Examining Teacher Assignments and Student Work at the Intersection of Content and Practice in Middle School Science

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Abstract: This poster presents two views of a year-long implementation of an NGSS-aligned curriculum including teachers' perspectives on challenges to provide opportunities for students to develop scientific practices and disciplinary content in tandem, and work produced by students as part of instruction. Initial findings that point to teacher tendency to use practices as an alternate student work product rather than as knowledge-generation activities are presented and discussed.

Introduction

Development of the Next Generation Science Standards (NGSS; NRC, 2012) and Common Core State Standards formalizes a complex view of teaching and learning that calls for new models or curriculum design, pedagogy, and assessment that consider strategic integrations of multiple dimensions of learning. In particular, these standards reflect frameworks that recognize that learning occurs within disciplinary practices and that teaching, learning and assessment goals should reflect this complexity. Stakeholders at the many levels of the education system (teachers, administrators, state department leaders, etc.) must contend with the problem of redefining success, both in terms of instruction and student achievement.

This poster presents self-report data about teachers' instructional goals, their decisions and examples of their students' work produced as part of instructional activities collected over two years. This work was conducted in conjunction with an efficacy study of NGSS-aligned instructional materials and professional development. The *major issues* addressed by this poster are the challenges of developing and evidencing new views into teaching and student learning in a multi-dimensional instructional space. *Significant contributions of the work* include rich pictures of teacher understandings and instruction of NGSS aligned science materials and samples and analysis of student work as evidence of how students' understandings develop in NGSS-aligned instruction. The ICLS 2014 *conference theme* articulates the need to better understand learning through and embedded in disciplinary practices, making this work a direct response to the conference call.

This work takes place as part of an efficacy study of the Project-Based Inquiry Science (PBIS) curriculum, a comprehensive, 3-year middle school science curriculum that focuses on standards-based science content and uses project-based inquiry science units to help students learn. NSF funded the development of PBIS over the past two decades, with major investments made in the design of materials and with associated teacher professional development for teachers to understand the content of the units and how to teach them. PBIS materials and activities, though produced before the NGSS and its companion framework were developed, are designed to incorporate modeling, construction of explanations and other scientific practices as a way for students to construct understanding of phenomena in the context of long-term projects and investigation.

This poster will present two complementary views of a year long implementation of PBIS activities including 1) initial findings about teachers perspectives on how they provide opportunities for students to develop scientific practices and disciplinary content in tandem and 2) work produced by students as part of those activities over the course of the academic year.

Theoretical Approaches

Classroom implementation is the lynchpin that will determine the impact of NGSS, as has been the case with past educational reforms (Fullan & Miles, 1992). Understanding the ways teachers may structure instructional activities, and understanding reasons for those choices, is necessary in order to evaluate how NGSS is impacting science learning. Specifically, exploring relationships between the kinds of instructional choices teachers are making and how those choices provide learning opportunities for students is a critical activity in examining and supporting implementation of NGSS (Henningsen & Stein, 1997). Professional development will need to be developed that can help teachers elicit and support student engagement in practices that integrate science concepts in meaningful ways. Moreover, teachers will need tools that will help them reflect on their instruction. This research is motivated by the need to further identify how the specific, strategic integrations of the disciplinary practices and core disciplinary ideas prioritized by NGSS support students' conceptual development along both dimensions, and how teachers might be supported to understand and elicit these processes. While the cross-cutting concepts are an essential dimension of NGSS, this work focuses on the integration of content and practices as an analytic starting point.

Methods

This study takes place within a larger, two-year randomized-control (RCT) efficacy study of the PBIS materials. All 6th grade teachers of a large, diverse, urban school district were recruited to participate in the study. 42 middle schools with more than 100 sixth grade teachers are participating in the efficacy study. At the beginning of the study, schools in the district were randomly assigned to a study condition where PBIS would be used or a comparison group where current science curriculum materials would be used. Teachers in both conditions were invited to participate in professional development about the NGSS framework and practices. Teachers in the implementation group also were invited to participate in PBIS professional development.

35 teachers in each condition were recruited to participate in data collection to examine their assignments (TA) and the students' work (SW) produced as part of those activities; we refer to these data as TASW. Year one of the study occurred during the 2012-2013 school year and year two of the study is underway. While Year one data is being analyzed, producing preliminary findings presented here, both years of data will be available for presentation at the conference. All teachers were asked to provide information about classroom activities conducted to meet a set of 3 physical and 3 earth science state standards. This ensured a comparable data set across the two conditions and because the district uses a pacing guide, it was meant to ensure that data would be collected at about the same point in the year for all teachers. Teachers were asked to provide examples of work from students representing below average, average and above average performance across all their classes.

Classroom assignments were coded to characterize the ways modeling and construction of explanation, two important practices in NGSS are integrated and to characterize the ways the use of the practice aligns with NGSS definitions. Codes were compared with teacher descriptions of assignments. When possible, student work was analyzed according to rubrics developed by the project team anchored around NGSS performance expectations. When assignments did not align to NGSS performance expectations, student work was analyzed using rubrics developed as the as part of summative assessment design conducted by the team. Data integrity will be established using similar methods to Borko and colleagues (2005) via triangulation to classroom video tapes and teacher interviews. Borko et al (2005) showed that the use of teacher report of classroom activities, in conjunction with student work, can be a reliable method to characterize what goes on in classrooms.

Preliminary Findings

Teachers who did not have the benefit of the PBIS curriculum were more likely to over estimate the role of the scientific practice in their assignments. These teachers were more likely assign activities that included modeling and explanation only as ways to describe phenomena rather than as a means to explore phenomena or to connect evidence and claims as part of explanations. Teachers who did not participate in professional development sessions were also more likely to assign activities where practices were not well integrated. Across conditions, students participating in these assignments, where modeling or explanation tend to be used as a means to help students identify components or elements of a situation or phenomenon, rather than as a means to make predictions or develop hypotheses, are less likely to show evidence of developing more complex understandings about the phenomena being studied. Further analysis will continue to explore these initial findings and relationships. Analyses of teacher reports will examine factors cited by teachers for instructional decision-making. Student work analyses will include comparisons of summative assessment data to contextualize student performances throughout the year.

Conclusions and Implications

Initial results confirm the assumption that implementing NGSS will be a difficult transition for science teachers who appear to struggle with integrating modeling and explanation practices into their instruction in ways that provide students with opportunities to generate models or explanations that represent emerging reasoning. Implications of this work include a call for more research that can provide examples and point to challenges of implementation will be valuable to teachers and designers as NGSS is adopted across the nation.

References

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