Jonathan Bergmann and Aaron Sams

Remixing Chemistry Class

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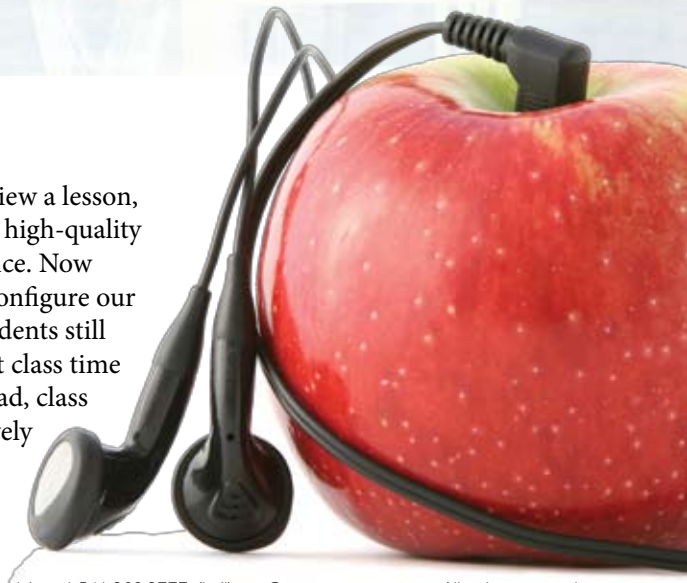
Two Colorado Teachers Make Vodcasts of Their Lectures to Free Up Class Time for Hands-on Activities

As educators, we continually strive to improve the quality of time spent in class with our students. As chemistry teachers, we know that lectures are necessary to convey content, but experiential learning is more effective at constructing and solidifying knowledge.

Podcasting and vodcasting our lessons at first proved to be an effective way for absent students to catch up, for struggling students to review a lesson, and for us instructors to have high-quality lessons available in our absence. Now podcasting has helped us reconfigure our chemistry courses so that students still receive direct instruction, but class time is not used to deliver it. Instead, class time is now reserved exclusively for lab activities, demonstrations, one-to-one assistance, and small group tutoring.



The jury is still out, but some of the pioneers of this model, such as 11th grade student Lauren Russ, are already on board.

"I have watched my science grade rise a letter grade just because of the way the podcasts have been helping me," Russ said. "I think podcasts should be done in all classes. I love podcasts, and hopefully one day all classes will have podcasts."

Turning Chemistry Class Inside Out

During the second semester of the 2006–07 school year, we decided to make video podcasts (vodcasts) of our chemistry lessons. We acquired software and hardware that allowed us to record our lessons live and make them available for later student use. (See "Nuts and Bolts of Podcasting" on page 24.)We fronted the money ourselves and were later reimbursed after our science department chair saw how vodcasting could revolutionize our classrooms. We soon realized that if we prerecorded our lessons, we could completely change the paradigm of classroom instruction.

Upon discussing the power of podcasting with some college students, we received some interesting feedback. The college students sang the praises of podcasting because they no longer had to attend class for a lecture. Instead, they could listen to the content on their own time. This made us evaluate the value of class time and contact time with our high school students.

We realized that our students most need us to be physically present when they are doing labs, working out problems, and wrestling with an assignment. Our physical presence is not necessary for the presentation of content, so we decided to flip the way we teach. Material that had traditionally been presented in an in-class lecture could be prerecorded, and the students could watch the vodcast at home before class. Material that had traditionally been assigned as homework could be completed in class with the benefit of teacher assistance if needed.

We do not believe that this model will eliminate the need for classroom instruction. Instead, we hope that by eliminating lectures, we can use class time for more student-centered and inquiry-based activities. (See Point/Counterpoint on page 8.)

Checking Results

Over the summer of 2007, we restructured our classes to implement the new vodcasting model. The model assumes that students have watched the vodcasted lessons prior to coming to class. Concerned that students would not watch them, we devised a system that allows us to check that they have viewed and interacted with the content.

Under the vodcasting model, we now have an additional 50–65 minutes per 90-minute class period to assist students with their understanding of the content. We can now conduct more hands-on learning activities. (See "Class Time Before and After Vodcasting" on page 25.)

We find ourselves actively walking around the classroom, engaging students, checking for understanding, and augmenting the content with higher-order questioning.

Prior to implementing our vodcasting model, we gave common assessments in our classes. Hoping to gather some numerical data, we agreed to use the same tests in 2007–08 as we did the year before, and we compared scores after every unit. (See "Checking the Results" on page 25.)

