A Qualitative Study of the Role of Mathematics in Engineering Capstone Design Projects

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The study of mathematics is a key component of the engineering curriculum across engineering disciplines. Design is a distinguishing feature of engineering and a major emphasis of engineering education curriculum as well. The goal of this project is to take a research informed approach towards understanding the role of mathematics in engineering design.

Specifically, this project's aim is to understand how engineering students use mathematics (and mathematical thinking) while engaged in senior capstone design projects. We are conducting a qualitative study using both observational and interview methodologies. Data include the observation of a team of five industrial engineering seniors working on their capstone design project and interviews with each individual team member. Additional insights from other engineering disciplines are gained via interviews with students enrolled in capstone design projects from nine other engineering departments. These additional students are interviewed twice: once at the beginning of their capstone project and once at the end.

The data will be analyzed using a framework based on the work of Alan Schoenfeld (1992). Specifically, we are coding the observations and interview responses with regard to five fundamental aspects of thinking mathematically: core knowledge (e.g., calculus), problem solving strategies or heuristics, effective use of one's resources (or cognitive structures, such as memory), having a mathematical perspective (e.g., looking for patterns), and engagement in mathematical practices. We are also using a design process coding scheme that has been utilized to study engineering student design processes in a series of laboratory studies (Atman and Bursic, 1996).

Early results from the observational study of the capstone students indicate that the students engage in mathematical reasoning and processes more frequently than they report in the interviews. In addition, their design processes tend to follow the expected level of design expertise for graduating seniors. In this paper we intend to present the analysis of this dataset to characterize engineering students' use of mathematics while engaged in their capstone design projects. Results from this study will provide useful insights for capstone design instructors as they support engineering students' integration of mathematics and mathematical thinking into their design practices.

References:

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