Open Education, Flipped Instruction & Social Learning

Through several years of innovating using technology to support learning, and influenced by seeing the impact of the open-source movement and how it has ignited the trend in Open Education, I am developing an educational approach that I see as going beyond "Education 2.0." It started by the use of lecture screencasts to support students and evolved into open educational resources (OER). Having these resources led me to apply the "flipped classroom" approach, where the content transfer that traditionally happens in lectures is moved to video and classroom time is used for active problem-solving and assimilation of knowledge. In this model, peer-supported instruction naturally fits into class activities. The next ingredient is social learning using an online platform (I used Piazza, a student-led Q&A forum) and finally allowing outside students following the OER to participate in the online forum, enriching the social experience for on-campus students. Additional elements in one course included public writing projects via a course blog and invited remote speakers via video chat. The flipped instruction model generated the most positive outcomes and increased student achievement measurably. Having used this model for the first time in Spring '12, I intend to continue developing best practices and gaining experience by applying it in my next courses, while streamlining the use of new media and social learning.

Objectives & Educational Outcomes

The objectives of my educational innovation are (i) to use the flipped instruction model enabled by educational video and new media to increase student engagement and achievement, (ii) to share the educational media openly for enhancing recruitment, supporting off-campus learners and other broader impacts, and (iii) to incorporate social learning and peer-support platforms.

Approaches such as active learning and project-based learning have been gaining traction in the last few years because they are proven to be effective[1]. It is well known that pure lecturing is quite ineffective as a teaching method, and evidence is building in this respect (especially coming from the physics education community). Flipped instruction (also called the "flipped classroom") has the same advantages as other active-learning strategies in regards to promoting mastery and deep understanding. Enabled by technology (easy-to-create videos such as screencasts and free online dissemination), the flipped model also frees up classroom time for more activities and personalized teacher attention to students in small groups. With creative design of class activitites, students become engaged and benefit from positive peer support. Thus, the educational outcomes of this innovation are (i) more in-class engagement leading to retention and increased conceptual understanding, and (ii) out-of-class engagement via social learning and open content contributing to student motivation and broader impacts.

Developmental History & Materials Developed

Lecture Capture and Screencasting

The first premise of this innovation is technology-driven engineering courses that embrace blended learning. I started experimenting with lecture capture a few years ago, trying several combinations of technology, and have now settled on using minimalistic projected slides and digital inking during class, recorded live using a screen-capture app to produce screencasts. These experiences were presented in BU's 1st Instructional Innovation Conference in 2009.[2]

Ventures into Open Education

Initially, I shared lecture videos with students via the institutional LMS (Blackboard™), but more recently I ventured into sharing them openly via iTunes U and You Tube. All my courses as an Assistant Professor of Mechanical Engineering at Boston University can be found on iTunes U, and have consistently been the top downloads of the university's iTunes page. The *Fluid Mechanics* course on iTunes also includes homeworks and solutions. My lectures on *Computational Fluid Dynamics* (CFD) are now also available on You Tube and have ammassed nearly 38,000 views since being uploaded during the Spring '12 semester (checked July 22, 2012).[3] The immediate benefit to students taking the courses has been the option of

lecture replay and reinforcement, plus catching up quickly if they have missed a lecture. But I have also received appreciation emails from students at other institutions and self-learners around the world who benefit from the open educational materials, which evidences the broader impact of this effort.

Flipped Instruction

Having collected about 40 hours of video lectures for the *Computational Fluid Dynamics* course, I "flipped" the Spring '12 version of this course. Many of the homework assignments of the previous year were adapted for in-class activities, and I assigned the lectures for home viewing.[4] A big challenge was devising new active-learning tasks to do in class; two examples: (i) a pair-programming exercise, where one student's solution to a coding assignment is analyzed and improved with another student; (ii) a 'Navier-Stokes speed-dating' game, where students had three minutes to show and defend their solution with each peer, after which the 'best' solution was chosen as a group.[5] There was obvious engagement during class and the student evaluations for this course averaged 4.875 on a scale of 1 to 5.

Social Learning

To support the 'flipped' CFD class, I adopted an online student-led, collaborative Q&A forum called Piazza. In this platform, students post and edit (wiki-style) questions and answers to those questions, and the instructor can endorse the student answers or post a new answer. One innovation in the way to use Piazza was inviting outside participants. More than 150 people from around the globe registered and followed the class activities, several of them interacting with on-campus students.[6]

Innovative Courses

The objectives listed above are being pursued incrementally in three engineering courses aimed at, respectively: freshmen, juniors (*Fluid Mechanics)* and seniors/first-year graduate students (*Computational Fluid Dynamics*). The freshman course is *Bio-aerial Locomotion*, an introduction-to-engineering module presenting the physics of animal locomotion through the air (incluing falling, gliding and flying). This course was offered in Fall '11 for the first time and featured widespread use of open media (You Tube videos), live-recorded lecture screencasts, open student assignments via a course blog, and remote guest speakers via video chat. These innovations were presented at the 4th BU Instructional Innovation Conference in March 2012.[7] In the next offering of this course in Fall '12, I plan to apply the flipped instruction model by editing the lecture screencasts from 2011 to assign for asynchronous viewing as 'homework' and developing new interactive class activities. Similarly, the next time that I teach the *Fluid Mechanics* course, I would like to apply flipped instruction; in this case, I will need careful design of methods to ensure student accountability for viewing the material, as well as new in-class activities that focus on conceptual understanding. One idea I plan to explore is using concept inventories for this course.

References

[1] Hake, R. R., Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses, *Am. J. Phys.*, **66** (1): 64–74 (1998).

[2] Barba, L. A., Digital inking and lecture screencasts, *1st Annual Instructional Innovation Conference*, Boston University, March 27, 2009. fig**share** doi:10.6084/m9.figshare.94015

[3] See the video playlist on You Tube at: http://www.youtube.com/playlist?list=PL30F4C5ABCE62CB61

[4] See my essay: http://people.bu.edu/labarba/Lorena_Barba/Blog/Entries/2012/2/1_This_CFD_class_is_flippin.html

[5] The effort caught the attention of the College of Engineering writer, who visited the class and produced this feature on 03/15/2012: http://www.bu.edu/phpbin/news-cms/news/?dept=666&id=59184

[6] See "Innovator of the Week" feature: http://blog.piazza.com/2012/04/03/the-flipped-class-meets-the-open-class/

[7] Barba, L. A., Digital pedagogy in three parts: screencasting, course blog, remote guests, 4th *Annual Instructional Innovation Conference*, Boston University, March 1, 2012. fig**share** doi:10.6084/m9.figshare.94016 — screencast on You Tube http://youtu.be/Zit1fgu_i1s