Reflective Decision Making within the Discourse of Urban Elementary Engineering Classrooms

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Abstract: The emergence of engineering in K-12 education has promoted the need for research on discursive practices associated with successful pre-college engineering. Specifically, elementary students need support for engaging in collaborative, reflective decision-making during engineering design activities. In this poster, we describe an initial phase of work that looked to identify connections between elementary students' reflective decision-making linguistic practices and students' community/home-based linguistic practices.

Introduction

In this work, it is our intent to help students and teachers become aware of the disciplinary discourse practices of engineering design, and how these intersect with their "everyday," or personal discourse practices. Elementary students' engagement in engineering is not a new phenomenon, but the National Research Council's recent *Frameworks for K-12 Science Education* (2012) and the *Next Generation Science Standards* (Acheieve, Inc., 2013) derived from the *Frameworks* brings urgency and importance to the task of exposing young students to the practices and big ideas of engineering. This study specifically focuses on promoting and supporting students' *reflective decision-making* in collaboration with others (NRC, 2012; Schön, 1987). The National Research Council (2012) writes, "Engineers, too, make decisions based on evidence that a given design will work; they rarely rely on trial and error." *Reflective decision-making* by a group of people requires tools for interaction, including ways of communicating engineering ideas and ways of thinking like an engineer (Atman, Kilgore, & McKenna, 2008).

This poster focuses on Phase One of a larger study and should be considered work in its early stages of development. Specifically, we highlight work with teacher researchers in identifying the practices and linguistic patterns associated with *reflected decision-making* in elementary students' engineering planning and design. The significance of this work is:

- Advancing educators' knowledge of how to identify and build upon intellectual and linguistic resources that students bring to engineering design processes.
- Empowering educators to support young students' development of a reflective stance toward engineering design, in preparation for a society that increasingly demands technological literacy of its citizens.

Theoretical Approach

This study utilizes a "resources perspective" (Hammer & Elby, 2003) for recognizing the intellectual and linguistic practices that children from urban communities bring to engineering design processes. A variety of challenges associated with urban schools have often led to the portrayal of students in ways that are consistent with a "deficit perspective" on performance (Varelas, Kane, & Wylie, 2010). In contrast, educators and researchers who adhere to a "resources perspective" (e.g., Bang & Medin, 2010; Emdin, 2011) argue that numerous characteristics of urban communities, schools, and students can be interpreted as resources rather than challenges or deficits.

Methodological Approaches

For this study, we utilized a case study approach (Yin, 2009) in order to recognize elementary students' reflective discourse practices during a pre-engineering unit focused on motion and design. Specifically, the linguistic practices utilized within a group of four, 4th grade African American boys while engaged in the design of miniature drag racing vehicles were examined for this study. The full research team, which includes educational researchers and classroom teachers, convened twice a month in order to examine and analyze collected data, including video recordings and transcribed classroom conversations from four classroom interactions. Audio recordings and field notes from these research meetings also served as additional data sources. We identified patterns and themes from the corpus of data via discourse analysis (Gee, 2001) grounded in the particular analytic approach of microethnographic study of classroom cultural practices (Bloome, Carter, Christian, Otto, & Shuart-Faris, 2005).

Preliminary Findings

Preliminary coding of transcribed class sessions and team meetings has raised two themes of ongoing interest to be investigated further in the microanalysis. The first is the role of power within the design team's negotiations. We find that design proposals, decisions, and suggestions for redesign are communicated via a synthesis of engineering-specific language and everyday, personal expressions, and that engineering specific language plays a role in elevating the status of students' ideas. We are exploring this theme by asking how does the appropriation of specific everyday or discipline-specific discourse by participants shape the exchange and adoption of ideas. The second theme that has emerged is the distribution of physical manipulation of materials with other linguistic modes as contributing to the design activities and reflection (Aurigemma, Chandrasekharan, Nerssian, & Newstetter, 2013). In what way does physical manipulation of materials contribute or distract in shaping the discourse along with other linguistic resources? A detailed microanalysis of transcripts from classroom engineering experience will allow our research team to explore which interactions of multiple resources (everyday and disciplinary language, physical manipulation) result in design changes or reflections.

Relevance to Conference Theme: "Learning and Becoming in Practice"

This work contributes to the conference theme through its specific focus on cultivating ways of recognizing and building upon students' intellectual and linguistic resources. Developing ways for recognizing students' strengths is accomplished by integrating three focal domains for inquiry -- big ideas in engineering design and discourse, students' sense-making, and issues of race, culture, and language. By supporting inquiry through structured settings of professional work and resources for documenting and analyzing practice in engineering, we look to contribute to the theoretical and practical knowledge-base for pre-college engineering activities in elementary school settings.

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