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Contents

Contributions in: Engineering Education Research, Service Learning, Distance Laboratories, Studio Courses, University-Industry Cooperation, Mechanics, Manufacturing Engineering, Electronic Engineering, Software Engineering, Mobile Technologies

FINE392: Technology Art Studio is a unique course developed as a collaboration between Engineering and Fine Arts at the University of Waterloo. Both disciplines require the application of significant creativity and problem solving, and the unique context of this course provides fascinating opportunities for immersive, cross-disciplinary learning, not just of the immediate subject material, but of working methods and approaches. The course provides an opportunity to research the effective facilitation of cross-disciplinary fertilization, both in the course and in the broader context of other interdisciplinary interactions. This paper describes the course learning goals, structure and syllabus, and presents several examples of student work. Through the results of a feedback questionnaire administered to students as well as instructors' reflections on three offerings of the course, we investigate evidence suggestive of student transformative learning and present a number of best practices we have identified.

Keywords: collaboration; interdisciplinary; cross-disciplinary; studio courses; sculpture; engineering; learning transformation

This article describes the structure and content of educational software, developed with the aim of training engineering students in the calibration of standards and instruments in the field of dimensional metrology. The virtual character of the environment created makes it possible to substitute practising with real metrological equipment for versatile and interactive simulations that provide advantages such as: the reduction in the cost of acquiring and maintaining standards and instruments; the absence of time and space constraints; the provision of training in any metrology condition, and accessibility for students with movement or sensory limitations, etc. The structure of the programme requires the students to engage in active learning. As such, they have to make metrological decisions that ensure traceability and estimate the uncertainties in accordance with the established calibration procedures. A pilot project was carried out with the aim of analysing the teaching viability of the program. This made it possible to objectively evaluate the level of learning reached by mechanical engineering students at the Polytechnic University of Madrid.

Keywords: engineering education; metrology; calibration; virtual learning; educational software

The Faculty of Applied Science at Queen's University has introduced an integrated and comprehensive approach to engineering education called Integrated Learning. In order to support this program, a new building, Beamish-Munro Hall, has been constructed to provide multidisciplinary plazas and innovative teaching studios as well as supporting facilities for team-based, project-based learning. One element of the plan has been the use of the technology inherent in the building itself to support the educational program. We call this aspect of the program 'the live building'. This paper describes the construction, development and operation of the live building elements chosen; the problems encountered; and some preliminary results.

Keywords: active learning; project-based learning; live building; building technology; building systems; sustainable building; interactive website

A unique undergraduate laboratory, called the Learning Column, has been implemented at Queen's University. The laboratory consists of a steel column and hydraulic jack that are used to apply controlled and known loads to a floor beam that is part of a new engineering building at Queen's, the Integrated Learning Centre. Sensors mounted on the floor beam allow students to measure beam strains and deflections. Students can access the Learning Column facility at any time and can conduct the test on their own, following instructions provided by a touch screen. The Learning Column has been used to illustrate the basic concepts of axial member and beam bending behaviour for students in a second year undergraduate solid mechanics course. For example, data from the tests can be used to illustrate the linear variation in strain in the beam under bending, one of the fundamental assumptions for understanding beam behaviour. The Learning Column also provides an opportunity to discuss advanced structural design concepts and construction practices. For example, students can clearly see that the load and boundary conditions for a real beam are vastly different from the idealized beams normally analysed in a second year solid mechanics course.

Keywords: solid mechanics; undergraduate laboratory; steel; instrumentation; beam bending; column; connections; idealized boundary conditions; full scale structural testing

Attending in-class paper demonstrations and performing experiments in solid mechanics courses are very effective ways for students to gain an understanding of the complicated concepts of mechanics. This paper explores a few applications of dogbone tensile tests, stress concentrations and crack kinking or mixed-mode fracture. Furthermore, this handy technique can be extended to other broader areas of mechanics education. Since only simple materials and supplies are used: copy paper, staples, scissors and a paper punching machine, students can repeat these typical mechanics experiments in future in other locations, such as in an office or at home. Therefore, this simple and effective technique can have a remarkable influence on the student's long-term career.

Keywords: mechanics education; mechanics of materials; solid mechanics; experimental mechanics

Students in an introductory engineering mechanics (statics) course are randomly divided into two groups. Both groups receive identical instruction except for roughly once per week, for the first half of the semester. During these exceptional sessions, one group is given hands-on manipulatives with which to solidify concepts, while the other group is not. The degree of learning is assessed with a mid-term multiple choice concept test and mid-term problem solving whose questions have multiple interconnected parts. Overall, the two groups show no notable difference in learning. However, when one looks at electrical engineering (EE) students and mechanical engineering (ME) students separately, it appears that the EE students benefit from the hands-on exercises, while the ME students might be better without.

Keywords: engineering mechanics; statics; hands-on; inquiry learning

Computer-assisted instruction is an innovative instructional strategy that has been receiving increasing attention in engineering and technology education. This paper describes our recent efforts to develop and implement a computer simulation program to enhance student learning of a manufacturing course. Examples of student work assignments that demonstrate our instructional strategy are included. Student learning outcomes were evaluated by using a Likert-type and open-ended questionnaire to survey students' attitudes and experiences toward our computer simulation program, and by developing a unique mechanism that includes technical questions at varying degrees of difficulty to investigate if our computer simulation program helps enhance student learning.

Keywords: computer simulations; instructional strategy; learning assessments; manufacturing

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Chaos Training Boards: Versatile Pedagogical Tools for Teaching Chaotic Circuits and Systems

This paper introduces a versatile pedagogical kit that consists of two Chaos Training Boards and a virtual measurement system for experimentally studying chaos and chaotic dynamics in science and engineering undergraduate programs. The proposed Chaos Training Boards have been designed in a systematic way and have been implemented as educational tools so that science and engineering students can easily investigate autonomous, non-autonomous and mixed-mode chaotic dynamics.

Keywords: chaos; chaotic circuits and systems; education; training board; pedagogical tool