In addition, we wanted to compare the relative academic abilities of our students before and after implementing vodcasted lectures. We compared scores on the Colorado state exams, which cover reading, writing, math, and science. The average results were lower for the 2007–08 group, most likely because we decided to lower the math prerequisite from enrollment in algebra II to enrollment in geometry.

The average scores of our students on identical science tests given before and after implementation of the model were nearly the same. The data is preliminary, but it is still encouraging to see that the new model is at least as effective as, if not more effective than, traditional instruction. We are meeting our goal of achieving comparable test scores with a lower-level group of students.

Anecdotal Evidence

Already we have noticed that our students have a better grasp of the content. Our students like being able to pause their instructor and rewind when necessary. They can view the lessons at their leisure and can break them up into smaller segments if needed. They appreciate having individualized attention from their instructor when wrestling through a concept in class that they don't understand.

Russ admits that she sometimes struggles with the content, but vodcasting gives her an edge she didn't have before. "I think it is the best idea for teaching I've ever had in school. I like being able to work at home in my own way, at my own speed. I have always had trouble keeping up in class, but being able to pause the teacher and play a part over and over until I get it has helped so much."

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Statement of Ownership
Statement of Ownership, Management, and Circulation (Required by 39 U.S.C. 3685). 1. Title of Publication: Learning & Leading with Technology. 2. Publication No.: 1082-5754. 3. Filing date: September 25, 2008. 4. Issue Frequency: Monthly except for Bi-monthly December/January, March/April, June/July, and September/October. Number of Issues Published Annually: 8. 6. Annual Subscription Price: $100.00. 7. Complete Mailing Address of Known Office of Publication (Not Printer): International Society for Technology in Education, 180 W 8th Avenue Ste 300, Eugene, Lane, OR 97401-2916. 8. Complete Mailing Address of the Headquarters of General Business Offices of Publisher (Not Printer): for business name and address refer to #7. 9. Full Names and Complete Mailing Addresses of the Publisher, Editor, and Managing Editor: Publisher—for business name and address refer to #7; Editor—Kate Conley, for business name and address refer to #7; Managing Editor—Paul Wurster, for business name and address refer to #7. 10. Owner: Refer to #7. 11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities: None. 12. The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes has not changed during preceding 12 months. 13. Publication Name: Learning & Leading with Technology. 14. Issue Date for Circulation Data Below: August 2008 (Volume 36 Number 1). 15. Extent and Nature of Circulation. Average No. Copies Each Issue During Preceding 12 Months. 15a. Total No. Copies (Net Press Run): 35,204. 15b. Paid and/or Requested Circulation. 15b1. Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541 (Include advertiser's proof and exchange copies): 32,285. 15b2. Paid In-County Subscriptions Stated on Form 3541 (Include advertiser's proof and exchange copies): Zero. 15b3. Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution: Zero. 15b4. Other Classes Mailed Through the USPS: 932. 15c. Total Paid and/or Requested Circulation [Sum of 15b (1), (2), (3) and (4)]: 33,217. 15d. Free Distribution by Mail (Samples, complimentary, and other free) 15d1. Outside-County as Stated on Form 3541: Zero. 15d2. In-County as Stated on Form 3541: Zero. 15d3. Other Classes Mailed Through the USPS: Zero. 15d4. Free Distribution Outside the Mail (Carriers or other means): 78. 15e. Total Free Distribution (Sum of 15d): 78. 15f. Total Distribution (Sum of 15c, and 15e): 32,295. 15g. Copies not Distributed: 1,909. 15h. Total (Sum of 15f, and 15g): 35,204. 15i. Percent Paid and/or Requested Circulation (15c divided by 15f times 100): 99.77%. Actual No. Copies of Single Issue Published Nearest to Filing Date. 15a. Total No. Copies (Net Press Run): 21,994. 15b1. Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541 (Include advertiser's proof and exchange copies): 19,576. 15b2. Paid In-County Subscriptions Stated on Form 3541 (Include advertiser's proof and exchange copies): Zero. 15b3. Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution: Zero. 15b4. Other classes Mailed Through the USPS: 1,027. 15c. Total Paid and/or Requested Circulation [Sum of 15b (1), (2), (3) and (4)]: 20,603. 15d. Free Distribution by Mail (Samples, complimentary, and other free) 15d1. Outside-County as Stated on Form 3541: Zero. 15d2. In-County as Stated on Form 3541: Zero. 15d3. Other Classes Mailed Through the USPS: Zero. 15d4. Free Distribution Outside the Mail (Carriers or other means): 48. 15f. Total Free Distribution (Sum of 15d): 48. 15f. Total Distribution (Sum of 15c, and 15e): 20,651. 15g. Copies not Distributed: 1,343. 15h. Total (Sum of 15f, and 15g): 21,994. 15i. Percent Paid and/or Requested Circulation (15c divided by 15f times 100): 99.77%. 16. This Statement of Ownership will be printed in the Dec/Jan 2008/2009 (Volume 36, Number 4) issue of this publication. 17. Name and Title of Editor, Publisher, Business Manager, or Owner: Tiffany Montes, Staff Accountant, International Society for Technology in Education. Date: September 25, 2008. I certify that all information on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).

