A NEW TAKE ON STUDENT LAB REPORTS

Screencasts are a valuable tool for motivation, collaboration, expression, and authentic assessment

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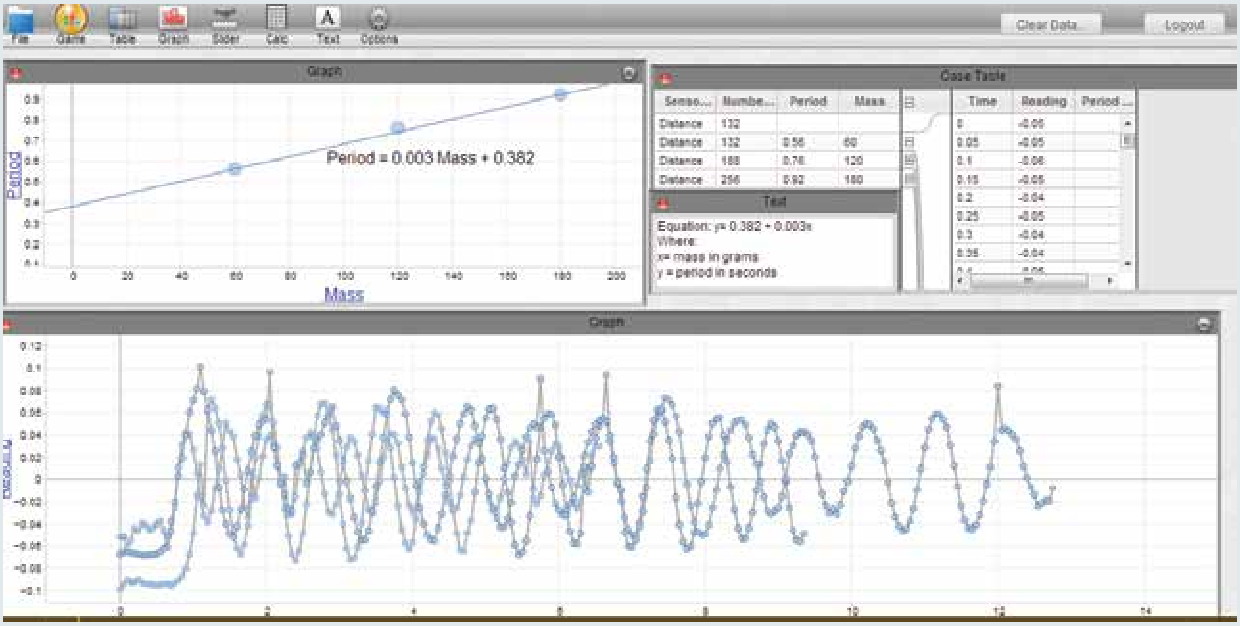
"Great indeed are the things, which in this brief treatise I propose for observation and consideration by all students of nature. I say great, because of the excellence of the subject itself, the entirely unexpected and novel character of these things, and finally because of the instrument by means of which they have been revealed to our senses." —*Galileo Galilei (1610), referring to the first astronomical telescope*

The written lab report—a concise and accurate accounting of an experiment, including a summary of the procedure, presentation of the results, reasoned analysis, and thoughtful explanation—is essential to the scientific endeavor and a key expression and product of inquiry. Generally, however, students and teachers dislike these reports, the former for needing to write them and the latter for needing to read them; but suppose an alternative reporting strategy existed, in which

- teachers review a report in a few minutes and quickly gain insight into student thinking;
- answers tend to be substantial rather than minimal; and
- student teams
  - enthusiastically tackle the task of composition;
  - spontaneously cooperate in generating the report, verbalizing and discussing the content and arguing about the most accurate way to describe the experiment;
  - readily put forward explanations of the results in some depth, whether or not scientifically accurate;
  - easily refer to data in table or graphical form; and
  - comfortably produce reports even if less confident as writers.

FIGURE 1

Student data from a mass-spring experiment, showing a set of time-series graphs of amplitude vs. time (lower) and a summary graph (upper left) of period vs. mass.



Too good to be true? We at the Concord Consortium, an education research group, observed all of these virtues to various degrees when students created short, non-editable screencasts (i.e., digital video recordings of computer screen images that include audio narration) to report on their computer-based science labs. In this article, we share our encouraging preliminary observations and suggest that further exploration of this tool could yield exciting results for science teaching.

Using screencast software

We used screencasts in a three-week pilot as part of a National Science Foundation (NSF)–funded project to encourage original student experiments at the secondary level. We used software called *InquirySpace* (see "On the web"), which integrates a graphical data exploration tool with probeware and computational models, to analyze trends in real and virtual experimental data collections. InquirySpace allows students to take measurements with sensors, run simulations, and analyze the resulting data using graphs. Each simulation produces a time-series graph and students can combine simulation results to summarize them in a second graph (Figure 1), revealing relationships among multiple variables. (Note: Teachers don't have to use InquirySpace with this activity. They can employ screencasts for any computer-based laboratory investigation or simulation.)

