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Participation in Structures Classes via Student Made Videos

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She worked as a project manager for the City of Oklahoma City on municipal infrastructure construction projects. These projects include roadways, utilities, bridges and buildings; including two LEED building projects, a library and fire station.

Dr. Mosier's areas of academic interests include heavy highway estimating and structural design. Her research interest has been the cost of sustainable construction to owners, specifically Oklahoma City. Additional work is on-going in area of sustainability in construction. Other research interests include technology in the classroom.

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Participation in Structures Classes via Student Made Videos

Abstract:
Opportunities for hands-on student participation in structures classes can be limited. Teaching labs are useful, but are limited in the ability to use non-traditional methods. In order to increase participation, students were asked to create their own videos like math or science teaching videos available online. The integration of technology in the classroom has been identified as technological pedagogical content knowledge. In this study, the students were allowed and encouraged to investigate the technology on their own to supplement in class education. The students were asked to create videos of strength of materials related content as review for structural design courses. The content was limited to solving truss problems, centroid and moment of inertia problems, which were presented in previous courses by other faculty. A survey of the students to assess their perceptions of their understanding of the content and video creation was performed. The importance and competence levels were self-assessed by the students through a survey instrument. A comparison of grades was utilized to determine if underperforming students increased performance. Using the course content from previous semesters allows the study to compare grades from the previous course to the current course to determine if using this technique increased overall grades.

Introduction:

Lecture Based Learning (LBL) is the basis of many classes. Students who have been raised in the cell phone and internet age can find LBL uninteresting. The internet can provide some alternatives to LBL. Standard math equations may have mnemonic devices, like the quadratic formula. By performing a quick internet search, multiple videos on www.youtube.com offer rap videos for the quadratic formula. Mr. W of "sciencemusicvideos" youtube channel[1] has written many songs and has great videos for a variety of high school science topics. These mnemonic devices stick in the brain and, when set to music, are called "earworms[2]."

An internet search of structural engineering topics like truss solutions or column design will provide results in LBL format. These are videos of example problems solved classroom style. There is no catchy tune or mnemonic device for the equation. In class, students specifically requested something different from the traditional lecture. Turning the tables, an experiential learning problem was given to them. Students were asked to create their own videos like those available online. The students were asked to present a truss problem solved by joint or section method, a centroid problem or moment of inertia problems. Determination of the content was based on review material only which had been presented in previous semesters by other faculty.

The students had previously been provided example problems, completed in class work and homework and been tested on the material for the videos. Statics and strength of materials concepts are reviewed before moving into design problems. In order to provide the students with the opportunity to be creative and present their knowledge, an assignment was given to reward innovative approaches to solving these traditional problems.

The integration of technology in the classroom has been identified as Technological Pedagogical Content Knowledge[4,5]. The technology in this case is the use of videography and performing the

task of uploading to youtube.com. Faculty should be able to perform the same tasks they require their students to perform; taking and editing a video, uploading a video and sharing the video to a specific group. However as this is a structures class and not a videography class, the onus of the videography portion of learning is on the students. The experiential or problem based learning portion (PBL)[6] of the assignment was for the students to teach themselves or share group knowledge on the video tasks. The students were allowed and encouraged to investigate the technology on their own to supplement education in structural design.

The objective of the assignment was for students to demonstrate existing knowledge of statics and strength of materials, which are the basis for structural design courses. Additionally, the video portion was to give the students the opportunity to be creative in developing a response to presenting their knowledge. The concept was for the students to solve a problem outside of the traditional green engineering paper and be able to find a new medium for their solution.

The initial assignments were extra credit only and equivalent to one homework or in-class assignment in points. It was important to determine the student's capacity for this sort of experiential based learning. Unknown student factors included: will they participate, will they be able to produce a product, and will there be enough information. The assignment sought to reduce these unknowns by providing the incentive to participate through extra credit. By focusing on a review topic, the students were provided with an excellent opportunity to produce a project. There was not a limitation on problems to solve, so they were able to use their old homework, class notes or examples. The time requirement was to ensure that they actually explained the problem in detail. In reality most of the videos were extremely lengthy and going from 5-15 minutes.

