

Creating Self-Paced Online Engineering Courses for Post Graduate and Senior Undergraduate Students on Pavement Management

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Compared with traditional engineering courses taught in classrooms, a self-paced online engineering course has the advantages of distance learning, flexible study schedules, and it utilizes rapid growing technologies including computers, internet, and software. In this paper, the knowledge and experience of creating several self-paced online pavement management courses were synthesized. Using these pavement management courses as examples, this paper illustrates the procedure for developing online courses, and the dos and don'ts of designing online classes. The principles of developing these online courses are also presented in the paper. These principles include making contents attractive with graphs and videos, creating effective quizzes with proper feedback, developing exam databanks with randomly selected test questions for fairness, making navigation easy within a course, and automatically generating certificates to document successful completion. In addition, the paper presents the advantages and challenges of distance learning on self-paced engineering courses.

INTRODUCTION

Currently, the internet and computer technology greatly impact people's lives including education. Online education has become popular in many levels of training. In fact, some universities are offering online degrees. Over the years, the California Pavement Preservation Center has developed multiple online learning courses related to pavement engineering to educate both senior undergraduate students and postgraduate professionals. The purpose of developing these classes are to save travel time to and from classes and increase study time flexibility so it can fit any busy schedule. There are guides available to help develop or manage distance learning (Gerson, 2016). To make the online class successful, it would be helpful to increase the interaction activity in distance learning (Roblyer and Ekhaml, 2000). Yu and Levy tried different techniques to engage the students in distance learning (Yu and Levy, 2016). In this paper, the knowledge and experience of developing several pavement management related online classes are summarized. These classes include CIVL 685 Pavement Management System for Pavement Preservation for the California State University, Chico, and several online classes for learning Pavement Management Program (StreetSaver) for Metropolitan Transportation Commission (MTC) of the San Francisco Bay Area.

CREATE PAVEMENT MANAGEMENT ENGINEERING ONLINE CLASSES

Over the years, multiple self-paced engineering online classes were developed to educate the civil engineering students in California State University, Chico. Based on these experiences, the following steps are considered as the effective way to develop the pavement management related classes.

Step 1: Develop Course Contents.

It is very useful to have course contents developed first. The course contents could be based off in-person classroom teaching materials. It would be good to have the class taught in a classroom environment first. Then you would have feedback and knowledge that the teaching materials are complete and correct.

Step 2: Convert the Course Teaching Materials into Internet Digital Format.

Put the teaching materials into PowerPoint, Word, Excel, AutoCAD drawing, etc. After generating these contents, use some web design tools to convert the digitized contents into web contents, such as HTML pages, or links to the files.

Step 3: Organize the Teaching Materials into a Learning Management System (LMS).

There are many LMSs available for administration, documentation, tracking, reporting and delivery of e-learning courses or training programs. The most popular ones are Blackboard, Cornerstone, SkillSoft, and Moodle, and new versions and features keep emerging. The basic feature of a LMS should at least include quizzing, grading, evaluation, user management, and email functions.

Step 4: Organizing the Course Contents in a Logical Learning Sequence.

At the beginning of the course, it should have welcome page, introduction page, and course syllabus pages. The course references should be presented in the introduction part so that students will be able to find the textbook information, useful web resources, and any downloadable manuals needed for the course.

Then the course contents should be organized into multiple learning modules or chapters. Each learning module could have lecture portion, interactive practice portion, and a quiz. The interactive practice will help the students obtain the knowledge and develop deeper understanding of that module's subject. Quizzes will provide feedback to students and further enhance their learning experience. We normally give students multiple chances on quizzes to (1) make sure that a student fully understands the knowledge and (2) give credit if one puts more efforts into learning the module. To ensure the quality of learning, students may have to reach some minimum scores before accessing other related learning modules.

Step 5: Develop Effective and Fair Exams.

For university classes, make sure the exams are fair and effective to measure the learning outcomes of the developed courses. The exams should be given on the same time in a test center environment. It should be good to have one or two mid-term exams, and one final exams. For professional development short courses, the exams can be developed shorter to fit professionals' busy schedules. In this case, a question bank with a lot of example questions should be prepared.

Step 6: Test Run the Online Course before Formally Publishing It.

There are a lot to check before publishing an online engineering course. A test run to a small group of students will make sure that all contents are correct. The feedback from the test run will ensure quality of learning, less mistakes on contents, and the similar learning outcomes as the traditional class room offering.

Step 7: Make Sure to Assign Experienced Instructors to Manage Online Classes.

Managing the online classes may not be an easy task because it is not a face to face communication, especially for the self-paced online engineering classes. Instructors should be very familiar with the teaching materials and web contents because they need to figure out solutions based on partial information and limited communication with students.

Step 8: The Course Should Be Checked Regularly.