The project also developed a comprehensive inquiry cycle that matched the capacities of the software. Students performed several mechanics experiments, each time following the same general steps that closely aligned with the science practices in the *Next Generation Science Standards* (Figure 2; NGSS Lead States 2013). Ultimately, students used the same steps and technology to undertake a final project of their own choosing; their experiment was, thus, extended inquiry.

Screencasts (see "What are screencasts?") are an efficient research tool for collecting a record of the evolution of students' thinking as they move to less scaffolded experiments. We were inspired by Scott Stuckey (2012), who studied student-created screencasts for his dissertation at Appalachian State University. During an activity based on a computational model of climate change, Stuckey prompted one group of students to generate screencast explanations and another group to report on the same activity in writing. All students experimented with the model to figure out various influences on climate change, and Stuckey then compared inquiry behaviors and explanations. The results were encouraging. His analysis found that, compared to written reports, student screencasts produced more words, model references, time with the model, time on task, careful attention to answering questions, and references to causality.

FIGURE 2

Addressing the *NGSS*.

The InquirySpace activities address all eight essential practices of science identified by the *NGSS:*

1. Asking questions
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

What are screencasts?

The term "screencasts" is used here to refer to short, real-time recordings of activity taking place on a computer screen with student voice-over narration for explanation. The software (see "On the web") is usually free for short recordings, non-editable, and easy to use and save, either locally or to the web. Screencasts can be used with any lab that produces information visible on a computer screen, e.g., tables, graphs, simulations, snapshots.

Our study

Motivated by Stuckey's results, we used the same technique in a slightly different setting. Students worked in teams of two or three and used Jing—a free, easy-to-use screencast software from TechSmith—to take screencasts and create the analysis part of their lab reports. (Note: Free alternatives to Jing include Screenr and Screencast-o-matic. See "On the web.") Students saved their screencasts locally using a careful file-naming protocol.

We conducted a three-week pilot in a range of settings with diverse groups of students, comprising two physics classes of juniors and seniors in suburban, middle-class schools, and a ninth-grade physics class in an inner-city charter school of mostly minority students with little experience participating in science labs and hands-on experiments. We worked with over 64 student teams and observed over 300 screencasts.

Students conducted an experiment in which they measured the period of a mass hanging on a spring. They positioned a motion sensor below a paper cup and then placed various amounts of mass in the cup, collecting distance measurements as the bottom of the cup reflected signals and produced a simple sine wave. Students varied the number of 60-gram weights (fishing sinkers), the spring constant (by adding springs in series or parallel), and the amplitude.

At the end of each experiment, students created 2-minute screencast summaries, displaying their graphical data. The brevity helped focus student explanations and made the assessment practical for teachers. We provided several screencast prompts for students to use as a guide. For example:

- State your question.
- Explain your procedure for collecting the data.
- Identify the variables and describe how you measured them.
- Describe the pattern you identified.
- Explain why you think this pattern exists.
- Describe any problems you had collecting data and how you overcame them.

Results

Students seemed to become more comfortable and confident with the medium over the course of the three-week project. Although there was no control group writing similar lab reports, our observations agreed qualitatively with Stuckey's results:

- Students enthusiastically tackled their screencasts, often creating multiple versions until they were satisfied.
- Team collaboration was creative, active, inclusive, and varied.
- Students' accounts were powerful, expressive, humorous, and dramatic.
- Teams followed the guiding questions when organizing their presentations.
- Less proficient writers were comfortable (see "Do students like screencasts?" p. 60).

Perhaps the most astonishing discovery was how student teams tried a whole range of interesting collaborative production processes with little coaching from the teacher. For the most part, all students in each group participated, actively discussing how to respond to the questions and deciding who would speak. Students spontaneously employed a range of collaborative techniques, such as:

Do students like screencasts?

Asked in a post-project survey about which they like better—screencasts or written lab reports—students generally responded with positive answers about the value of screencasts but also gave some nuanced answers. Here are some sample responses.

Favoring screencasts:

- "It was easier to communicate what we did and more engaging."
- "Everything is fresh in your brain and you can also show examples visually."
- "I like to talk more than write."
- "We can show actual data collected from the computer."
- "The data is fresher. It is easier to quickly sum up an experiment in a screencast … it would be good to use the screencasts [and] then write a report."
- "You worry less about making it sound good or have good mechanics and just say what you think and what you found."
- "It is more natural and easier to explain things as they come to mind."
- "It allows us to talk and display our graphs and tables."
- "I think a screencast is much more accurate. For one thing, it isn't as overwhelming and hard to do. They are more fun and easier to do than a written report. And speaking, I find it slightly easier to explain my thoughts. However, it does help to have a written form of a script—something to help organize thoughts before speaking."

Favoring written reports:

- "I think a written report has the tendency to require more thought, which would give a more accurate picture of the experiment."
- "Writing is typically clear and concise whereas screencasts are improvised and jumbled."
- "[With writing], it's easier to include more and go more in depth than in a screencast."

- writing collaborative outlines and scripts for their presentations,
- dividing the screencasts into sections, each with different speakers,
- pausing the screencasts between sections,
- selecting one narrator,
- spontaneously talking back and forth during the presentation, and
- retaking the screencast if team members thought they messed up; this was easy to do since the report was less than two minutes long.