Video Assignment 1:

Create a youtube video not less than 1 minute and thirty seconds in length on one of the following topics.

- Solving a truss by joint method
- Solving a truss by section method
- Determine the centroid of a built-up section
- Determine the moment of inertia of a built-up section

This work can be performed in groups up to 4 people. Upload the video link to the online classroom site.

In accordance with the Institutional Research Board, the students were asked to sign a waiver to release images. All of the students agreed to release video images. Students submitted videos via youtube.com or as .mp4 to a dropbox. The students submitting via youtube.com retain privileges to the content and can delete the content at any time. For this reason, no links to external content have been provided.

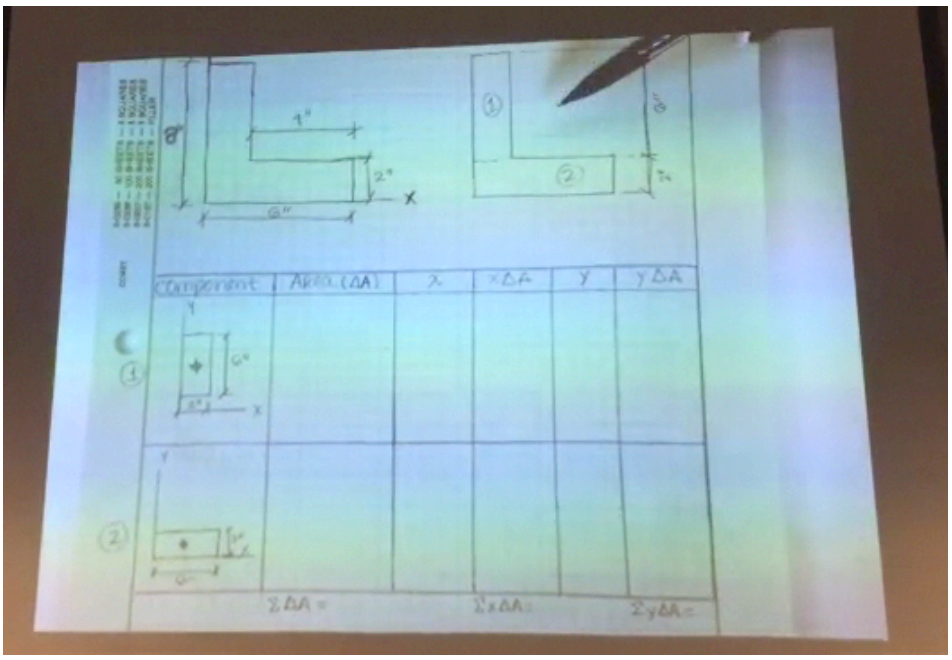

Figure 1: Student Video Submission to Assignment 1

The submission in Figure 1 included the use of a traditional classroom and an overhead projector.

