Abstract Title: Value-Added Approach to Program Implementation: Using School Factors and Student Achievement to Guide the Implementation of Partnership-Based Reforms

MSP Project Name: Rhode Island Technology Enhanced Science (RITES)

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120 word summary:

The RITES MSP is working with schools across Rhode Island to improve student achievement through the development and use of technology-enhanced inquiry science activities, high quality PD, and other school-level supports. Historically, similar curricular reform efforts have been difficult to sustain. Currently, there is significant interest in using data to gauge the effectiveness of teachers and schools. This study describes the use of existing student achievement data from the state NECAP science assessment of 8th and 11th graders' understanding of science concepts and ability to engage in inquiry, as well as school climate data to create a value-added model (VAM) capable of identifying potential barriers to program implementation, making it possible to develop support strategies tailored to meet schools' needs.

- Section 1: **Questions for dialogue at the MSP LNC**.

  There is wide recognition that our schools are in need of improvement, especially in Science, Technology, Engineering, and Mathematics (STEM) areas. The Rhode Island Technology Enhanced Science (RITES) partnership is focused on improving student achievement by working with schools across the state to provide high-quality professional development as well as science investigations that teachers and students can use in their science classes. Similar programs have generally failed to gain the traction needed to be sustained and spread beyond the settings of their initial implementations, and have been criticized for not addressing the needs of the schools where they were implemented. This study describes our efforts to use data that describes conditions within schools to understand how these conditions affect student achievement in science and in turn tailor project supports to help each school improve critical conditions.

  Questions for discussion include:
    - How are other MSPs using state, district, and school level data to customize their program elements?
    - As the data that is being collected changes how are MSPs maintaining their databases?

- Section 2: **Conceptual framework**.

  Context

RITES a partnership between Rhode Island College (RIC), the University of Rhode Island (URI), the RI Department of Education, and Concord Consortium, is currently in its third year of operation. The project is being implemented in stages in both middle schools and high schools across Rhode Island. The centerpieces of RITES are online tools for facilitating science inquiry in classrooms, including online investigations that use probes and models as well as professional development courses team taught by higher education and K-12 faculty occurring in the summer and during the year that help teachers use these investigations with their students. Our collection of investigations is augmented each year as classroom teachers work with scientists at RIC, URI, and Brown on "resource teams" that refine existing investigations and develop new ones.

Teachers that choose to participate in RITES take part in its two-year, professional development (PD) program that includes the equivalent of six graduate credits of coursework in life, physical, or earth science.

Currently, RITES is working in thirty-two schools in sixteen districts that are either urban, urban ring, or suburban, and whose students have low to moderate success on the state's standardized tests. Participating teachers have committed to using the investigations and attending the PD. During their first two years, teachers are compensated for their involvement, and are unpaid volunteers thereafter.

Hypotheses

Initial studies were undertaken with data that were collected immediately before the implementation of the RITES project. These studies had two primary goals: 1) to develop a value added model for the assessment of RITES impacts; and 2) to determine whether core conditions for program adoption were associated with differential levels of achievement in Science.

We anticipate that inquiry-based science instruction will be adopted more readily when the following conditions are present. First, barriers to instructional improvement will be minimized by preparing teachers for the use of inquiry based methods, increasing organizational support at the district and school level, and enlisting parental support. Second, high initial levels of achievement emphasis as well as pro-social peer interactions will characterize climate conditions. Third, changes in teachers' roles that are engendered by the intervention will not lead to ambiguity and conflict in teachers' work roles. Further, efforts to promote the utilization of inquiry-based learning will provide teachers with opportunities to take a meaningful role in decision-making. Finally, the practices associated with inquiry-based learning will be congruent with prior practices and attitudes among staff in the school.

Our measure of student science achievement is the standardized test administered in Rhode Island to meet its requirements under the No Child Left Behind Act. The New England Common Assessment Program (NECAP) was designed to measure specific *NECAP Science Assessment Targets* and *Inquiry Constructs*. Though NECAP is only one indicator of student performance, it serves as a proxy for student achievement in this study.

