



Exploring Design Failure in the Design Process: A comparative case study of young engineering students

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Research Questions

What are design failure experiences in elementary engineering contexts?

In what ways do elementary engineering students react to design failure?

What are the coping strategies students use during and after design failure experiences that lead them to persist or not persist through failure?

Purpose

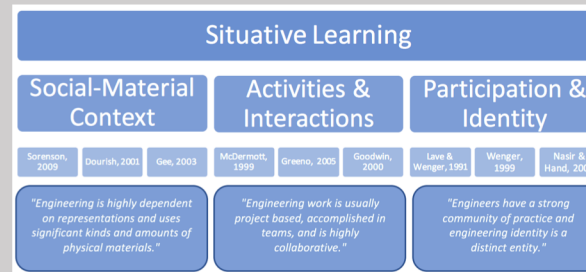
A central part engineering problem-solving is experiencing struggle, or uncomfortable moments where a designed solution is not working as it was intended. This study examines what these experiences look like for young engineering students, including how they react, and the strategies they use to persist (or not) through failure.

Background

While several variations of the design processes are used throughout K-8 engineering classrooms, the overall process encourages students to identify the problem, brainstorm possible solutions, design and build at least one of the solutions, test the solution, and continue throughout an iterative cycle of redesigning and retesting until the solution is successful. An inevitable component of this design process is the experience of design failure, which occurs “when a designed solution, or aspect of a designed solution, does not meet criteria under constraints as specified by the problem” (Lottero-Perdue, 2015, p. 2). One’s ability to persist and learn from failure has been recognized throughout policy documents (NGSS Lead States, 2013) and research studies (Cunningham & Kelly, 2017) as an essential skill, or habit of mind, that successful engineers possess. However, when looking at societal views and the generalized school view of the word “failure,” there tends to be negative connotations and teachers typically associate failure with academic expectations or abilities (Lottero-Perdue, & Parry, 2017).

Conceptual Framework

The overarching theoretical framework that guides the proposed research work is a *situative learning* framework. Johri and Olds summarize a situative framework as having, “a central aim... to understand learning as situated in a complex web of social organization rather than as a shift in mental structures of a learner” (p. 160). As a broad perspective, situative learning will enable me to position the students’ lived experiences within the context of their engineering classroom and guide my narrative inquiry using the three analytical aspects as guides.



Methodology

In order to develop an understanding for participants’ experiences in high school engineering and how they actively make meaning of what it is to experience design failure, I will be using a multiple case study design (Yin, 2012) that utilizes participant observations, open-ended interviews and student artifacts as the primary sources of data collection.