Introducing Modeling to First-Year Engineering Students for Effective Implementation in the Engineering Design Process

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Abstract

Modeling and Simulation are fundamental skills for all engineering students [1]. However, students are usually introduced to these concepts during their junior or even as late as their senior year. Our research aims at familiarizing students with Modeling and Simulation tools in their first year of engineering studies. We consider the fact that proper learning involves using long-term memory (in contrast with working memory) and this is accomplished by the gradual introduction and practice of the concepts to learn [2]. The concept of Scaffolding is applied for this purpose. Scaffolding is a teaching method where the instructor gradually decreases the assistance provided as students increase their understanding of the material presented to them [3].

Our methodology involves a project-based approach, where students enrolled in an Introduction to Engineering course explore the Engineering Design Process by completing a semester-long design project where they work in teams to design, build, and test a prototype. Modeling and Simulation concepts are illustrated by using MATLAB and Simulink software, providing numerous opportunities to analyze connections between software models and physical models, and integrating guided mathematical modeling instruction. CAD modeling and 3D printing is also explored by having students design, model, and 3D-print a small part to be used in their prototype.

The course material is designed so that students begin to make connections between virtual, mathematical, and physical models starting early in their academic career, solidifying these concepts in their long-term memory to facilitate and improve learning of engineering fundamentals in the years to come [4,5].

Keywords: engineering fundamentals education, introduction to modeling, teaching first-year engineering students, introduction to modeling methods, introduction to the Engineering Design process

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