The NECAP test includes facts, formulas, processes and content that students should know across the three content domains of science: Physical Science, Earth Space Science, and Life Science. The NECAP science assessments focus on three question types: Multiple Choice Questions, Constructed Response Questions, and an Inquiry Tasks. Multiple choice and constructed response questions on the NECAP Science test flow from Rhode Island Grade Level Grade Span Expectations (GSE) Science Standards. The Inquiry Tasks measures each student's ability to engage in the science process as defined by Four Broad Areas of Inquiry: 1. Formulating Questions & Hypothesizing, 2. Planning and Critiquing of Investigations, 3. Conducting Investigations, 4. Developing and Evaluating Explanations.

- Section 3: **Explanatory framework**.

Research Design

The Development of a Value-Added Model: In our work within the RITES project, we sought to develop a Value Added Model (VAM) that would enable us to estimate the contribution that RITES activities made to students' Science achievement. Contemporary work in value-added models attempts to estimate the contribution of an educational intervention after factoring out variations in students' prior achievement (e.g., Sanders & Horn, 1998).

In the absence of annual testing of students in Science, efforts to develop a value-added model for Science had to rely more heavily on showing that an educational practice or program results in an increase in achievement over and above the level predicted by students' background characteristics. The purpose of these value added models is to more clearly isolate the effects of a practice or intervention apart from variations due to background characteristics. By factoring out these background characteristics, the value added approach acknowledges, and tries to account for the fact, that students are not randomly assigned to naturally occurring educational conditions.

This approach to value added modeling inherently involves a multi-level model that incorporates the effects of both student-level and school-level characteristics. In order to incorporate both student-level and school-level effects, we used an approach that is built around Hierarchical Linear Modeling (HLM). HLM is uniquely well suited to the analysis of nested data, and can incorporate both student and school-level effects into the model.

Core Program Conditions for the Adoption of Innovation: The initial stages of our work also sought to identify core program conditions that facilitate or impede the adoption of an innovative curriculum or instructional approach. Our work considered an initial set of core conditions that have been related to implementing reforms, including a.) barriers to instructional improvement; b.) school climate; c.) teachers' work roles; and d.) congruence with prior instructional practices and attitudes.

Data Collection

Participants were teachers and students in high schools located in a Northeastern state. Data on students' Science achievement and demographics were collected from archival records that were provided by the State Department of Education. Teachers completed surveys on program conditions as part of broader school self-study and improvement processes. Participation by teachers in these surveys required voluntary and informed consent. Staff completed surveys during the school day. Procedures allowed for the matching of teacher survey data to student achievement data at the school and grade levels. Teachers were provided with time to complete surveys during the school day and return them to drop-boxes in sealed envelopes without their name on the survey.

Results

The main analyses of this study then examined two related topics. The first phase of the main analyses examined the association between students' science achievement and their background characteristics within a multi-level framework. The second phase of the main analyses then built on the value added model by examining the relationship between school conditions and students' achievement on the NECAP Science test, after controlling for the demographic characteristics studied in phase one. Additional secondary analyses explored factors that are associated with equity in Science achievement.

In order to assess the impact of program conditions on Science achievement, HLM was employed. Measures of program conditions were added as school-level predictors to models that included the student and school level demographic variables described by our VAM. One preliminary result suggests that Lack of Organizational Support was associated significantly with Science Achievement: schools in which teachers reported fewer problems with Organizational Support were ones in which students exhibited higher levels of Science achievement, even after controlling statistically for individual differences in students' background characteristics (IEP, LEP, poverty, gender, and minority status) as well as school-level differences in the proportion of students in poverty and the proportion of students with IEPs. To the extent that the provision of organizational support for instructional improvement is associated with higher levels of achievement after controlling for these background characteristics, then this program condition is one that adds value to educational outcomes.

Insights

According to our model, statewide science achievement is influenced by several school level variables that may potentially be influenced by a district university partnership willing to allocate its resources strategically. Two of the most important factors were barriers to implementation, including a lack of organizational support for their reform efforts as well as a lack of the school's readiness for reform as far as having a clear vision, curriculum materials, and support program for teachers. Traditionally, innovation-driven reform efforts have focused on the latter barrier, i.e. providing materials, professional development, and classroom support. Our model suggests that it is also important for the partnership to address the support teachers perceive from other educational organizations. This result emphasizes the importance of the partnership communicating the vision of their program to stakeholders with the state and district, and securing a commitment for alignment and cooperation.