Student perception of their learning in a flipped class for non-majors

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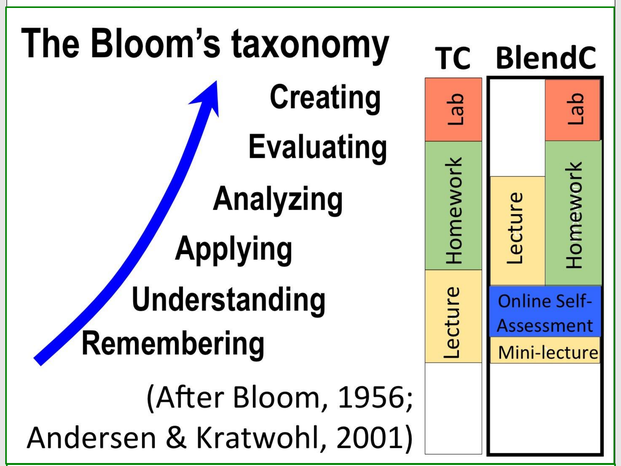
Abstract

We report the experience of teaching a large service course in Electrical Engineering (EE) for non-EE majors in a flipped, or blended classroom format, for five consecutive semesters during 2014 and 2015 (total, ~650 students).

To engage students in active learning outside the classroom we created a large number of online Self-Assessments, which are focused on the lower levels of Bloom's taxonomy. During lectures, we focus on the higher levels, engage students in solving problems and peer instruction. Our main research tools include the official end-of-semester course evaluations, which included both standard (University-wide) questions and the questions specially designed for the assessment of our course. We also used the statistics of students' votes with clickers during the lectures.

Theoretical foundation

Bloom's taxonomy provides the guidelines for organizing the teaching activities within and outside the classroom.



(After Bloom, 1956; Andersen & Kratwohl, 2001)

The left part of the diagram presents the Bloom's taxonomy
The right part compares the traditional classroom (TC) with the Blended classroom (BlendC); see our results below.

The optimal conditions for learning are between boredom and anxiety

By creation of online self-assessments, we strive to reach optimal conditions for learning

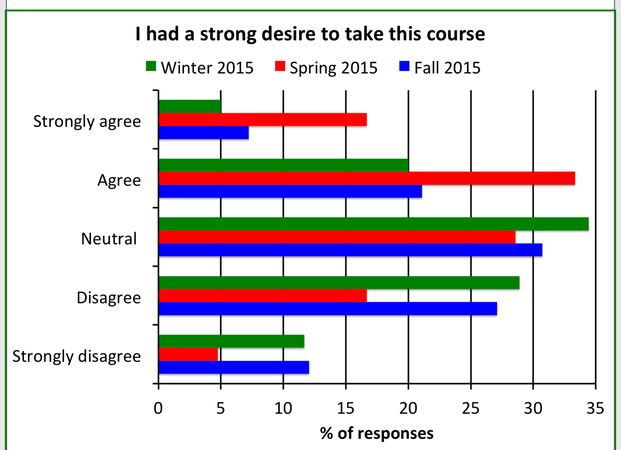
(After Csikszentmihalyi, 1975, 2014, etc.)

Methods

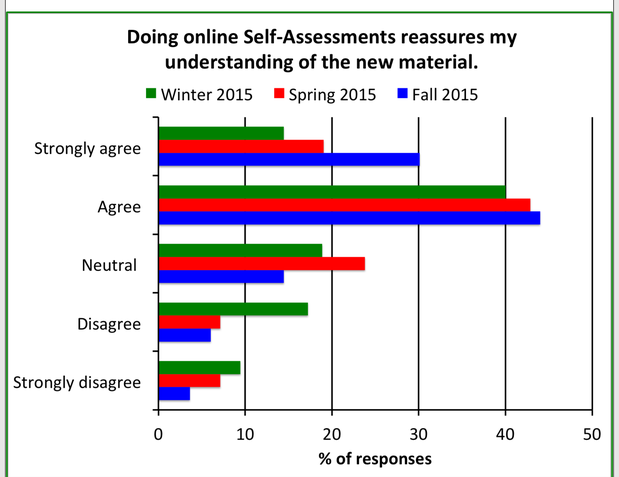
The students' responses to University-wide end-of-term evaluations, which include questions specific for our course, are compared for 3 consecutive semesters – Winter, Spring, and Fall 2015. The clicker voting data were automatically recorded during the lectures.

