Deep integration of software into mechanical engineering classes to enable authentic assessment

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ABSTRACT

CONTEXT

There is a perceived gulf between tertiary engineering education and the skills and problems faced by practising engineers. Engineers employ a range of software in professional practice, however, learning and teaching applications of software are not commonly integrated into mechanical engineering courses. Careful embedding of software in engineering courses can significantly enhance authenticity. Software can help decouple concepts from calculations and facilitate the use of higher order cognitive skills. Further, the use of software improves the efficiency of learning and allows assessment of far broader range of engineering skills.

PURPOSE OR GOAL

The authors teach senior undergraduate and postgraduate courses on engineering analysis. The purpose of this paper is to describe the integration of analysis software (MATLAB and ANSYS) into all aspects of the course design and assessment; from augmenting theoretical concepts to all assessments including quizzes, projects and exams The goal of the transformation was to provide authentic learning and assessment experiences which closely mirror professional practice.

APPROACH OR METHODOLOGY/METHODS

For every theoretical calculation taught in the class using traditional hand calculations, we develop a digital counterpart using MATLAB live script and/or ANSYS. The digital counterparts follow a common three-step framework: replicate the class example, generalize the calculation, then extrapolate to a set of similar problems. Class projects are designed to encourage students to extend the scripts and models provided to them. Open-web final examination leverage software and the technical skillsets students have developed over the course.

ACTUAL OR ANTICIPATED OUTCOMES

Bringing software to engineering courses helps students develop algorithmic problem-solving skills. Using software, theoretical concepts can be effectively augmented with simulation and visualisation. In the teaching surveys, students regularly comment the use of software and careful interrelation of theory and practice as some of the best features of our courses.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Software skills are necessary for authentic learning and assessment for engineers. Software can significantly enhance the learning experience. However, it is important to simultaneously integrate software into lectures, quizzes, projects and examinations to align student incentives and motivation.

KEYWORDS

Authentic learning, authentic assessment, software, learning experience