Overview

In a talk given on Sept. 6, 2011, President Kim B. Clark discussed a concept of learning that he claimed would lead to “an increase in the capacity or power to Know, to Do, and to Become.” We have applied this framework in our biology classes by providing videos for the students to watch outside of the classroom in order to assimilate basic content knowledge. Then we use classroom time for active learning strategies that deepen understanding and introduce practical applications in the field of study. The emphasis in the classroom changes from one of knowing to one of doing. This pattern will prepare our students to become better learners and future leaders in their careers.

A revolution is underway in education to change the face of the traditional classroom.

We are seeing a transition occur between the traditional classroom and what is now being called the “flipped classroom”. The concept is fairly simple and harmonizes well with the BYU-Idaho learning model. We provide resources and require students to learn content on their own outside of the classroom, and then we use class time to review, answer questions, practice problems, and apply concepts. In short, lecture is moved out of the class and “homework” is moved in.

Although the concept has been around for decades, it has experienced a renaissance in the last five years spurred on by advances in technology that allow relatively easy creation and dissemination of high quality multi-media content. Video lectures, or Screencasts as they are often called, appeal to the current technology-centered generation of students and are able to provide a multi-sensorial experience that has never been achievable through printed text.

The use of screencasts to deliver content has several advantages over traditional faculty lecturing. First, the student can watch the screencast at his convenience, be it just after school or later in the evening. He can watch it on his laptop computer, tablet computer, or smartphone. Second, the screencast may be stopped, rewound, and watched again if the concept was not understood the first time. A student may spend as much time as is necessary to achieve mastery before moving on to the next concept. In fact, the student can even return to the same material weeks later when he needs to remediate for a more advanced topic. And last, the screencast is able to deliver wherein lectures and a textbook are used to convey knowledge, and student acquisition of knowledge is only assessed with tests. The traditional classroom can no longer keep up with the extraordinary pace of change that is occurring with advances in technology.
the same content material each time, whereas a lecturer might alter his teaching plan with each lecture.

If a student has prepared in advance and already viewed the lecture material, the classroom can now become a place of active learning. While in the classroom, students talk to each other and share ideas, at the same time helping each other with the homework assignment. The teacher becomes a coach instead of a lecturer, and walks around the classroom helping where necessary. Having just mastered the information for themselves, sometimes students can answer each other’s questions better than the teacher can.

This idea of flipping the classroom was made popular by Aaron Sams who is a teacher at Woodland Park High School. He made a YouTube video explaining how he uses this process in his classroom (www.youtube.com/watch?v=2H4RkudFzlc).

Salman Khan, a retired consultant who first started making videos to assist his cousins learn algebra, has played a role in the further advancement of inverted curriculum with his videos teaching high school subjects. (www.khanacademy.org) His website now contains an assortment of videos that can be watched to learn at one’s own pace.

In this paper we provide instructions on how we produce our own screencasts, along with some data from our Introduction to Biology course demonstrating the advantage of screencasts to reading the textbook. We present active learning strategies that lead to the deeper learning we are trying to achieve.

To Know
We are in the process of producing our own content screencasts for students to watch before they come to the lecture. The computer software that we use is PowerPoint, which allows us to make slides with animations. These animations can follow a scientific process from start to finish. In addition to PowerPoint, we use Camtasia, which allows us to make a video with a voiceover attached to it. A high quality microphone attached to the computer, along with speakers, permit us to dub the Camtasia video. In addition to drawing animations, we are also using a Wacom tablet attached to the computer loaded with SmoothDraw3 and Windows Journal software to produce videos that scroll through the content, much like what you see on Khan Academy.
Making screencasts is labor intensive and requires time that faculty don’t necessarily have. To overcome this dilemma we hire students to do the work for us. We sit down with a student and write up an outline of what it is that we wish to cover in the screencast. The student writes a script and makes some initial drawings. We evaluate his work and give feedback, and then the student begins the animation process. We meet with each student weekly to discuss his progress and make sure he is still on track. We provide all of the resources on campus that the student will need to complete this project, and we can even offer college credit for students who spend many hours working for us. By meeting together often we can correct mistakes early on before the final product is released.

By using students to produce our screencasts we find that they can explain things in a way that their peers will better understand.

After many revisions the final product is made available to students in our classes. By using students to produce our screencasts we find that they can explain things in a way that their peers will better understand. It also teaches them new skills on the computer, and they become proficient with the content since they are mastering it while they make the animations.

We produced our first two screencasts and were pleased with what we had; however, we weren’t sure of their efficacy over the printed text. Before investing more time producing screencasts that teach content we decided to perform an experiment to find out just how effective they were in teaching students outside of the classroom. We designed the experiment to test students who either read the textbook or watched the screencast for a given chapter. Students were brought into a laboratory where half of them watched the screencast we produced. The other half sat quietly and read their textbooks that covered the same material. Then all of the students were given the same 20-question quiz. The quiz covered all of the same material found in the screencast and the textbook. Our data indicate that there was no statistical difference between the two groups of students in their test performance (See Figure below, Exam 1).

This experiment was done using content that had previously been taught in lecture, so we undertook another experiment on a subject that had not yet been covered in lecture. The same parameters were used to test two sets of students, one group reading the textbook and the other group watching the screencast. This time there was a significant difference between the two groups, with the screencast group performing better on the quiz (See Figure). These results are encouraging, to the point that we are now producing a screencast for every lecture, and we hope they will replace the use of our textbook.