Nuts and Bolts of Podcasting

A piece of software called Snapkast allows us to record PowerPoint slide shows, which include live voice-over audio and pen strokes created on a wireless tablet. The software converts the presentation into an MP4 file that students can access in a number of ways. Students can see the PowerPoint slides, hear our voices, see diagrams annotated, and see problems worked out. In addition, some interactive whiteboards (specifically Promethean) come with software that allows screen capture that is converted into a (somewhat large) movie file.

We teach in a rural area, and some students do not have access to high-speed Internet. Some student home computers may also not be able to download and play the large video files effectively. Therefore, we make vodcasts available in a number of ways: on our Web sites, iTunes, Google Video

Shoestring Budget	
Software	Snapkast (PC)/ Snapzpro (MAC)
Tablet Device	Wacom Bamboo Tablet
Mic	Basic PC Mic
Propagation Method	Student Flash Drives
PC	Basic Desktop

	Midrange		High-end Project	
$56–$80 $69	Snapkast (PC) Snapzpro (MAC)	$56–$80 $69	Camtasia Promethean Software	$250 Included with Hardware
$70	Wacom Graphire Bluetooth Tablet PC	$250 $600–$2,000	Interactive Whiteboard	$2,000
$10	Microsoft LifeChat Wireless Mic	$40	Samson Podcasting Mic	$150
$10/each	DVD Burner and Software	$100	Server with RSS Capabilities	N/A
$300	Tablet PC	$600–$2,000	High End Media PC	$1,500

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via Teacher Tube, classroom computers, and DVDs. Students then watch the vodcasts on their home PC, school PC, iPods, video-enabled cell phones, or home DVD players.

Students without high-speed Internet connections are encouraged to bring in flash drives and download the files directly from our school network. Students who do not have flash drives are allowed to check them out from us. Those students without computers are accommodated with DVDs containing the podcasts. Our district has provided us with computers that quickly process and burn the DVDs.

Class Time Before and After Vodcasting

Before Vodcasting	Time	With Vodcasting	Time
Warm-up Activity	5 min.	Warm-up Activity	5 min.
Go Over Previous Night's Homework	20 min.	Q&A Time on Podcast with Chemical Demonstrations	10 min.
Lecture New Content	30–45 min.	Lecture New Content	0 min.
Guided and Independent Practice or Lab Activity	20–35 min.	Guided and Independent Practice and/or Lab Activity	75 min.

Checking the Results

Exam	2006–07	2007–08
Unit 2	78.7%	78.7%
Unit 3	84.5%	86.8%
Unit 4	81.6%	80.7%
Unit 5	N/A	N/A
Sem 1	67.9%	66.2%
Unit 6	75.1%	74.1%
Unit 7	89.0%	81.2%
Unit 8	N/A	N/A
Final	73.9%	71.7%

Parents who at first were confused and skeptical have commended us on better use of class time. Some parents are even watching the vodcast lessons and learning chemistry along with their kids.

"I have to admit I was skeptical about the podcasts at first," said Teri Saxton, the mother of an 11th grade AP chemistry student. "I had a fear that they would reduce the amount of direct contact with the students, and questions about the lectures would go unanswered. I am happy to say I was very wrong."

Some parents lauded the innovative approach. "I bet it appeals to this electronic generation just for a 'cool' factor, which is always a good angle in education," said Dan Heimerdinger, the father of a 10th grade student. "It is an introduction to a different teaching technique that might hint at some of the things they will encounter in college. It is similar to the lecture/recitation set-up that most kids don't see until college. That will give them some advantage."