Just because it is a self-paced online class, it doesn't mean that a course instructor should leave everything to the students. Students may have all kinds of issues especially with different computers, browsers, and internet speeds. Some students may have trouble even logging on to the online course. The instructor should be able to monitor the progress of the students and give them technical support that they need to be successful in the class.

PRINCIPLES OF DEVELOPING ENGINEERING ONLINE CLASSES

Engineering classes are different from some other disciplines because it requires more math, science, and deeper thinking. Some engineering courses also require hands on laboratory experiences. Without the support of the laboratory testing, it is hard to fully understand the fundamentals and principles of engineering work. Some engineering subjects contain 2D/3D visualization, while others include abstruse theories and require complex math derivations. Designing these engineering classes requires more detailed thinking and careful planning. The following are some principles for developing online engineering classes.

1. Know your audience

One should design the online course contents based on the background and capabilities of students who will take the class. For pavement management classes, one should make sure that students have met the required math and engineering pre-requisites. For professionals, the contents should be designed to be more practical with less theory.

2. Make web navigation easy for students

It would be good to keep the appearance of a website consistent. The website should be simple and easy to follow. Contents on each page should be organized into different groups and have clear titles.

3. Provide timely technical support

For self-paced online engineering classes, students can run into all kinds of technical issues such as log in failure, no access to certain modulus, misunderstanding of instructions, making wrong choices, losing internet connection during a quiz, etc. It could be frustrating if someone gets stuck in any of the above situations. Timely support to solve any issues that a student faces will be very helpful to the student's learning experience.

4. Make contents attractive by using graphs and videos

Because there is no lab or direct interaction with instructors in an online course, using pictures can be worth a thousand words. A nice video can serve as a good illustration of an engineering process, which is kind of like a virtual lab.

5. Keep the slide show or videos short and interesting

It can be tiring just sitting in front of a computer for a long lecture without any interaction with an instructor or other peer students. Therefore, it would be good to keep the lecture slide shows or videos short. To keep things refreshing and interesting, it would be good keep them within 20 minutes for each session.

6. Add interactive contents

Interactive contents are more effective than static contents such as purely presenting knowledge and information. It would be good to let students make choices, input values, and try out different scenarios. By making the learning process more interactive, students are in the active learning stage. The active learning promotes the deeper thinking and better understanding than passive learning.

7. Use quizzes to promote learning

Because there is no face to face interaction, it is hard to know if students truly understand course materials or not. Quizzes becomes a very important tool to evaluate the outcomes of student learning. Unlike quizzes in a classroom scenario, students should be given multiple chances for quizzes so that they can improve their answers each time. In the end, the correct answers should be given for any students who couldn't figure it out because it is a learning tool.

8. Create fair exams using question banks

For locations that test centers or common testing times are not available, it would be good to create a question bank with a lot of questions and then generate exams with a small set of questions from the question bank. Each student will get a different set of questions when students take the exam online. The levels of difficulty of the questions should be kept the same among students.

9. Track the progress of student learning

Instructors or course administrators should set up goals and schedules for online courses. The progresses of student learning should be tracked throughout the learning process. The information should be given to both instructors and students. Students will be able to know whether more efforts should be put into the course. Instructors will be able to provide additional support to the students if needed. The ultimate goal is to keep students on track and help them to become successful.

10. Generate certificates to document successful completion

A certificate of completion can be generated automatically after students pass exams and all course requirements. The certificate will be emailed to the students as well as a course instructor. This is a good practice to award the successful students in a timely manner.

ADVANTAGES AND CHALLENGES OF DEVELOPING ONLINE ENGINEERING CLASSES

The advantages of engineering online classes include the following:

- Flexible learning schedules. The online class can be designed as self-paced learning modulus. Students can choose study time by themselves. Even if a person has a full-time day job, one can study the modules at evenings and at one's own pace.
- Study at distant locations. As long as one has a computer and internet, he or she can learn the course at remote locations. There is no need to stay close to a university campus for online engineering classes.
- Provide an increased access to engineering classes. Not many universities offer pavement management classes although every major city or counties should use a pavement management system to help plan the short and long-term pavement maintenance and rehabilitations. People can take online pavement management classes to obtain the knowledge that otherwise is not accessible.
- The course can host many students at the same time. The students from different parts of the United States can take the class at the same time. The number of students can be large because there are no classroom limitations for online classes.

There are also some challenges for online engineering classes. The online engineering education is not for everyone. The following are a few examples.

- Some students are not familiar with computers and internet. Some students. have trouble to concentrate when they don't have an instructor to talk with.
- Some students would have trouble to fully understand course contents because the communication between the teacher and students are often limited for self-paced online classes.

SUMMARY

In summary, this paper presented the procedure to create an online engineering course based on the experiences of developing multiple pavement management engineering classes for senior civil engineering students and post-graduate professionals. The principles of developing these online classes were also described. And at the end the advantages and challenges of developing online engineering classes were summarized.

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