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Learning material preference in the flipped classroom

Introduction

I currently teach BioEngineering 1010: Biology for BioEngineers. This is a one credit course taken by second semester general engineering majors. It is intended to provide a basic understanding of biology for incoming freshman and prepare them for the biological portions of upcoming higher level courses. The class covers a broad range of topics including basic structure and function of common cellular macromolecules, gene expression, protein synthesis, cell membranes and signaling, and the integration of cells into functional tissues. In previous semesters I taught the course in a traditional format of in-class lectures, homework, and tests. Each 50 minute class consisted entirely of lecturing with very little time for anything besides returning exams and briefly going over the correct answers. There was a lot of information to cover without much time to cover it. I wanted to have more interactions with students to assess how they were learning the material and to determine which topics I needed to spend more time teaching. I found a solution to this problem in the flipped classroom. A flipped classroom takes the traditional style of lecturing in class and assigning homework to be completed outside of class and flips it on its head. In class time can be spent on active learning activities like group problem solving, while out of class time is spent watching lecture videos.

I implemented this style of teaching by creating weekly online lecture videos. The first few videos I made consisted of me running through the PowerPoint slides while recording my lecture through a microphone. This style was not very dynamic or engaging. My next series of videos consisted of me explaining the concepts while drawing diagrams on screen using a Wacom tablet. This style was more engaging, but did not utilize the helpful figures that the PowerPoint slides provided. In the end I combined the two approaches by showing PowerPoint slides while writing extra notes or pointing out specifics by writing on the slides with the Wacom tablet. This style presented all relevant information without being boring to watch.

In-class time was divided evenly between a short review lecture and an in-class activity. My original plan was to lecture for 5-10 minutes at the start of class. However, I ended up lecturing for approximately 20 minutes at the start of each class. This was necessary to reinforce the material from the online videos that was required to complete the in-class assignment for the day. After lecture, the class split into groups of between 2 and 4 students to complete an in-class assignment. The majority of students grouped up with others in their immediate vicinity. In-class assignments consisted of 2-3 long answer questions. These questions were more difficult and involved than either homework or test questions. The goal was to have the students work together to reach a deeper level of understanding than just memorizing facts. Questions often had students compare and contrast different concepts or discuss analogies between certain ideas. During this time I would walk around class and answer any questions the students had. If I saw that multiple groups were getting hung up on the same area, I would temporarily stop the assignment and address the issue for the whole class to hear. I was able to engage directly with the students during this time and evaluate what issues were tough for them to master.

This style of class was new to both me and the majority of my students. A survey was created to evaluate the effectiveness of the flipped classroom and to ensure that I was not running a class that was detrimental to student learning.

Methods

Data was gathered through an anonymous online survey. As an incentive to fill out the survey, extra credit on the final test was given if 80% of students completed the survey. The survey was completed by 70 of 74 students for a 95% completion rate. Results are presented as 100% stacked columns with the number of responses labeled for each data series. An open-ended answer option was provided at the end of each question in case the student had additional comments. Individual questions are presented and discussed in the following section.

Results and Discussion

Information for this course was provided through several different mediums. The core of the course was based on the textbook *Essential Cell Biology*. All figures used in PowerPoint slides and online videos were taken from this book. The structure of the lectures also followed the chapters in the text. Additionally, many homework and in class problems were taken from the textbook. Purchasing the textbook was listed as a requirement in the syllabus and weekly reading assignments were given in the course schedule. The other two mediums of information that students could access at any time were the online lecture videos and the PowerPoint slides. The textbook contained a greater amount and detail of information than was covered in lectures and videos. To determine which sources students were using I asked the following question: “How frequently did you use the following materials?” Responses are summarized in Figure 1.

The students showed a clear preference for the PowerPoint slides and online videos. The textbook was rarely or never used by nearly 70% of students. This was reflected by several responses in the open ended portion of the question. One student wrote “*I did not find the textbook very helpful with understanding the course material.*” Some students also expressed dismay at “wasting” money on the textbook. The students were very comfortable with learning from digital sources like PowerPoint slides and videos. One factor the survey did not address was what percentage of the students actually purchased the textbook. It could be that the book was rated poorly because students did not purchase it in the first place. The textbook is very useful to me, as it is the source of much of the information in the course. However, with the drastic increase in textbook prices and the availability of instructor-created resources, many students have stopped using physical text books. I will still list the textbook as a resource in future iterations of this course, but I do not plan on stressing it as a requirement.