Another benefit of the new paradigm is that we have gotten to know our students better. Because our role is now to rove around the classroom and check for understanding, we can quickly assess student progress and make immediate modifications. We often find ourselves bringing together

Podcasting Lectures Catching on in K–12

Inspired by Jonathan Bergmann and Aaron Sams, who presented about podcasting at NECC, Brian Hatak, a chemistry teacher at Arapahoe High School in Centennial, Colorado, decided to change the paradigm for his classes this year. Hatak said he had been frustrated for years by the way his class was working.

"I would ask the students to read, and they would act like they did, and perhaps some of them did, and then I would lecture over the material the next class day. It seemed that the students were learning that they did not have to read, since I would be covering the exact material in class."

Hatak decided to flip his approach. He is now creating vodcasts of lectures and is uploading them to multiple sites, including to his blog, to TeacherTube, and directly to his course page. He's posted his blog into an iTunes feed, and he burns DVDs for students who have slow connections or no Internet at home. He spends class time clarifying, guiding, and answering students' questions.

Some parents have been skeptical of the approach, Hatak admitted. They think the content—not the questions—should be driving the discussion in class. But Hatak feels he needs to help students in the areas where they need it most. "That would be on the problem-solving and higher-level material and not just what they could gain from the book."

Most of Hatak's students have been pleased with the transition. "The cast allows the students to work at their own pace (either faster or slower) and to revisit information when they want to," he said. "The students seem to enjoy being in charge of their learning."

And Hatak has more class time to discuss "the big picture of science and chemistry specific to the world in which they live. As one example, we looked at how LCD screens are made and how they function. That's something we never had time to do before, but it is at the heart of what chemistry is all about."

Eleventh grader Ben Horblit is a big fan of the vodcasting approach. He told Hatak in an e-mail: "I am personally very excited about the way you have decided to use technology to fundamentally change the way you run your class. The way you perceived an issue and saw how technology could be used to effectively address it is a prime example of how the expertise of teachers is key to effectively integrating technology into a class."

—By Diana Fingal

small groups of students with similar problems and doing small group teaching. With this model, the role of the teacher has changed dramatically.

This shift has also led us to invest more time and energy in the students who need the most help—those who struggle with the content. In the old lecture-discussion mode of teaching, it was often the bright kids who raised their hands and got all of the attention. In the vodcasting model, the students who get the teachers' time are those who struggle. Our brighter students tend to learn the concepts taught through vodcasting, so they are able to work more independently than before. This allows them to move ahead at their own pace while we provide guidance and reinforcement to our lower-level students who struggle. This is one reason we think that our lower-level students have been more successful this year.

Successful Models

We have had the opportunity to conduct numerous workshops and an ISTE webinar in which we have trained

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other teachers in the use of our vodacasting model. In doing so, the participants have enthusiastically adopted and adapted the model for their specific content areas. For example, foreign language teachers are recording conversations and grammar lessons for the students to watch, and they use class time for conversational use of the language; a math teacher has created tutorial lessons for specific mathematical topics; and a middle school team is using our model to record lab instructions to gain additional class time for the completion of the actual lab. (See "Podcasting Lectures Catching on in K–12" on page 26.)

Future Vision

Our vision for the future of our model is that of guided independent study, individualized education, and inquiry-based science education. As a result of the success of our model, we have received $11,000 in grant money to help outfit our classrooms with new scientific data-collection devices. Someday we hope to receive additional support to equip our classrooms with computers so students can more efficiently work at their own pace.

Beginning this year, students watch the podcast lecture, do their assignments, conduct lab experiments, finish projects, and take authentic and written assessments all at their own pace. Benchmarks are in place for students interested in meeting minimum requirements, and advanced topics are available for students interested in getting ahead.

This model allows a very gifted student to complete both chemistry and AP chemistry in one year, and it can potentially put an end to the idea that learning is linked to seat time instead of mastery of the content.

Resources

Bergmann's Web page: www.wpsdk12.org/~jbergmann

Hatak's blog: http://21chatak.blogspot.com/2008/08/good-ideas-seem-to-come-in-sets.html

Hatak's podcasting blog: http://hatakappodcast.blogspot.com/

Sams's Web page: www.wpsdk12.org/~asams

Snapkast: http://snapkast.com/

Web site on how to start vodcasting lessons: www.educationalvodcasting.com.

Jonathan Bergmann teaches science at Woodland Park High School in Woodland Park, Colorado. In 2002 he was awarded the prestigious Presidential Award for Excellence in Science and Math Teaching.

Aaron Sams teaches science at Woodland Park High School in Woodland Park, Colorado. As the recipient of various technology grants, he has had the opportunity to experiment with a range of technological teaching tools.