

Uncovering Elementary Teachers' Notions of Science and Engineering Design Practices Using Video Captured Instruction

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The Next Generation Science Standards and the Framework for K-12 Science Education (National Research Council, 2012) ask elementary, middle, and high school teachers to incorporate science inquiry and engineering design practices into their lessons and instructions. These set of practices included asking questions (for science) and defining problems (for engineering), developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations (for science) and designing solutions (for engineering), engaging in argument from evidence, and evaluating and communicating information (NRC, 2012, p. 42). However, developing lessons with these practices is challenging to do particularly for elementary teachers who have limited knowledge, pedagogy, and experiences in the domains of science and engineering (Macalalag, 2012; Schwarz, 2009).

In this study we explored what experienced teachers noticed in viewing videos of teacher enactment of lessons in two different elementary science classrooms. Uncovering teachers' initial and developing ideas about components of good science and engineering instruction can provide insights on the teachers' notions about the general and specific teaching methods that are important to them. Our study included 17 elementary teachers enrolled in one semester of Introduction to Science, Technology, Engineering, and Mathematics (STEM) Education course. This course is designed to provide teachers with experiences, knowledge, and pedagogy needed to successfully implement STEM in their classrooms. The majority of teachers (N=14) have been teaching for 10 or more years and have undergraduate and graduate degrees in Early Childhood, Elementary Education, and General Education. However, only two teachers have educational background in Mathematics and Educational Media Technology.

We analyzed teachers' written reflections and critiques of lessons. We asked teachers to view two videos-- an educator teaching a balloon rocket investigation lesson and a teacher teaching a lesson on designing water filters (Engineering is Elementary). Our teachers wrote reflections before and after group/class discussions to describe what worked well, what did not work well, and what they would do differently in the lesson. We used constant comparative method (Merriam, 1998) and quantitative analysis of qualitative data (Chi, 1997) to develop categories and themes from our data. Our findings suggest that majority of teachers focused more on general teaching methods and few specific science and engineering practices. They mentioned: (a) engagement and motivation of students, (b) classroom management, (c) leveraging and scaffolding students' prior knowledge, (e) lesson structure, (f) asking students to brainstorm, predict, ask questions, or make claims, and (g) reviewing and engaging students in the engineering design process. However, only few teachers mentioned the following practices in their reflections: (a) identifying the design criteria, (b) making predictions, models, prototypes, and (c) defending and justifying claim in discourse. We will provide more categories and examples during our presentation.