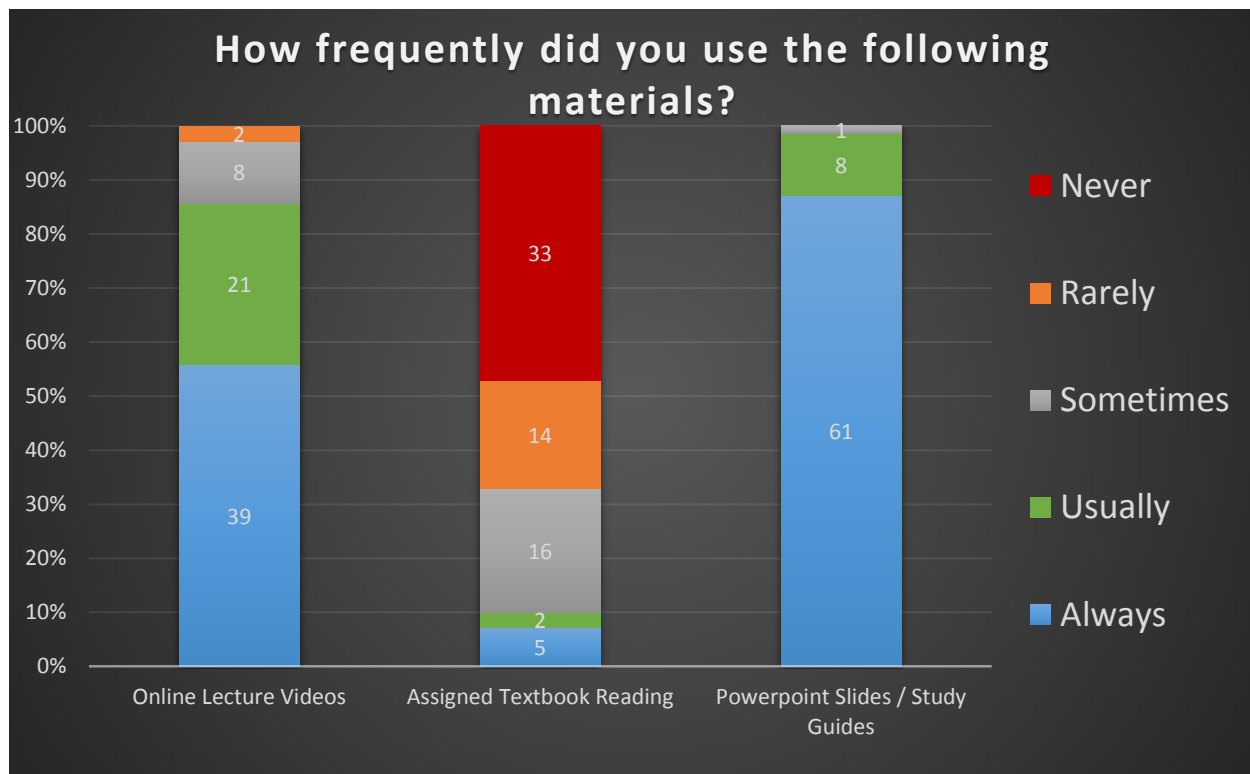


Figure 1. Use of course materials.

There are 6 types of learning materials used in this course: online lecture videos, in-class lectures, in-class assignments, homework, textbook, and PowerPoint slides. To determine which of these materials contributed most to student learning I asked the following question: “How well did the following materials enhance your understanding of the subject material?” Responses are shown in figure 2.

PowerPoint slides were ranked as the most helpful resource. This agrees with the previous assessment that the slides are the most often used resource. Students find these valuable in part because I have included my own notes below the slides.

Online lecture videos were ranked slightly higher than In-class lectures. The difference between the two lecture types is small and not enough to claim that the online videos are more helpful than in-class lectures. However, it is encouraging to see that replacing in-class lecture time with other activities is not perceived as detrimental to student learning. A general response type is summarized by one student’s statement that *“I liked being able to learn in a different way through videos so that if I did not understand something I could just re-watch the video instead of flipping through countless notes like other classes.”* Several other students commented that the different learning materials worked in a synergistic fashion. *“I liked that material was enforced through several methods because it helped me understand the material.”*

Students also viewed in-class assignments as more beneficial than homework assignments. There was some push back on the in-class assignments with several students responding that they did not like working in groups and they were not comfortable with the in-class assignment’s effect on their grade. Finally, as well as being rarely used, the textbook was perceived as a poor contributor to learning. Again, this could be due to students not purchasing the book.

