Planning and Developing an Online Course

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Abstract

Planning and development of an online course in engineering and widely applicable to engineering technology curriculum are described here. A case-study of an engineering mechanics “dynamics” course currently at the planning and development stage at the School of Engineering Technology at Daytona State College is presented. The course will be the second required course in a statics plus dynamics sequence. With the statics course launched successfully 3 years ago, this course is a general engineering course at the junior level and it is planned for it to become a program required course. Related pedagogical focuses of the course are identified and the course objectives are developed accordingly. Dynamics is an engineering foundation course that is offered traditionally via live modes of instructions where live interactions provide opportunities for a more active learning environment. As such, there exists the challenging environment for offering this course online where the modular-based course model described here may be of great benefits to the learners. The authors rely on their collective previous experiences of many years of planning and developing online courses. The sequence of statics and dynamics taken as two separate but related courses will replace a single course in applied mechanics as a program required course offered currently.

Keywords: Dynamics, engineering, engineering technology, online, modular-based, Student Outcomes,

Introduction

At Daytona State College (abbreviated here as DSC) located in Daytona Beach, FL, a new course for engineering is under development. The course itself is a classical course among the engineering foundation courses: Dynamics. Dynamics is planned to be launched as an upper level required course in the engineering technology curriculum at the College. The process involves steps that are provided here. First, based on a set of required skills acquired by the graduates of the course, the student outcomes must be developed for the new course that fits within the program of study outcomes. Detailed course outcomes for dynamics as provided below help with developing the learning objectives more effectively. This course that is new to our program will be part of the sequence of two separate but closely related statics and dynamics courses that is to be taken in two consecutive semesters by both the engineering and engineering technology students. Both statics and dynamics courses are planned to be offered as online courses. Based on the successes of statics, we expect that dynamics to be well received by the
students. Statics is a prerequisite for dynamics, and it has been developed as an engineering course back in 2012 and has been taught since.

The following observations apply to the currently offered online statics course. On average, the current overall passing rate of the statics is 90% and above, among 50 students with at least 70% or more of the students scored 80% or higher as their overall passing score. Both engineering and engineering technology students have taken the course with no observable difference by major in students’ passing or failing rate in the course. There have been no significant noticeable differences by major in the grade distribution between engineering and engineering technology students. Using the results of quizzes and exams, there are also no notable difference distinguished by major in problem-solving abilities of the students, whether engineering majors or engineering technology majors. It is noteworthy to mention that both engineering students from other engineering programs at other institutions and full-time or part-time students at DSC can take statics. Nothing could be hypothesized in this case.

It has been the consensus of all full-time department faculty expressed during faculty meetings that dividing the currently offered applied mechanics single course into two separate but closely related courses of statics and dynamics will serve our student population more effectively, and they would help them to acquire a more in-depth knowledge of the subjects. The current 3-credit hours applied mechanics course due to its credit hours limitations allows only limited coverage of both statics and dynamics topics\(^1\). As the last step before the course can be offered, we will seek the approval of the college curriculum committee. A seamless approval of the dynamics course is expected by the college curriculum committee.

**Course Outcomes**

The course outcomes are the major framework for a course. The course outcomes basically provide a road-map for the course, what the focus of the course should be and what materials should be covered, intuitively some more in-depth than the others. They also help with prioritizing the course resources and efforts\(^2\). For a dynamic course, the following outcomes apply as stated below.

This course is designed to help students achieve the following outcomes:

1) Ability to analyze kinematics of the particle motion in various coordinate systems including Cartesian, polar, and cylindrical.

2) Understanding of the concepts of displacement, velocity and acceleration as vectors and how to determine them (also covered in mechanics)

3) Understanding of the notion of a force as a vector (also covered in statics)

4) Ability to understand concepts of kinetic, potential and mechanical energies and the concept of a conservative force.

5) Understanding of the concepts of power and mechanical efficiency.

6) Ability to analyze particle dynamics
   a) Ability to make a right decision related to a choice of the system of particles whose motion is to be studied.
   b) Ability to correctly draw the free-body diagram (FBD) for the system.
   c) Ability to write and solve Newton equations of motion for the system.
d) Ability to use principles derived from Newton’s second law, including Work & Energy, and Momentum.

