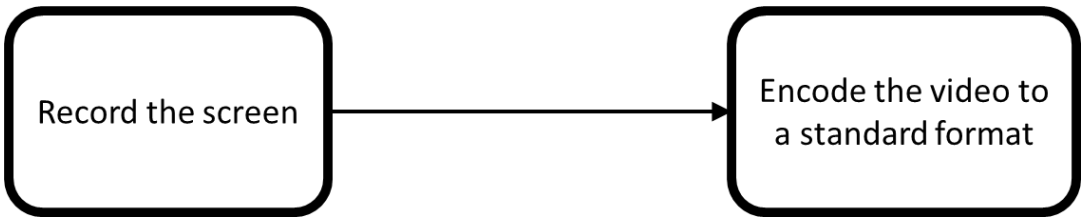

Figure 1. The most basic screencasting process requires two steps.

The author began creating screencasts of homework solutions for an analysis-heavy class using Jing from TechSmith (http://www.techsmith.com/jing.html) for both of these steps. The strength of Jing is that it's free and has a relatively simple interface. The major weaknesses of Jing are (1) the recording has a maximum length of 5 minutes, (2) the resulting file is in .swf format, and (3)

there are no editing capabilities. Videos in .swf format play with Adobe's commonly-available Flash player, but cannot be easily edited. Liberal use of the pause control allows capturing a video that takes much longer than 5 minutes to create on-screen, as long as the playback time remains under the 5 minute maximum. However, if your intended usage of screencasts is short videos, the 5 minute limit and lack of editing capabilities may not necessarily be problematic.

If your institution uses Microsoft's Lync software, you can hack together a screencast by creating a meeting with only yourself attending, sharing your screen or using the Whiteboard feature, and recording. The resulting video file is easily saved in .wmv format. As Lync is intended for online meetings, the results probably won't be particularly polished. This might be a good option if you are troubled by the 5-minute limitation of Jing and already use Lync.

The advanced form of screencasting, Figure 2, includes an editing step between making the recording and encoding the video. Editing might be necessary to remove mistakes and pauses or to add annotations, titles, and other media.

Figure 2. The advanced form of screencasting includes an editing step.

If your desired screencast result requires some editing of the recorded video, Camtasia Studio is the go-to program to perform all three of these steps. From the same company that offers the free software Jing, Camtasia Studio is $300. The major reason for spending the money for Camtasia Studio is that there is no set recording time limit and the powerful editing tools. Editing out mistakes, combining multiple recording sessions, adding zoom and pan effects, inserting on-screen captions/annotations, changing the playback speed, and controlling the encoding options are all possible with Camtasia Studio. Drawbacks of Camtasia Studio are a frustratingly slow (and sometimes buggy) encoding process and a steeper learning curve as compared to Jing. Additionally, the powerful editing tools may tempt the user to fall into the editing trap—where too much time is spent editing to make the "perfect" screencast when "good enough" is what is really needed.

Discussed earlier as a free screen recording option, Lync creates .wmv files that can be edited using the freely-available Windows Movie Maker (editing out mistakes, inserting other .wmv files, adding captions/annotations, and changing the playback speed.) These simple editing tools might make Lync and Windows Movie Maker worth investigating if you do not have the resources to purchase a Camtasia Studio license.

A significant limitation of the processes described above is that they are fundamentally geared towards screencasts of software demonstrations and slide presentations (where capturing a screen's display is sufficient). A screencast that focuses on handwritten analysis, similar to what an example problem or derivation on a whiteboard would look like, requires some kind of hardware to capture these handwritten notes. Figure 3 shows the addition of handwritten note hardware to the three-step process just described. While handwritten note capability could be added to the simpler two-step process described in Figure 1, a screencast involving handwritten analysis is likely to require an editing step.

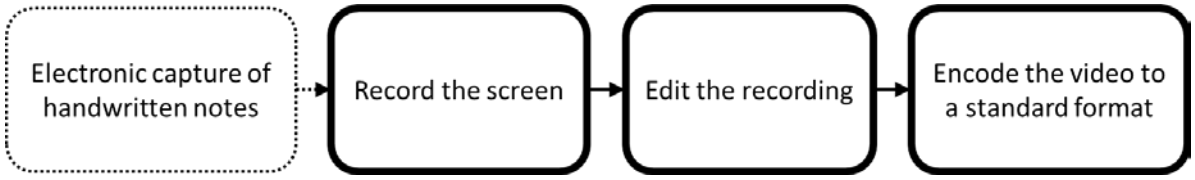

Figure 3. Screencasts of handwritten notes requires capable hardware.

A pen-based tablet or convertible laptop could easily provide this hardware, particularly if one is already available for use. Necessary features are some kind of pen-based input for precise writing, and some kind of software to capture handwritten notes electronically. For example, Lenovo's ThinkPad X Series convertible tablets include the necessary pen-based input.