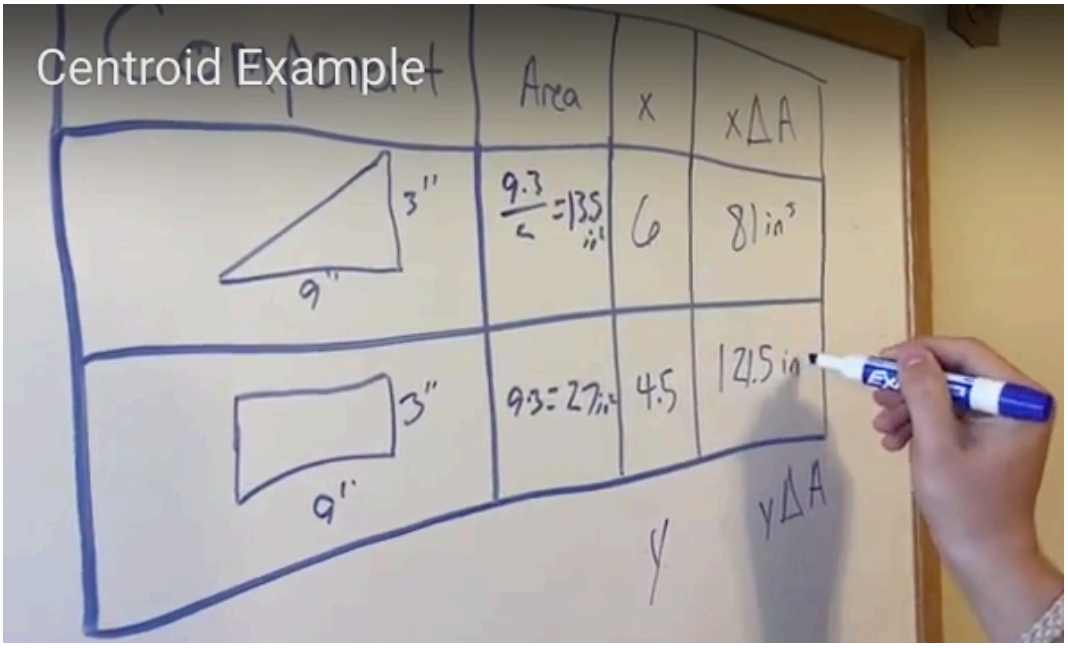

Figure 2: Student Video Submission to Assignment 1

Figure 2 is another typical response of students emulating LBL style techniques. This student group used a whiteboard to solve a centroid problem.

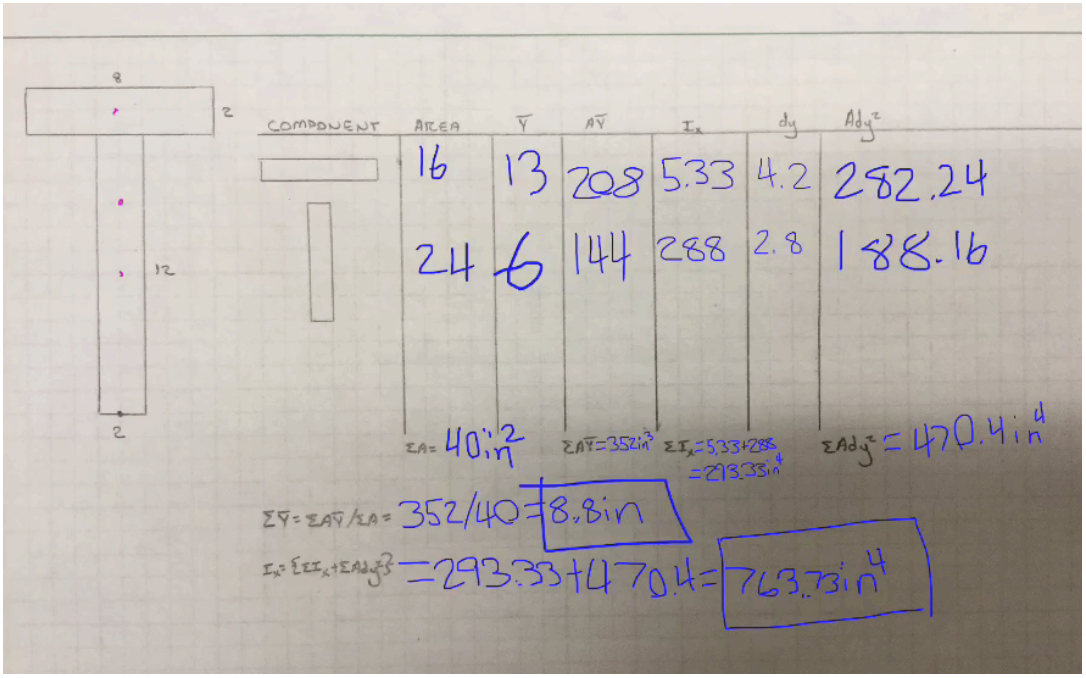

Figure 3: Student Video Submission to Assignment 1

Figure 3 illustrates the skills the student possessed or learned during the video process. This student group used software to write on a picture of the problem. This is similar to many videos teaching math skills online, but also shows additional creativity from the student group. The students were given Assignment 1 with verbal directions about the creativity portion. The requirements for the video were open and intended to allow creativity.

