Project Based Learning with MATLAB in Engineering Modeling and Design Course

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A primary attribute of engineering education is its focus on preparing future engineers to model and design engineering systems. Understanding of mathematical models, conventions, and procedures for the design of experiments, data collection, and simulation is essential to operate seamlessly in the multi-disciplinary technological fields. One of the most used pedagogical models for teaching modeling and design is through project-based learning (PBL). The logic behind the use of PBL in design thinking is that students are exposed to the complex processes of inquiry and learning that designers normally perform in a systems context. They make decisions as they develop the project, work collaboratively with team members, and interact with their peers to complete the project. Engineering modeling and design curriculum enables students to go through hands-on, PBL activities and develop self-belief and optimism in their competence to accomplish tasks and produce expected results.

I have used the PBL strategy using MATLAB and Simulink in third year Engineering Modeling and Design course (ELEG 3003). The course covers topics on reduction of engineering systems to mathematical models, methods of analysis using MATLAB and Simulink, interpretation of numerical results, optimization of design variables, three-dimensional Computer-aided Design (CAD), and engineering system modeling and design projects. The course is fully hands-on, providing students with opportunities to model, simulate, and design complex engineering systems. The examples of engineering systems are drawn from various engineering disciplines.

To assess the effectiveness of PBL strategy, in addition to traditional methods such as quizzes, homework, exams, and projects, I also conduct a pre and post course surveys using an instrument designed to assess their self-efficacy. I analyze the collected data to gain insights into student learning and improving pedagogy. To focus on computational skills, the course assessments have two parts: an objective part which is focused on assessing the deeper understanding of the computational concepts as well as a problem set that requires students to code and build models using Simulink. The course is completely paperless and content is managed through Blackboard. One of the primary challenges is ensuring the academic integrity during the course assessments while allowing the students freedom to use MATLAB's online and built-in help features. I focus on enabling students to develop good programming skills, and use a top-down design approach to solve computational problems. Based on student feedback, the strategy has been very helpful in improving computational skills in students. They appreciate the opportunity to learn programming as it helps them during more advanced courses based on MATLAB such as Signals and Systems, Digital Signal Processing, Controls, and Communication Systems.