If such pen-based hardware is not available, there is a particular class of devices that serve the purposes of educational screencasting nicely—interactive displays. These devices act as a display device, like a normal flat-panel monitor, combined with pen-based input, necessary to capture the desired handwritten notes. Interactive displays are not actually laptop replacements; they do not run the operating system or any software. Instead, they replace the usual display device and add the pen-based input as a kind of secondary mouse input. Wacom produces a series of devices under the name "Pen Display DTUs" (http://www.wacom.com/products/pen-displays/dtus) that work very well for frequent screencasting, priced around $1250 and up.

A cheaper alternative to the interactive displays may be Wacom's Bamboo product line http://www.wacom.com/products/pen-tablets/bamboo with a significantly smaller input area and lack of the interactive display aspect. If watching a different screen while writing on the small input area does not seem problematic for the intended screencasting usage, the cost savings is significant (starting at $80).

These devices can be thought of as computing accessories instead of computer replacements. The advantage of this separation is that when a laptop or desktop is replaced, the interactive display can be retained and used in the future, provided the necessary drivers are available. To complete the screencasting setup, software that captures the pen-based input is needed. There are many options available, but PDF Annotator has a simple interface and feature set that works well for screencasts based on annotating PDF documents. PDF Annotator is $70 from http://www.grahl-software.com/en/pdfannotator/index.php.

Screencasts can supplement traditional classroom interactions

Screencasts can be used to supplement traditional classroom interactions. In contrast with the inverted classroom model[2, 5, 7, 9, 10, 16], the intent here is to use screencasts as a supplement to, not as a replacement of, the traditional classroom structure. Potential uses in this category include providing extra resources for inquisitive students or to present a detailed solution to an in-class example problem when you find yourself running out of time during class. In addition, content that is not fundamental to a course, but falls into the category of "interesting to students", might be best presented as an additional classroom supplement.

Don't rush to scribble out the last few lines of an example analysis—make a screencast. This technique is especially useful when students are working on example problems in groups. If they know the instructor's solution will be posted after class, they should be more engaged in attempting the problem instead of waiting for you to solve it for them.

A "tricky" derivation that you want students to be familiar with in a general way, but don't want to dedicate half of a class period to recreating could be presented as a screencast. In class, show the beginning of the derivation and then the final result—referring students to the screencast for the intermediate steps. Make sure students know you expect them to view the screencast. Some course management software allows tracking of who views which videos, making enforcement of this requirement possible.

Sometimes there are multiple valid ways of solving a problem but not enough class time to demonstrate each method. In these situations, demonstrate one method in class and screencast the other method(s).

In a software skills-focused course, there is rarely time to cover all of the useful features that students might find useful in the future. Screencasts demonstrating some of the advanced features could be used as a resource for the more advanced students who desire an additional challenge above and beyond the basic material.

Screencasts can help answer student questions outside of class

Screencasts can be an effective method of answering student questions. When teaching a class that involves the use of software (such as a Solid Modeling class), many student questions are difficult to answer over email. The author has found that creating a screencast to show common student problems *along with their solutions* can be a valuable resource for students. The advantage for the instructor comes when these screencasts are reused when the question is asked again (as many common student questions are).

Any class that involves student questions not easily answered over email is a candidate for this technique. In a software-focused class, a multi-page document full of screenshots could be

replaced with a relatively short screencast *showing* the technique or solution instead of *describing* it.

If the same student questions come up year after year, a repository of solutions can be built for the students. Hosted by course-management software (or a simple HTML page on the instructor's website), the repository could provide a method for students to consult a reference and research the solution to their own problems instead of waiting for expert help. If a student does not first check this repository for solutions, the instructor could gently nudge them in the right direction. Additionally, this repository would be useful for any instructors teaching the course for the first time, so they can benefit from the years of experience of other instructors.

Screencasts can provide guided analysis practice for study and reference

Screencasts can be used to provide guided analysis practice. In analysis-heavy classes (where the application of a few governing principles or equations to many situations make up the bulk of the content), screencasts showing the instructor working all the way through problems can be a useful resource for students who need extra guidance. There are many different ways of presenting this guided analysis.

Some students spend all their time in class furiously taking notes as accurately as possible. They may not have time to reflect on what they're writing or to absorb the concepts. The inherent time-disadvantage of lecture can be overcome by a screencast because of its repeatability. Posting a screencast of an example problem discussed during a lecture can give students an additional opportunity to make sure their lecture notes are both correct and complete without the potential social stigma of asking the instructor to slow down or repeat a major point.

A screencast of a past homework solution is an opportunity for students to compare their analysis method to that of an expert. While the author's experience indicates that students do not naturally review their past homework assignments immediately, they do find previous homework solutions a useful resource to study for tests and exams. Presenting a homework solution in screencast form instead of a fully-worked-out document (like a PDF) makes it a little harder for students to skim the solution and say to themselves "That makes sense, I would have done it that way." Instead, the linear nature of a screencast slows down their review and encourages them to think about their path through the problem. Student feedback about homework solution screencasts suggests that there might be a difference in student usage of a screencast solution versus a PDF.

