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Teaching for Transfer in Engineering High School Programs: A Study in Progress

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Science, Technology, Engineering, and Mathematics (STEM) literacy is a critical component of 21st century education (AAAS, 1989[1], 1993[2]; NCTM, 2000[4]; ITEA, 2000[3]). The need for a STEM literate population provides the basis for America's current educational reform agenda. The central tenet of STEM literacy is the preparation of people who are knowledgeable of the connections between the content and practices of the STEM fields. This is in contrast to the silo method of education, which teaches the STEM disciplines independently of each other. When conceived as an integrative curriculum model designed around teamwork and problem-solving environments, Integrative STEM education is the ideal pathway for achieving STEM literacy (Sanders, 2008[6], 2006[5]; Wells, 2008[7]).

Research Design

The purpose of this study was to begin to understand the impact of overtly teaching for transfer on students learning Science, Technology, Engineering, and Mathematics (STEM) content while working through engineering design problems. Teaching for transfer offers a vehicle to foster the transfer of STEM content through the abstraction of knowledge in each individual discipline.

The conduct of this research follows a case study design, specifically a multiple case: embedded design. Engineering design teams comprise the cases in this study and individual students in each team comprise the embedded unit of analysis (Yin, 2009[8], p. 29). For example, if two teams were being studied then they would each be one case. Individual students in each case would be the embedded unit of analysis. A case is embedded when collecting and analyzing data from each participant (unit of analysis) in each case (Yin, 2003[9]). The criteria for a case

study as outlined by Yin (2003[9]) allows for the collection and analysis of multiple types of data in order to create an accurate picture of a phenomenon. The goal of each type of data source is to highlight a different aspect of the phenomenon. Points of convergence are identified through data triangulation.

Participants

The nature of this study required the participation of individuals involved in pre-engineering design-based activities at the secondary level. There were 40 students enrolled in pre-engineering courses participating in this study. Those students ranged from freshman to seniors. Attention was given to the interaction of students at various grade levels. This study took place in a low-income school district that has a 100% minority population. This group of students allowed for a unique lens, which looked at underrepresented groups and their experience with engineering design.

Data Collection & Analysis

Data collection included Audio/Video recordings, field notes, and group interviews over the course of several engineering design projects. Student work was aligned with teaching for transfer lessons to identify whether the instruction was fostering the transfer of STEM content.

Findings & Conclusions

Preliminary findings indicate that when students are overtly made aware of STEM content connections in the initial design projects they are more likely to transfer STEM content on their own in later design projects. Findings such as these have broad applications for curriculum development in the future. If teachers have the tools to teach for transfer and train students how to transfer knowledge they will be better equipped to solve more complex engineering design problems as they get older.

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