

## Exploring the Efficiency of Teaching “STATICS” Online

Development of an online course in “Engineering Statics” is reported in this paper. In an attempt to explore the possibility of offering “Statics” as an on-line course it was offered as a hybrid course during the Fall 2012 semester at Kansas State university. The course was a combination of traditional class lectures and online lectures.

Quizzes on the material taught during traditional class lectures and the online recorded lectures showed no major difference in students’ performance. Students preferred online lectures due to their flexibility.

Success of the hybrid course encouraged the author and the department to offer “Statics” as a completely web-based course in summer 2013.

All of the course resources were designed and provided to address students’ need for a good learning experience. Various parts of the online course, opportunities and challenges are discussed in this paper. Success of the course will be assessed during and after the completion of the course and will be reported in the final paper.

Keywords: Statics, online, web-based course

### Introduction

Engineering Statics is a required course for many engineering majors. As a branch of engineering mechanics, “Statics” is the first course in a series of mechanics courses that engineering students are required to pass.

The course provides an introduction to fundamental concepts and engineering practice related to analysis of systems in static equilibrium. As perhaps the most fundamental course underpinning professional-level study and engineering practice for the civil and mechanical disciplines, this course provides the necessary background for study of Mechanics of Materials, Structural Analysis, Structural Dynamics, and many other courses requiring a fundamental understanding of static equilibrium, and related phenomena. Through homework, quizzes, and exams, students demonstrate competence in topics that are needed for the later courses, as well as for problems such as are encountered on the Fundamentals of Engineering (F.E. or Engineering In Training, E.I.T.) exam.

The main resources for students when “Statics” is traditionally offered in a class are lectures, class notes, textbook, office hours and possible help sessions by instructor and teaching assistants and solution to problems including quizzes, homework and exams. Assessment tools are traditionally homework, frequent quizzes, and exams.

While some of the graduate level courses have been successfully offered as web-based courses through the department of continuing education at Kansas State University, no undergraduate course has been

offered as a completely web-based course. The author has occasionally combined online lectures, examples, and other electronic resources to enhance the course quality for undergraduate courses such as Design of Reinforced Concrete Structures; however, the courses were offered in their traditional format. Students' performance and feedback in these courses was consistently positive.

Understanding the possibility and efficacy of online offering of a basic undergraduate such as Statics, is an important issue before a final decision. A quick literature review shows that "Statics" has been successfully offered as a web-based course, or through a web portal in recent years (Gramoll 1999; Dollar 2007) and its efficiency has been studied in various ways (Rutz 2003, Gramoll 2005).

In an attempt to explore the possibility of offering "Statics" as an on-line course considering the quality of students' learning experience, it was offered as a hybrid course during the Fall 2012 semester at the Kansas State university. The course was a combination of traditional class lectures and online lectures covering one session of the three weekly lectures. Class size was around 120 students from three major areas of civil, mechanical and architectural engineering. For large classes like this, close instructor-student interaction in class is very limited. Setting office hours and weekly help sessions by instructor and teaching assistants is a way to address this deficiency. For a successful online offering of the course students should have access to all of these resources.

During fall 2012, while a third of lectures were online, all other resources were provided in their traditional form, including office hours by the instructor and teaching assistants distributed over the weekdays, and a 3-hour weekly help session. Quizzes on the material taught during traditional class lectures and the online recorded lectures showed no major difference in students' performance. Based on their individual responses, students preferred online lectures due to additional helpful videos and animations well as the flexibility of watching lectures and repeating parts that they needed. They could focus more on the material than note taking.

### **Web-Based Statics**

Success of the hybrid course encouraged the author and the department to offer "Statics" as a completely we-based course in summer 2013 for the first time through the Kansas State University Department of Continuing Education.

All of the necessary components, including resources for students and assessment tools were designed and provided to address students' need for a good learning experience. The course was organized targeting efficient student learning and instructor delivery. So, the course could be used by in-campus students as well, if needed.

### **Resources:**

Various parts of the online course including lectures, notes, solutions; along with homework problems, weekly online quizzes and solutions were available through the course website (onlie.k-state.edu). These resources were posted based on the course schedule showing the dates that notes, lectures and other resources were available. Due dates for homework problems, online quiz dates and times and the dates

to take the proctored midterm and final exam were clearly stated on the course schedule and explained in an introductory video covering the course general information. Here is a list of these resources and a brief description comparing the traditional and online formats and pertinent challenges and opportunities.

**Textbook:** while homework problems were posted on the class site, no e-book was available to students online. Students could use the same hard copy as used by in-campus students or its electronic version.



Figure 1: The main page of the course.

**Class Notes:** notes for each lecture were prepared as PDF files and posted gradually on the class site before lectures. Notes included the subject matter and a number of examples and short quizzes.

**Lectures:** were posted gradually on the class site and covered the subject matter, frequent animations and videos, some short demonstrations by the instructor and step-by-step solution of the examples and short quizzes. While lectures were interactive and students could jump to parts that they needed to repeat, no real-time interaction with the instructor was possible. However, for a large size class (with 120 or more students) this is rarely possible in the traditional setting as well. To address this need, a Q/A bank was designed and answers to the frequently asked questions on a subject were recorded and posted on the class site. Students had also the opportunity to ask their questions and get individual answers by phone during pre-determined office hours by the instructor or teaching assistant, or e-mail. The course white board will be used in the next offering of the course for a better student interaction. Students were also placed in a single group and could interact with each other to understand the subject matter and homework problems.