A blend of the two previous techniques discussed is to share with students a screencast solution of an example problem that has not been discussed in class at all, and not a part of a homework assignment. Students who routinely ask for more example problems in lecture should be satisfied with this technique. Rather than another problem for students to reference when attempting the "find another similar-looking example and copy the method" technique, this extra-practice problem could model effective expert problem-solving methods. Discussion (in writing or in audio commentary) of why a particular governing equation was used or why a particular system

boundary was chosen could help students see the general principle being demonstrated. Ideally, this big-picture idea would then be used by the students on their own homework assignments or even help them formulate an approach to a problem during tests and exams.

Follow these rules to jump-start your screencasts

When getting started with screencasting, the temptation to make them perfect through editing can cause the time commitment involved to grow out of scale with the benefit to the students. Additionally, all the settings available during the encoding process can become overwhelming. The following rules are suggested to get the most out of screencasts with the smallest time commitment.

General Recording Rules

- Make the first frame useful for identifying the video.
- Not all mistakes need to be edited out. Decide if it's a minor error or a major error. Showing students how to identify errors and correct them can be an important advantage of screencasts. Editing out the mistake later can take much longer than you think.
- Pause for a second or two while recording. Editing becomes much easier if the content comes in chunks that can be easily separated if needed.
- If you have a small screen for capture (especially for small tablets or convertible laptops), make the most of your real estate. Arranging your work neatly and compactly can minimize the need for scrolling up or down.
- If you need to scroll up or down to reference previous work, make it clear to the viewer what you're about to do. An unexpected page up or down can be very disorienting to viewers. Accordingly, scrolling up or down is usually preferable to a page up or page down.
- Choose a very quiet setting if you're recording audio commentary. Microphones can pick up the click of a keyboard or sleeves brushing against the desk. It might be best to record the audio track after capturing the video.
- You don't have to include audio in an effective screencast. If the logistics of adding an audio track are troublesome, leave it out. Written comments and annotations can potentially provide the kind of guidance that an audio track normally gives.

Editing/Production Rules

- Just like in home videos, use zoom and pan features sparingly. A zoom effect can nicely highlight an important step or menu pop-up, but it can also disorient and annoy the viewer.
- Target a video resolution of 640x480 (standard screen ratio) or 1280x720 (widescreen ratio). An increase in video resolution can make a huge impact on the resulting file size. For example, the same one-minute screencast (widescreen ratio) was 1.4 MB when

encoded at 854x480 resolution versus 2.2 MB when encoded at 1280x720 resolution (both in .mp4 format).

- However, capturing a widescreen laptop screen's full 1920x1200 resolution and then encoding the video at 854x480 will render details (small text, details of icons and diagrams) very difficult to see. If the resulting screencast needs to have a small file size, set the recording area on the screen to be the same as the expected encoding resolution.
- Keep in mind the limits of where you plan to host your screencasts. Your course management software likely has a maximum file size and email attachments are also commonly capped.
- Encode into .mp4 format without embedded players. Many modern browsers and smartphones can easily handle .mp4 videos without any special considerations.
- While Windows Media Player can play .mp4 videos, the Quicktime player can display key frames while fast-forwarding and reversing the video. Since one of the advantages of screencasts is personal control of the playback, I strongly recommended to my students to use the Quicktime player.

Recording and Editing/Production Rules for Pen-Based Input on Analysis Problems

- When using pen-based input, try setting the hardware pressure level to the lowest setting. This setting makes all written notes show up using thick lines, regardless of the pressure used. Thin lines may disappear if the video is encoded in a much smaller resolution.
- Use colors systematically, connecting the screencast to the normal lecture. For example, always draw forces in red and system boundaries in blue just like you do in lecture.
- When working an analysis problem, have the problem statement already written out. There's no reason for students to watch you copy the problem statement from the book.
- Don't record audio while writing using the pen—the scratching of the pen against the display will be obvious in the audio track even if you can't hear it at the time of the recording. Using an external microphone may minimize or eliminate this problem.
- If a short screencast is desired, use the pause command to only record each line of the analysis after it appears. This strategy allows mistakes to be noticed and corrected before they show up in the recording.
- Produce the screencast at twice the recorded speed if not using the above pause strategy. Written explanations simply show up too slowly at the original recorded speed. If the video player allows pause and rewind functionality, students can always slow it down if they can't keep up. However, integrating a change in video speed with an audio commentary track might be challenging.

Conclusion

Learning from the past experience of others can help reduce the start-up time for becoming comfortable with a new technological tool. The discussion of screencasting tools and techniques

in this paper is intended to increase the number of faculty investigating screencasting and its potential impact on undergraduate education.

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