Objectives and Theoretical Framework

We introduce the concept of *science learning activation* as a combination of dispositions, skills, and knowledge that enables success in science learning experiences, and hypothesize that these successes lead to further increases in activation, thereby producing a critical positive feedback loop. Such a positive feedback loop is necessary for early interventions to have long-term benefits. In addition, activation is likely multi-dimensional as previous science interventions often find tradeoffs between motivational and cognitive effects. For example, students with the highest ability levels often have the lowest interest levels (Areepattamannil, Freemand, & Klinger, 2011; Shen & Tam, 2008).

We hypothesize that activation involves five dimensions. Specifically, the activated science learner:

1. is **fascinated** by natural and physical phenomenon (emotional and cognitive attachment/obsession with science topics and tasks);
2. **values** science (understands various interactions of self with science knowledge and skills, and places value on those interactions within their social context);
3. has **perceived autonomy** about participating in optional science activities;
4. has high **competency beliefs** about self in science; and
5. engages in **scientific sensemaking** (engages with science-related content as a sensemaking activity using methods generally aligned with the practices of science).

This construct combines insights from science education and cognitive psychology on what supports learning (Apedoe & Ford, 2010; Lehrer, Schauble, & Petrosino, 2001; Songer et al., 2009) with insights from educational psychology and social psychology about motivational and self-regulation constructs (e.g., Hidi & Renninger, 2006; Germann, 1988; Tan & Barton, 2007; Ryan & Deci, 2006; Schunk, et al., 2008; Durik, Vida, & Eccles, 2006) that support engagement and learning behaviors.

Methods and Data Sources

We report a study that investigated the relationship between the five dimensions of science learning activation and three indicators of success (choice, engagement, and learning) in science learning experiences. A diverse group of 5th and 6th grade students from 2 different regions of the United States participated in this study. Engagement was measured in two very different science learning contexts: across five months of a hands-on science curriculum, and at a visit to two different exhibits at a science center.

Results and Significance
Analyses using simple multiple regression and hierarchical linear models, with and without a number of demographic and math/reading ability measures include, we find significant correlations between each of the dimensions of activation and one or more of the measures of success. Closing the positive feedback loop, we further find using regression analyses that success variables predicted increases in levels of the dimensions of activation. That is, choices, engagement, and content learning predict increases in activation.

The study of science learning activation as a multidimensional construct has implications for theory, practice, and research. For example, the conceptual framework can be used to guide design work, helping to specify different motivational objectives. The quantitative measures of activation can be used to evaluate (for formative or summative purposes) the relative impact of various formal and informal science learning experiences.

References