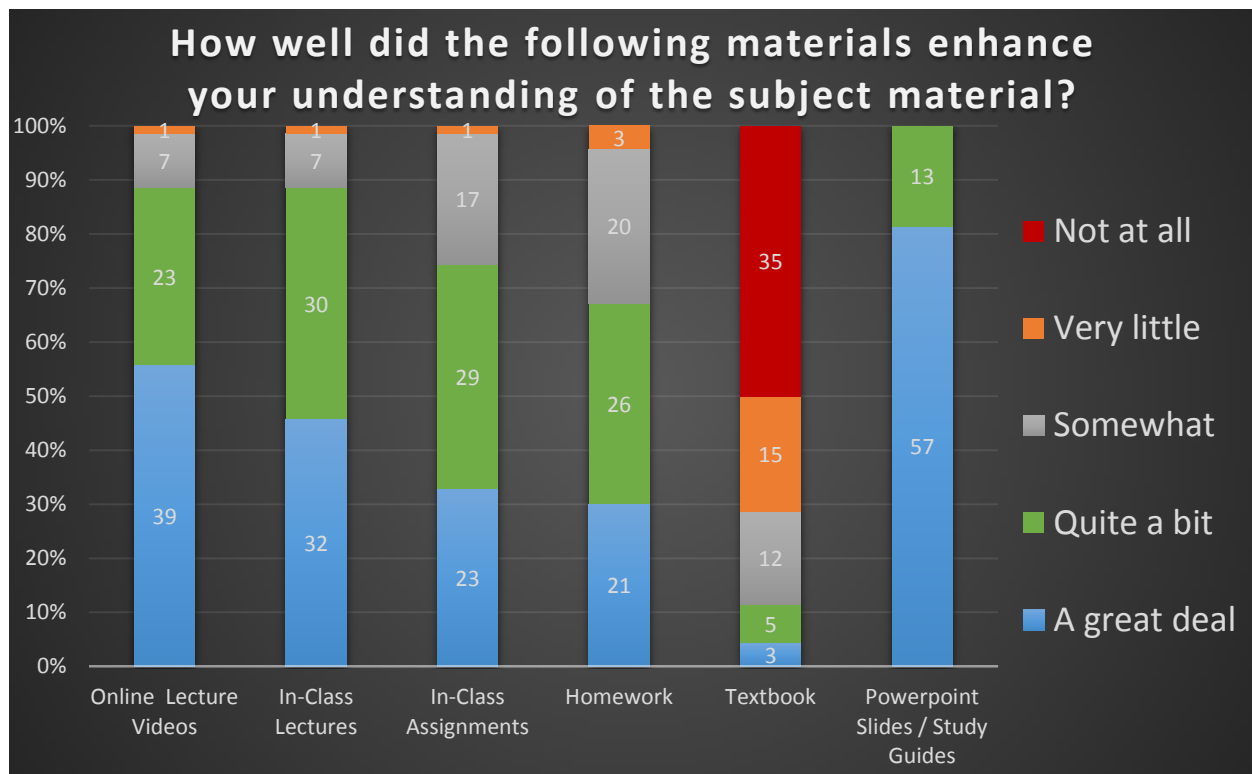


Figure 2. Learning by class material.

One of my major concerns in this course was organization. Many students are not used to watching online videos and completing in-class assignments. I did not want the students to become overwhelmed with the wide variety of materials being presented. To this end I created a detailed schedule of activities and was careful to send weekly reminder emails detailing due dates and assigned materials. Figure 3 presents the responses to the question “*How well organized do you think this course was?*” The majority of students thought the course was either extremely or quite well organized.

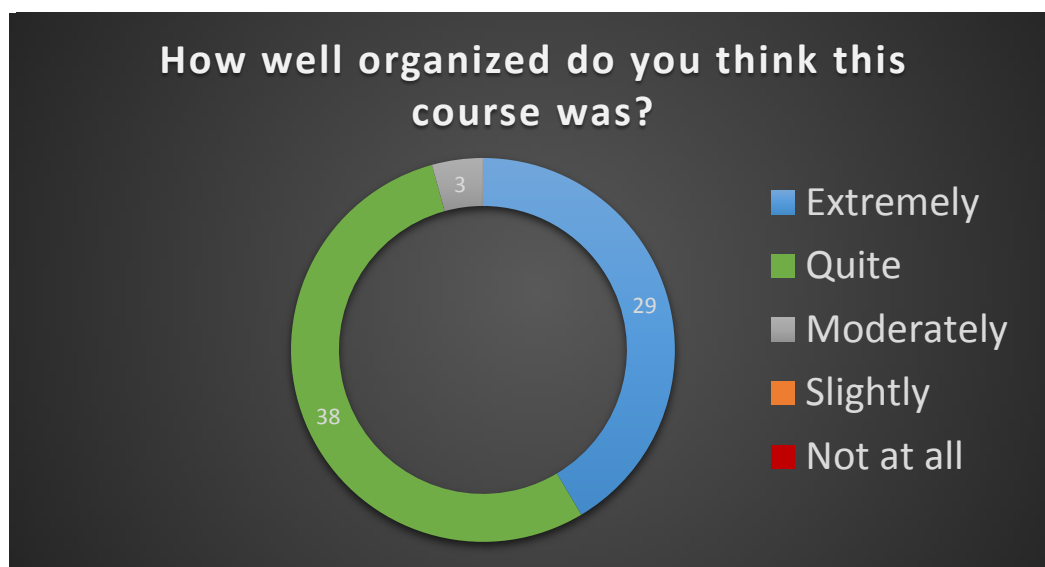


Figure 3. Course Organization

Conclusions

Flipping this class has been successful in many ways. First, the online videos have been well received and ranked highly for their contribution to student learning. These videos have freed up time in class for active learning assignments. Second, the in-class assignments allowed me to connect with and assess student learning at a deeper level than before. Additionally, these assignments were ranked as slightly more important to learning when compared to traditional homework assignments. It is important to organize and schedule a flipped course in a manner that is not confusing and won't overwhelm the students. The flipped classroom is well received by students and beneficial to instructors. I am excited to continue using and improving the flipped classroom style next semester.