Assessment and Evaluation of ABET Outcomes C and K in Engineering Courses that Utilize Solid Modeling Packages

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An assessment and evaluation method which focuses on the ability of students to design a system, component, or process, and to use modern engineering tools necessary for successful engineering practice (ABET learning outcomes C and K) has been developed and will be presented. The method is based on evaluations of students' work and focuses on their ability to apply two software packages, specifically, NX (formerly Unigraphics) in "Computer Aided Design and Integrated Manufacturing CAD/CAM/CIM" at the sophomore level, and Creo Elements/Pro (formerly Pro/E) in "Solid Modeling and Design" at the senior level. Homework, classroom assignments, and a self-selected term-project are evaluated on the basis of using the software efficiently, creating the correct geometry in both shape and size, and employing constraint-based solid modeling to transfer design intent from drawing to model. The grading rubric of the term-project examines several attributes of the design process, such as identifying the problem, defining criteria and constraints, brainstorming possible solutions, generating ideas and alternatives, constructing virtual models using solid modeling software, and refining the design. The rubric emphasizes taking an idea from concept to product-ready prototype. The value of evaluations, rubrics, surveys, and projects is discussed.

Since the inception of its mechanical engineering program in 2006, the Department of Engineering at Central Connecticut State University has maintained a comprehensive Student Learning Outcomes assessment process and evaluation. Several direct and indirect measures have been used throughout the process. Direct measures include regular exams and quizzes designed to test the mastery of specific skills, fundamentals of engineering (FE) style exams, computer projects, and lab or project reports. Indirect measures include student surveys, the exit interview, and input from focus groups and Industrial Advisory Board members. In this work, a web-based survey is used to provide indirect measures to complement the direct measures that evaluate students student learning outcome that focuses on the ability of students to use specialized engineering software tools for engineering design in classroom work guided by the instructor, in assignments without help of the instructor, and in design projects where students make an appropriate choice of the tool.

On contrast to the well-defined analysis problems with a single solution, design problems are vaguely defined with multiple possible solutions. Therefore introducing students to engineering design at an early academic age will definitely shape the thinking process and the way students approach problems in future design courses and professional practice. Solid modeling courses are ideal avenues as students take them early in their education and they usually begin by reverse engineering a part design from an existing part, and as their skill improves they progress towards true engineering design.

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