7) [Major Outcome] Ability to analyze the kinematics of two-dimensional (planar) rigid-body motion.
   a) Ability to use concepts of angular displacement, angular velocity and angular acceleration.
   b) Ability to draw a FBD for a system of rigid bodies.
   c) Ability to determine mass moment of inertia for some simple body geometries.
   d) Ability to use principles derived from Newton’s second law, including Work & Energy, and Momentum, to derive equations of motion for a general rigid-body planar motion.

8) Ability to use both SEI and English system of units in all mechanical quantities (linear and angular displacement, velocity and acceleration, mass, force, torque, work/energy, power, momentum, mass moment of inertia).

**Offering Dynamics Online**

The course is structured to be offered as an online course based on the course selection criteria presented in Mehrabian, et. al\(^4\), 2011. The course uses a modular based system of instructions. In this system, there exist several modules laid out according to the topics where each module provides a set of instructions.

A sample module is provided here in Fig. 1. Course modules make the e-learning environment guided, structured, robust and yet agile in both content delivery and instructional methods\(^3\). In such a system of instructions, it is less likely for the students to get “lost” or “confused” online since the set of instructions in each module is pretty clear and self-explanatory. Each course module provides the students with the topics, tasks, and activities as appropriate including reading and homework assignment, discussion assignment, short quizzes, and exams if applicable. A module can be provided as a separate text document for students to download, or it can be embedded into the course as an html text. The course modular-based methodology may also be applicable to a “live” class where students attend the lectures, read the textbook and other reading assignments, solve the practice problems, the assignments and other required course material, and take quizzes and examinations, as applicable. The anecdotal feedbacks from the students taking statics and seven other courses that use a similar modular-based approach of instructions suggest that this modular-based system work very well in keeping the students on track. Modular-based instructions in its current context used here also help students, especially those that take an online course for the first time to feel less alienated with taking online courses. That is a very important parameter in attracting more students to taking online courses in engineering and technology\(^5\). Needless to say that in an online learning environment one must not discount the quality of the lectures, lecture notes, and the faculty response time in answering the students’ questions. This also helps with an effective e-learning experience by increasing clarity of the subjects and the instructor’s expectations in the course, communications, transparencies, ease-of-access, and guided repetition.
Discussion

Intuitively, one must keep in mind the goal of innovation inherently blended in distance learning in an online course, referred to here as “e-learning”: The innovation is to make the e-learning more effective, efficient, guided, structured, and robust in both content delivery and in the instructional methods. For a more effective as opposed to a less-effective e-learning in engineering and technology, e-learners should have access to instructional guiding and mentoring throughout the duration of the course at the time and places of their choosing via the web. That can be viewed as more accessible in comparison to a student taking a “live” class in which he or she attends the lectures, reads the textbook and other reading assignments, solves the practice problems, the assignments and other required course material, and taking the quizzes and the examinations, as applicable. So the question here would be if e-learning would be more
effective if there were guidance and mentoring available throughout the course. And the anecdotal answer would be: effective e-learning in engineering and technology is best achieved by a structured approach to learning in which each and every step leads to the next more concrete step, and so on. Effective e-learning may maximize the learning experience by increasing clarity, transparencies, ease-of-access, and guided repetition. It will make the learning environment less confusing and more agile, and it should help with attracting and retaining more students to the online course. Effective e-learning is also greatly affected by the faculty response time of answering the student’s questions, providing encouraging feedbacks in a timely manner, and helping the students to make that connection with the faculty.

Conclusion

The article includes brief presentation of stages in planning and developing of dynamics as an online course offered in engineering and engineering technology curriculum. An online modular-based system within the context described herein is considered as effective and agile. The course will be the second required course in a two-course sequence of statics and dynamics where statics is a prerequisite for dynamics. Related pedagogical focuses of the course are identified and the student learning objectives are developed accordingly. The authors rely on their collective previous experiences of many years of developing curriculum and online courses. Innovation is inherently blended in the technology that is involved in delivering distance education referred to here as “e-learning.” The added innovation is to apply this technology to make the e-learning more guided, structured, agile, and robust in both content delivery and in instructional methods.

Bibliography