Jing screencasts cannot be edited, so each group rehearsed their real-time performance. The "pause" feature allowed students to plan and discuss on a sentence-by-sentence basis, and the playback feature permitted them to review their work in its entirety. Non-editing seemed to be a positive feature because students spent more time thinking about science and less time perfecting their final presentation.

Why are screencasts so effective?

Pride in product. We observed enthusiasm that teachers typically don't expect with written assignments. Though the novelty of the project may have contributed to student enthusiasm, we are confident that it wasn't solely responsible. We think that students appreciated the control and ownership of this process and the final product. Students seemed to find the medium empowering and were willing to assert firm explanations, even if incorrect. Though engagement and expressiveness do not necessarily equate with scientific correctness or accurate reasoning, they are the starting point to true scientific inquiry. And inaccurate statements reveal details of student understanding and misconceptions to the teacher.

The sense of audience is probably the most intriguing aspect of the student screencast. The screencasts evoked a sense of performance and the accompanying excitement while simultaneously avoiding the nervous self-consciousness and peer awareness that often accompanies a live presentation. Students' focus was internal—on the quality of the production. It was as if the medium demanded a well-told story.

Oral processing. An oral discussion is often more fluid than writing. While preparing to record their screencasts, many students would state a sentence aloud and then revise and restate it, adding something they forgot to mention. The inability to edit and the time constraints created a desire to "pull it together" and make a cogent product, focusing the group effort.

Student discussions would also naturally drift from the experiment to the graphs, to the explanations, and so forth. Whereas with writing, students must focus and sometimes truncate their thoughts, discussion is a natural medium for group collaboration. Discussion is also not as difficult to orchestrate as group writing.

Some groups chose to voluntarily write a script for their screencasts (we only required an outline). The fact that students had to perform their screencasts seemed to change their motivation: Writing became a tool of choice instead of a chore.

Future directions

Teachers often dread grading lab reports. Screencasts can use the same rubric and take the same amount of time (or less) to grade than written reports. One of our project teachers, who continues to use screencasts for lab reports, confirmed this: "For me, screencasts are more holistic than specific. I get a sense when students have really nailed a concept or are still struggling. And listening to them discuss it in preparation, I hear them talking about it in just the way I'd like but as a group."

Our experience also suggests that screencasts are a good window into student thinking. As the technology for real-time sharing matures, screencasts may prove to be a powerful tool—especially since students seem more comfortable engaging in screencast explanations than in whole-classroom discourse.

And screencasts are only one of many digital forms of reporting. Video presentations, which have been widely used in various subject areas, allow for rich expression and collaboration and probably give the same sense of ownership. Of course, video is a more complex and editable medium so it requires more time to make.

Teachers could also explore combining writing and screencasts. One school in the InquirySpace project has a focus on science writing, so screencasts alone are not sufficient. Teachers could ask students to make a team screencast and then require each student to write a complementary lab report. Students could organize their thoughts as a team, and then those students who are less motivated or more uncomfortable with writing would have a strong start on the writing process. In this scenario, screencasts could serve as a motivator and tool for developing fluency within the team, acting as a verbal preprocessing and discussion forum before the more formal written work. Several students even suggested this screencast and written report combination in their responses to post-activity surveys (see "Do students like screencasts?").

One limitation of screencasts is that students' work (e.g., data, graphs) must appear on a computer screen. But computer-based data collection and display is becoming more ubiquitous, and tablets or smartphones might provide accessible alternatives. In our pilot project, students at the inner-city school tried on-computer drawing, sketching their experimental setups when they invented their own experiments. The sketches were valuable but time-consuming. Photos of lab setups, with a text-labeling option, would probably be more efficient.

Conclusion

Our initial trials and Stuckey's findings offer a glimpse into the potential of an untapped technique that encourages expressiveness, engagement, ownership, and collaboration—commodities that teachers struggle endlessly to foster in students. Our pilot project showed that, regardless of demonstrated writing ability, students can produce clear, articulate, and careful oral explanations.

Though quoting Galileo may seem farfetched when reporting on the use of student screencasts for lab reports, the parallel is sincere. Galileo was the first to train a telescope on the night sky, and his astonishment at what he saw comes through in this 400-year-old text. This archetype of a scientist's excitement repeats every time an observational instrument reveals new phenomena (e.g., screencasts to view student thinking and learning)—though the scope isn't always as momentous as moons around Jupiter, Saturn's rings, or mountains on the Moon. ■

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On the web

InquirySpace: *http://concord.org/projects/inquiryspace*

Sample student screencasts: *http://concord.org/inquiryspace/screencast-examples*

Screencasting software

Jing: *techsmith.com/jing.html*

Screencast-o-matic: *screencast-o-matic.com*

Screenr: *screenr.com*

Jones Spring Co., a source for a good spring (item #174-C) for the experiment: *springsfast.com*

References

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NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states.* Washington, DC: National Academies Press.

Stuckey, S.E. 2012. Examining the impact of student-generated screencasts on middle school science students' interactive modeling behaviors, inquiry learning, and conceptual development. PhD diss., Appalachian State University.