Previously, students had made requests that non-lecture based teaching styles be utilized in the classroom. Basically all of the video submissions were LBL style videos, similar to classroom style examples or those already found online. Despite the fact the students wanted alternatives for teaching and learning, they also found difficulty in finding a unique way to approach explaining the topics.

Video Assignment 2:

Create a youtube video not less than 1 minute and thirty seconds in length on one of the following topics.

- Solving a truss by joint method
- Solving a truss by section method
- Design (size) a timber beam or column including stability (CL) or (CP).

This work can be performed in groups up to 4 people. Upload the video link to the online classroom site.

Rubric: 10 points for completion of the above.
5 points based on creativity above and beyond previously submitted videos.

Both assignments offer a truss option for solution as the students find the truss task difficult. Inherent in the video assignment is the purpose of demonstrating knowledge of how to solve statics and strength of materials problems. Video Assignment 2 was rewritten to strongly encourage participants to treat the subject matter differently by being more creative. One student group's video exceeded expectations in creativity.

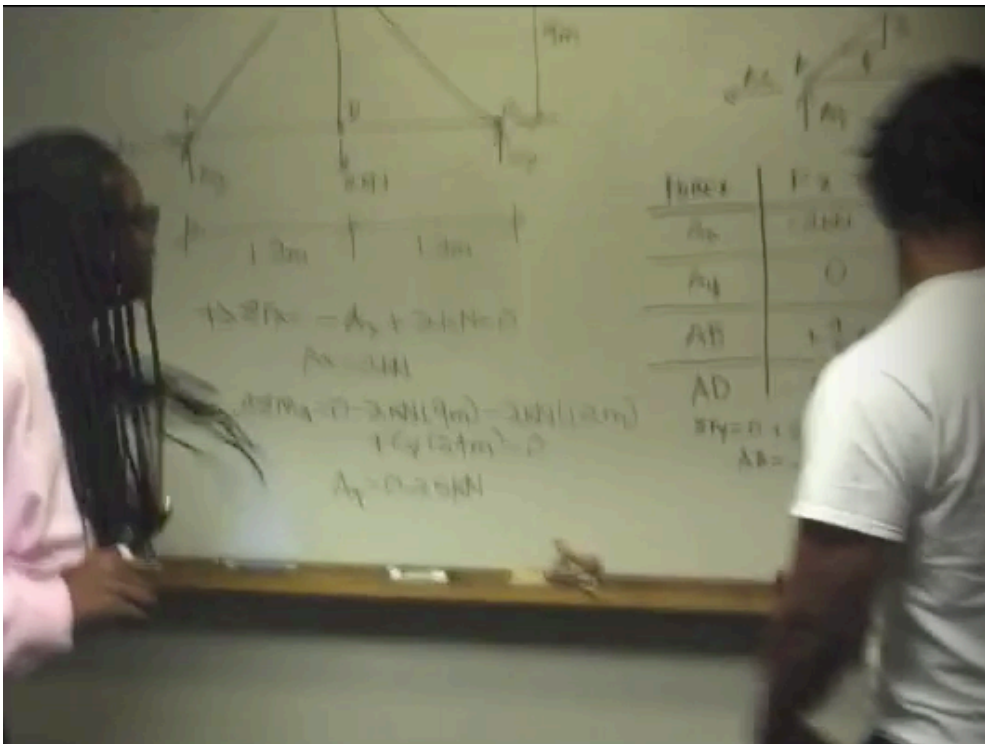

Figure 4: Student Video Submission to Assignment 2

Although difficult to see in a photo, the students shown in Figure 4 have combined LBL with rap and a song. However, some excerpts of the lyrics are available.