**Solutions:** homework, quiz and exam solutions were prepared and posted after due dates on the class site. Some of these solutions had also a video file prepared by the instructor showing the approach and step-by-step solution process.

**Homework Problems:** assigned from the textbook and posted in the class schedule. Problems were also posted on the class site for students' convenience. Students uploaded their solution as a single PDF file on the class site and in the pertinent dropbox. These solutions were then manually graded.

**Quizzes:** a set of 8 online quizzes were designed and each quiz was made available to students during a specific date. Students could access the quiz just one time within this time window and had 20 minutes to solve and submit the answer in a multiple-choice format. While in a traditional class setting, the quiz could be supervised, no supervision was done for online course and proctoring each quiz was not practical. Students were consistently reminded to consider the honor code. Quizzes were graded online.

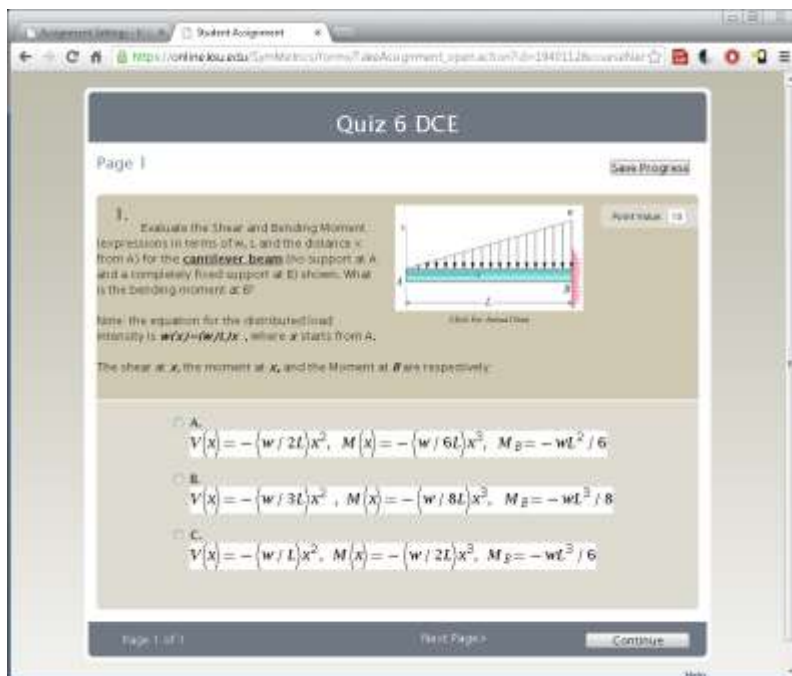


Figure 2: A sample online quiz

**Exams:** the midterm and final exams were proctored, and solutions were sent by the proctors. Students had a time window to arrange with their proctors to take the exam for the pre-determined duration.

### Assessment of the Course Quality

Students' individual interaction with the instructor and teaching assistants via e-mail, phone or class white-board; as well as their performance in the online quizzes and homework problems can be considered as tools to assess the course success; However, the proctored midterm and final exams are assumed to provide better means to assess the effectiveness of the course compared to in-campus case.

While a general assessment of the course is possible using the aforesaid tools, no conclusion can be made in terms of comparison of the online course with the in-campus version of the same course due to the fact that the same course was not offered as an in-campus course parallel to the online version. A fair comparison may be possible after the conclusion of the course with the in-campus offering of Statics in previous semesters by the same instructor and using the same textbook and other resources.

These assessments and comparisons will be conducted by the end of the summer semester; and a more reliable assessment will be done the next time when both online and in-campus versions of the course are offered during the same semester by the author using similar course resources.

### **Conclusion**

The hybrid "Statics" course during fall 2012 offered by the author at the Kansas State University had desirable results, and the students' performance and feedback enrolled in the web-based version of the course in summer 2013 are promising so far. The learning outcomes of the hybrid and online course seem to be similar if not better compared to the traditional offering.

While the overall student rating of the course for in-campus offerings is usually less than 4.0 and the average of the rating on the excellence of the course is between 3.0 and 4.0 in a scale of 0 to 5; the overall rating of the online course taken by 10 students in summer 2013 was 4.7, the excellence of the course was 4.3, and excellence of teacher was 4.7 out of 5.

The following are a couple of anonymous comments by students when evaluating the course through the university assessment procedure (IDEA):

-I thought that it was very difficult, at least for me, to take this course online with no "classroom" environment. However, you managed to have a very organized way of teaching the course, and also were very encouraging and helpful. I think if anyone else had taught the course, it would not have gone as well as it did. I think you did an excellent job overall with presenting the material and trying to get that "classroom" experience while online through your awesome use of the video sessions. Thanks.

- I really liked this class and wish Wichita State would have an online Engineering program. I almost want to switch to KSU.

Looking at the students' performance in the quizzes and exams, as well as their homework submission along with their comments expressed in the assessment procedure or communicated with the course instructor, it seems that the course was more successful and effective compared with its traditional in-campus offering format. Organization of the course, availability of the instructor and prompt response to inquiries, consistent schedule for due dates of quizzes and homework, providing the quiz and homework solutions in a timely manner along with sample solutions and step by step video examples are crucial to provide students with a good learning experience. Students feel more comfortable compared to an in-campus course when all of the aforesaid resources are available.

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