Results

Non-major students do not desire to take this required course

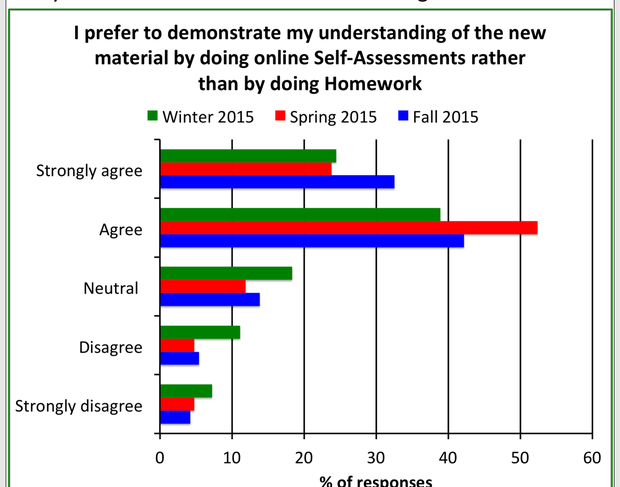


Students positively respond to online Self-Assessments



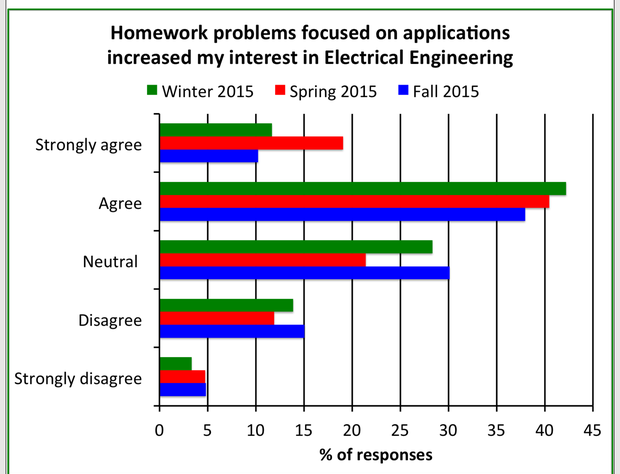
Our online Self-Assessments are based on Question Banks, each including 12 very similar (but distinct) questions on the same topic. One Bank corresponds to one Quiz; several Quizzes make up a Module. For each Quiz, every student is given 3 tries without penalty. For each try, the Canvas server makes a random draw from the same Bank.

Online Self-Assessments and Homework on paper are two ways to demonstrate the student learning of new material



Advantages of online Self-Assessments vs. HW include:

- ✓ Immediate feedback from the server, with correct answer provides guidance on how to approach the problem
- ✓ The feedback arrives while the student is still thinking about this topic (not a week later)
- ✓ Multiple submissions are allowed = 3 tries for every topic

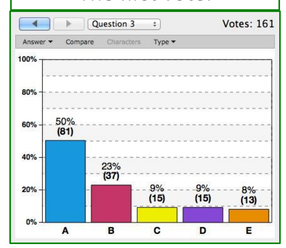


Due to online Self-Assessments, which are focused on the lower levels of Bloom's taxonomy, HW on paper gets shorter and is focused on the higher levels such as applications, which increase the student interest in the non-major field.

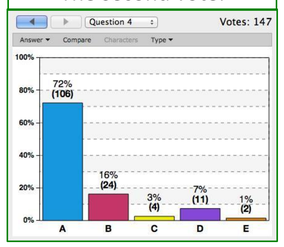
Additionally, students are motivated to learn the class material by the policy of dual submission of HW on paper: extra credit is earned if the HW is turned in before the discussion session (data not shown due to lack of space).

Active learning during lecture includes solving problems and convincing the neighbors that your solution is correct. Students positively respond to both methods of learning.

First, students solve the problem individually. The first vote:



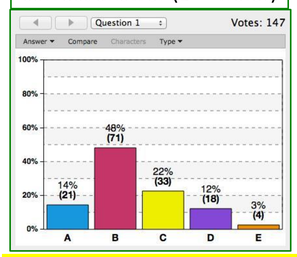
Then, they talk with the neighbors and vote again. The second vote:



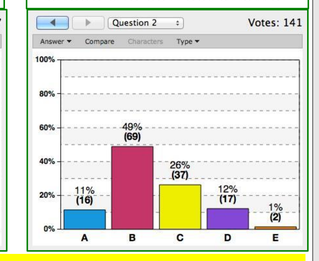
The number of correct answers (A = blue) has grown due to active learning in lecture time. This is peer instruction.

Is the lecture still needed as a method of teaching? Consider the following example:

On their first vote, only 12% students chose the correct answer (D = violet)

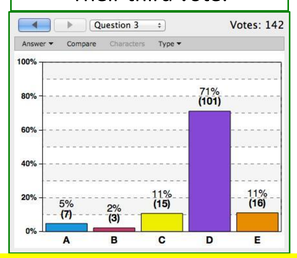


Talking with neighbors did not help: still, only 12% chose the correct answer

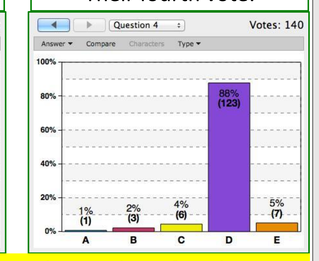


The instructor gave a mini-lecture on the problem-solving strategy but did not disclose which answer was correct.

Then, students solve the problem individually again. Their third vote:



Eventually students convinced their neighbors. Their fourth vote:



Within ~20 minutes of class time the number of students who solved the problem correctly increased from < 20 (12%) to > 120 (88%). **This demonstrates the value of lecture.**

Conclusions

1. Our methods are working.
2. Mini-lectures are needed and valuable.