In addition to testing the students, we also asked them several personal preference questions. When asked if they preferred the screencasts to the textbook many responded that they preferred the screencast to the textbook for preparing for class, but an overwhelming majority told us

Exam results from students who read the textbook or viewed the screencast, then answered a multiple-choice test. Sample size consisted of 123 students, with half of them randomly chosen for each group. The results between the 2 groups for Exam 1 were not statistically significant (Two-tailed T test P value = 0.07). There was a statistically significant difference for Exam 2 (Two-tailed T test P value = 0.0002).
they preferred the screencast in reviewing after the lecture and using it to prepare for the test. Almost every student told us they would recommend the screencasts to their peers who are studying this material.

One of the strengths that sets these screencasts apart from other screencasts already available on the Internet is their modularity. Each screencast consists of 10-15 individual chapter segments. Each segment discusses one concept. A student can go back and review just one segment at a time and can jump forward, skipping segments if they already know the material. An instructor in another class can use some of the segments for his students if he believes that they require some supplemental work. The modular segment idea allows these screencasts to be personalized for any classroom or subject.

**To Do**

Now that we have moved content out of the classroom, the next question we asked was, how can we best utilize the time we have in the classroom with our students? Our goal should be to produce deep learning in our students. If they come to class already understanding the material that they were asked to learn on their own, we can now turn the classroom environment into a place where they use critical thinking skills to apply the newfound material to their own situation. This change in the classroom setting is known as Active Learning or the Learner-Centered classroom.

We will present a few ideas of how we have turned our biology classroom into a center of active learning. Most of these ideas came from websites that we found by using a Google search of “Active Learning Strategies in the Classroom.”

**Think-Pair-Share**

The teacher asks a question, then each student is given a moment to quietly reflect on what he already knows. After pondering, the student turns to his partner and shares his knowledge verbally. Finally, student pairs are asked to share their findings with a larger group or with the entire class. Answers may be shared in oral or written format depending on the time available.

Think-Pair-Share activities can be done at different times during one class period. For example, at the start of a class period to assess prior knowledge and/or preparation, during a class period to summarize what’s been learned or to apply new knowledge to a novel situation, and/or at the end of a class period to summarize what’s been learned and to lead into the homework assignment or next classroom discussion.
In Class Quizzes that Last the Entire Class Period

We tell our students in advance to study the material thoroughly and to use one side of a sheet of paper (cheat sheet) to write any notes that they wish to use on the quiz. They use i>clickers in class to answer questions for the quiz. They may use their cheat sheet to help them. After each question, we look at the classroom response. If a significant number of students miss the question, then we immediately lecture on that material in class. If most students have answered the question correctly, we move on to the next concept. This technique has saved us lots of classroom time by not teaching material that the students already understand, and spending more time on those difficult concepts that the students need help with.

From Concepts to Pictures

Students are asked to draw a mechanism or process in their notes from start to finish without writing any words. By having an image in front of them, it helps them to visualize the process and how the individual parts fit together.

Worksheets

A worksheet is provided to the student as homework. They are expected to fill in all of the information on their own. Then, when they bring it to class, the teacher can go over some of the answers or use it to ask deeper learning questions. This idea can also be used by asking the students to bring an uncompleted worksheet and, while listening to the discussion, fill in answers. This can work with a question such as: What are the benefits and risks of this plan?

Brainstorming

Creativity is enhanced when students discuss a problem and how they would solve it. Brainstorming works best if there is not just one correct answer. Students can discuss ideas and help each other to recognize if an idea answers the question being asked.

Logical Analogies

There are models all around us that can be used to explain a difficult concept. We use images or descriptions in class and ask students how a model is similar or dissimilar to a concept we are teaching. These compare and contrast activities help solidify the concept in the mind of the student.

Role Playing

Getting students out of their seats is a useful way to energize an otherwise bored student. We bring the students to the front of the classroom and have them act out what we were discussing in class. With minimal instructions, we allow the students to figure out how it works. Through trial and error they come up with a role and act it out for their peers.

Physical Modeling

Sometimes the ability to touch an object is a teaching aid for the student. We use inexpensive objects to teach more difficult-to-understand concepts. Modeling clay is a highly versatile object that we use often. This is usually a fun way to learn, and the students appreciate being able to handle materials as they teach themselves.

Case Studies

A website at the University of Buffalo provides a wide array of case studies for many scientific topics. These case studies may or may not be based on real-life stories, but they provide thinking activities for the student, and they open up a large number of questions to be addressed.

In summary, we are using video presentations to deliver content to the student. Each student prepares for class by watching 20-30 minutes content in lieu of reading a textbook. Students are more interested in watching than in reading, and their enthusiasm carries over into the classroom. Having learned the important content on their own, they come to class with questions about material they didn't understand well. The teacher can then design activities in the classroom to promote deeper learning of the content.

Today’s students require new skills - the ability to think deeply and to contribute outside their own discipline. The use of screencasts, coupled with active learning techniques, is one way in which we can prepare students to be better equipped for the challenges they will face when they leave the University and are expected to make contributions to a dynamic world in which they live.