Making Engineering Accessible Through Simplicity
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Abstract
• Tested the merits of “engineering simple things in sophisticated ways” under the auspices of integrated STEM.
• Explored how a simple problem, like designing a better paperclip, can be used to engage students in engineering design.
• The use of simple problems minimized ambiguity, harnessed students’ prior experience, reduced the need for domain knowledge, encouraged iterations, and focused attention on the nature of engineering.
• Using a simple problem did not present any challenges relative to capturing and retaining student interest.

Introduction
• Numerous curriculum initiatives have addressed engineering principles and ways of thinking for elementary and secondary education.
• Basic engineering principles like predictive analysis, constraints, modeling, and optimization are not addressed overtly.
• Little attention is given to reverse engineering everyday things and engineering simple things to make mathematics and science grade-level appropriate.

Research Questions
• To what extent can a simple engineering design problem affect middle school students’ conceptions of engineering?
• To what extent will middle school students engage in guided inquiry in the context of a simple problem?
• To what extent will a simple engineering design problem retain the attention of middle school students?

Method
• Rural Wisconsin, Spring Valley Middle School (N= 110)
• Eighteen eighth & 19 seventh grade technology education students.
• Thirteen females and 24 males.
• Single group pretest-posttest design.
• Classroom observations, teacher testimony, and an analysis of students’ work.
• Pre- and post-assessments used an interview schedule featuring a series of open-ended questions designed to gather information about the students’ conceptions of engineering.
• Treatment was a series of guided inquiry tasks involving reverse engineering and engineering design activities.

Data & Results

Conclusions
• Students recognized a need for brainstorming
• They had difficulty generating multiple designs
• The treatment dispelled a common misconception (e.g., engineers fix things)
• Strong and consistent student engagement
• Engineering took precedent over making
• Students recognized new attributes of design (e.g., testing)
• They had difficulty deriving meaning from data
• There was a reluctance to capitalize on data
• Students produced designs that were analogous to those featured in historical patents

References