Methods for Teaching Statics

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Abstract:

Statics is a sophomore level course in Civil Engineering. The curriculum for Statics includes force systems, equilibrium, truss analysis, centroid, and moment of inertia. It is usually observed that this is a difficult course for students and there are often close to 20% of students who do not successfully complete this course at our university.

This semester, we implemented a variety of methods to reduce the failure rate of students in this class. These methods include: increasing use of whiteboard and reducing the use of PowerPoint, using in-class, hands-on demonstrations, using videos for out of class learning, using Mastering Engineering, and leveling the playing field. As expected, over 95% of students successfully completed the course. In this paper, the authors will describe the implemented changes in the Statics class.

Introduction:

It is recognized that learning styles of people can differ. Some learning styles include visual, verbal, physical, social, solitary, aural, and logical. A person could have one dominant learning style or have a mix of several learning styles. A class taught using several learning styles incorporated can benefit all the students. This paper outlines an effort made to incorporate several learning styles in the sophomore level Statics class.

The methods included in this paper are:

1. Whiteboard – Reducing PowerPoint
2. Classroom Demonstrations
3. Lightboard Videos
4. Mastering Engineering
5. Leveling the Playing Field

Whiteboard – Reducing PowerPoint

Whether to use PowerPoint or not is always a debate among Physics/Engineering instructors. The views on this topic are polarized. The camp which uses PowerPoint presentations advocates organization, clarity, and precision. On the other hand, the instructors who advocate the use of whiteboard take pride in modification of class, spontaneity, personalization, and pace. This paper encourages a mix of both methods.

For example, a problem question was projected on the whiteboard and students were also given the problem question on a handout. This ensured that students had the correct problem and that there was no time spent in drawing/copying the problem. This is especially important in the case

of 3-D problems. The instructor then solved the problem on the whiteboard while the students wrote it on the handout sheet. The slides with the solved answers were then posted on Blackboard for student review.

Classroom Demonstrations

Using hands-on activities/demonstrations to explain certain subjects that follow real world situations as much as possible can help students understand the subject and increase retention. Some classroom demonstrations were used in this course. The demonstrations were inspired by the ASCE ExCEEd Model. Some of the classroom demonstrations used were:

1. 3-D Vectors: clear box with arrows on long diagonals and a 3-D pipe demonstration
2. Equilibrium: pulley and string set-up
3. Truss: PASCO truss set and K'NEX kits
4. Centroid: various shapes with a string attached at different points
5. Moment of Inertia: PASCO I-beam and a Plexiglass beam

Figure1: Example of PASCO Truss Set and I-Beam

Lightboard Videos

In this current age of technology, practically every student enters the classroom with a smartphone connected to internet. A recent study from Baylor University has observed that male college students spend approximately eight hours a day on their cell phones and female college students spend an average of 10 hours a day on their cell phones. By harnessing this technology and taking the class lecture into social networking sites such as YouTube, we were able to successfully recreate the class lecture and place it on YouTube using lightboard.

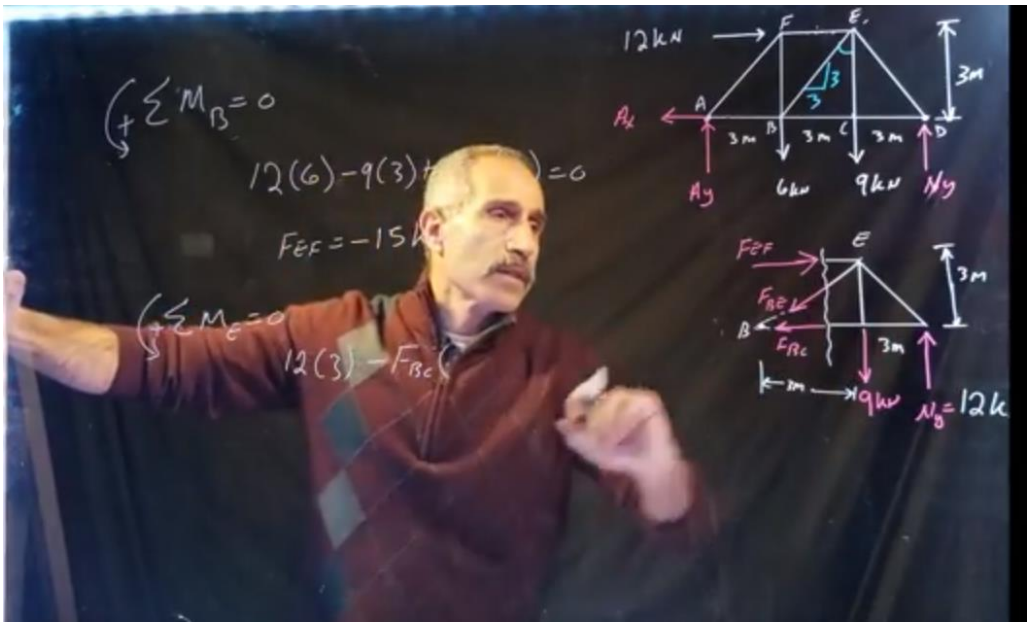

Figure 2: Instructor Using Lightboard to Supplement Learning

These videos make it easy for students to find relevant topics and learn/review at their own pace. It also provides a special connection with students when they can hear the emphasis of terms, see facial expressions, hand movements, and body language which, for some students, can make the topic easier to understand. The ease-of-access and flexibility allows students to watch videos at any time and in any location that they are comfortable. An advantage of the lightboard is that students can see their instructor which can create a welcoming warm atmosphere. This provides students with more tools and shows them where they can find support.

Mastering Engineering

Students often feel that they have a good understanding of the material in class. However, when they try to do the homework, they often encounter difficulties. They then have to wait to meet a tutor or instructor to ask a question and so valuable study time and interest is lost. Mastering Engineering is an online component of the textbook that our university uses. Homework using Mastering Engineering has been a useful tool by giving immediate feedback and help to students.

Leveling the Playing Field

In this age of technology, everyone has access to solutions of homework problems. Some students choose to use the solutions when they can access it, while others don't. To be fair to all students, this homework model was adopted.

1. Homework was a very small percentage of the final grade.
2. Homework was graded only for completion.
3. Homework was assigned on Mastering Engineering.

When a student does not answer a question correctly, they have several chances to solve again. If after a few attempts, if needed, the student has the opportunity to be guided through the process of solving the problem. The student gets full points for attempting to solve before the due date.

The next day, in class, the students were given one quiz question which was similar to one of the homework problems. If the student understood the homework problems, they would be able to solve the quiz question. Everyone would have access to the solutions, thus leveling the playing field.

Conclusion:

Since our university is not very large, it was not possible to have a control group and an experimental group to conduct an educational experiment. We were, however, able to measure the increase in student success rate by over 10%. The students still find the course challenging, but now find it exciting and interesting as well.

References:

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