> "..popping up, eating fig newtons, forces in the x-direction's two kilo-newtons
> then you take a moment, but only for one moment (moment)
> follow each step, because it gets pretty crazy…"
>
> "…So we got three in the y, four in the x (yeah)
> five is the hypotenuse, let's see what's up next…"
>
> "…Do you believe the truss will hold up?
> I have taught what you need to see to solve it for reactions at A and C (Oh-oh)
> Do you believe the truss will hold up?
> I have taught what you need to see to solve it for reactions at A and C"

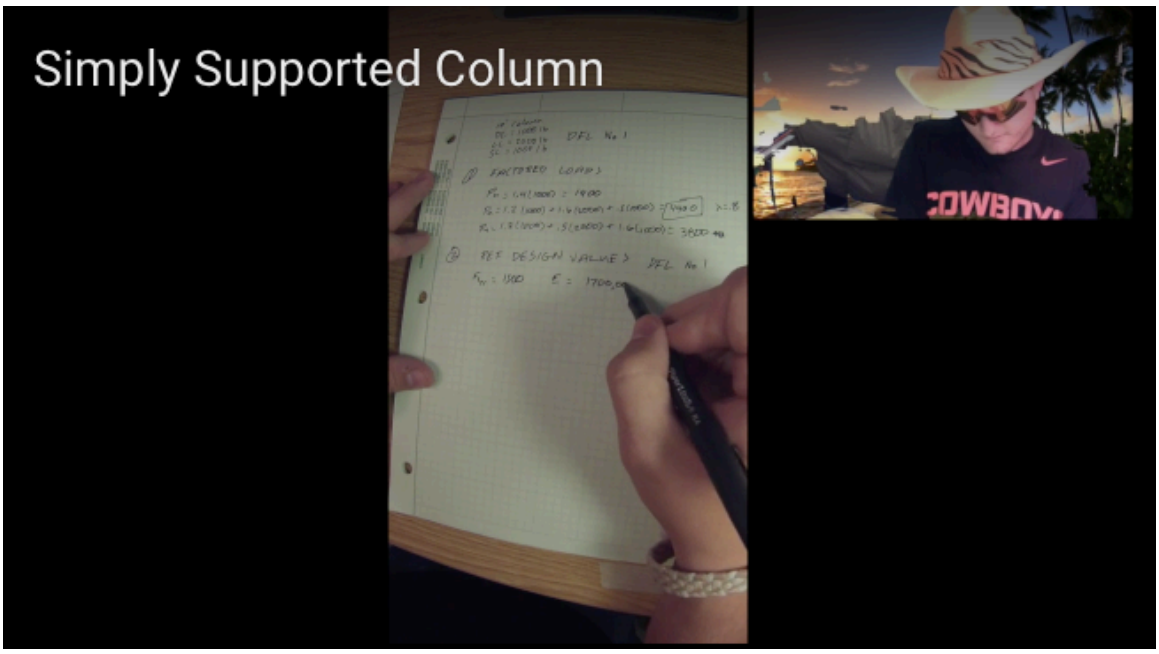

Figure 5: Student Video Submission to Assignment 2

Figure 5 illustrates growth in the video skillset from Assignment 1 to Assignment 2. Figure 2 illustrates the same student group. Similar to many online teaching techniques, the students used a two-camera system to show the lecturer and the example problem at the same time. The cowboy hat and island backdrop use provided for creativity points.

Discussion:

Exam 1 and exam 2 for this course were compared to determine if exam grades increases. There was not a notable increase. Rather, there was an overall decrease from an average of 77.6 to an average of 75.5 or a 2-point decrease. A comparison of the grades of the Fall 2014 class and Fall 2015 class was made. No significant change was identified.

Over the two prerequisite engineering courses, Statics and Strengths of Materials, the grades were quite similar. Specifically, for student "A", with a grade of "B" in Statics, followed by a grade of "C" in Strengths, produced a "C" in Structures 1. It was identified that the Statics and Strengths of Materials grades could be a predictor for the Structures grade. Further, the prerequisite courses have been modified and it is anticipated that the students will be more prepared for this course.

Conclusion:

Utilizing non-traditional assignments with submission as youtube.com encouraged students to be more creative. Although creativity was identified in the rubric, students had difficulty identifying a new or creative way to present the solution to the assignment. Video results, as shown in Figures 1 through 5, illustrate students performing the assignment. Although there was not a significant increase in the overall grades, video assignments will continue to be used in this course.

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