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NAVIGATING the Storm: High School Mathematics Teachers, the Common Core, College Readiness, and Quality Management Tools

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Abstract

Classroom teachers sit at the confluence of national and nationally-initiated state education policies that tie the standards of expected student success at each grade level to teacher effectiveness. However, many district-developed learning targets are loosely aligned with state standards. For high school mathematics teachers, this misalignment is further skewed by a mismatch with post-secondary mathematics placement exams. This research demonstrates how quality management tools and curriculum articulation strategies can help high school mathematics teachers prioritize these policy demands.Three major findings point to tools and policy changes to smooth a PK-16 curriculum sequence for students matriculating across disparate systems of learning..

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1. Introduction

Today, a sea of national and nationally-initiated state education policies tie the standards of student success expected at each grade level to teacher effectiveness (e.g., adoption of the Common Core State Standards and the College and Career Readiness Standards tied to Race to the Top and Elementary and Secondary Education Act funding). The theory of action in these efforts is to elevate student achievement levels, particularly for learners historically underserved by local public schools (e.g. Bales, 2006; Hamilton, Stecher, & Yuan, 2008;). From a policy perspective, this movement to a "de facto national intended curriculum" (Porter, Polikoff, & Smithson, 2009) swells local efforts already in play.

Classroom teachers sit atthe confluence of these policies, making instructional decisions about how to best support students' academic growth while paying close attention to the accountability mechanisms that measure their performance. Teachers must decide which set of standards to use and which assessment tasks best demonstrate and inform student learning. For example, in the Midwest, district-developed learning targets loosely aligned with the Wisconsin Model Academic Standards do not easily map onto the recently adopted Common Core State Standards (CCSS) for Mathematics (Porter, McMaken, Hwant, & Yang, 2011). For high school mathematics teachers, this lack of alignment is further skewed by a mismatch with the University of Wisconsin System mathematics placement

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exam (Kolmetz, 2011; Lundell, Higbee, & Hipp, 2005; McCabe, 2001). These types of curricular and instructional issues are compounded in large, urban school districts, where teachers and administrators already struggle to meet Adequate Yearly Progress (AYP) demands. This complex and high stakes situation begs the question, how do high school mathematics teachers retool their instructional practice to stay a course through this perfect storm of unprecedented standards of performance? This paper presents research that shares how quality management tools and curriculum articulation strategies helped high school mathematics teachers in a large urban school district sort through and prioritize these policy demands so students can be offered a challenging, CCSS-aligned curriculum that prepares them for a post-secondary educational experience. Although this study takes place in the Midwest, the situation is not state or subject-specific. As such, the findings should be useful to policy-makers, administrators, and teachers in every state.

2. Theoretical Perspectives

The research design in this two-year project draws on two theoretical perspectives. The first theory offers insights on how quality management tools and methods can be used in education (Akdere, 2009; Goldberg & Cole, 2002). The second theoretical lens views teacher learning as a situated, distributed, and social activity (Lave & Wenger, 1991; Putnam & Borko, 2000) and development of a professional practice as an interactive with the ever-changing dynamics of a classroom (Dall'Alba & Sandburg, 2006).

2.1. Changing Teachers' Tools: Quality Management Integration in Education

The concept of quality has long been debated in educational settings. In the United States, quality processes have been an integral part of the business world since early 1980s. Quality management is defined as "an integrated approach to achieving and sustaining high quality output, focusing on the maintenance and continuous improvement of processes and defect prevention at all levels and in all functions of the organization, in order to meet or exceed customer expectations" (Flynn, Schroeder, & Sakakibara, 1994, p. 342). In educational settings, quality management involves schools that continuously learn and improve through the systems perspective. Goldberg and Cole (2002) argue that more systemic change will enable schools to alter behaviors, culture, and structure, and result in more purposeful lasting reform. "The techniques and tools utilized in quality management are uniquely proven to help raise student learning and achievement, enhance institutional accountability, and help administrators and teachers meet legislative requirements" (Akdere, 2009, p. 295).

2.1.1. Changing How Teachers Learn and Develop a Professional Practice

Current research suggests that teacher learning is a situated, distributed, and social activity. This is because teachers, as an occupational community (Lave & Wenger, 1991; Lieberman & Miller, 2008;), must now refine their expertise in new curriculum standards and, at the same time, learn the effective pedagogical practices that guide student learning to align with those defined outcomes. This perspective suggests that teacher learning should (a) involve socially organized activities situated in classroom practice, (b) draw on participants' pedagogical histories and diverse experiences, (c) be grounded in authentic activities that draw upon the individual's knowledge base and other teachers' understandings of similar events, and (d) offer structural resources that promote professional growth.

Development of a teacher's classroom practice, however, does not occur in linear stages (Bales & Mueller, 2008; Bell & Gilbert, 1996; Day, 1999). Rather, such development evolves over time. In other words, as new practices are adopted, less productive ones wane. Here we draw on the work of Dall'Alba and Sandburg (2006), who put forward the notion that the teaching and learning relationship is shaped by ever-changing classroom dynamics that require pedagogically skillful decisions which challenge teachers to continually expand their professional capacity. Viewed this way, professional development activities are structured so they create "opportunities for learning that both call into question and extend participants' current understanding of practice" (Dall'Alba & Sandburg, 2006, p. 402). In

doing so, the traditional understanding of teacher development as the acquisition of a finite package of knowledge and skills is replaced with a vision of professional practice that is inter-subjective, dynamic, and pluralistic in nature.

3. Research Design

The expected outcomes of the project were twofold. First, an aligned curriculum would better prepare students for credit-bearing college mathematics courses. This, in turn, would lead to increased student success and, potentially, improve their access to science, technology, engineering, and mathematics fields of study. Second, the resulting curriculum alignment would produce specific state and local policy recommendations. With these goals in mind, we utilized both quantitative and qualitative modes of inquiry to study how learning quality management tools and processes affected high school mathematics teachers' classroom practice and offer a curriculum sequence to credit-bearing, college level courses.

3.1. The Sequence of Teacher Learning

The project put forward a sequence of teacher learning delivered in three linked graduate-level courses delivered in a 50 percent hybrid format over three semesters. Each course met face-to-face for six hours one Saturday per month for four months. An online course component occurred between face-to-face meetings. The face-to-face meetings focused on teachers' construction of new knowledge on quality management. The online component purposefully pushed teachers to link theory-to-practice and practice-to-theory through the creation of an online community where they shared examples of how instructional or curricular changes generated, or failed to generate, student learning. Participants had ongoing online access to readings, activities, and discussion forums even after a specific course ended. This structure helped the teachers build a conceptual framework focused on a curricular and instructional *system* for learning mathematics. Course I introduced teachers to quality management tools and methods with an emphasis on issues related to alignment, assessment, and accountability, and the implications for teaching and learning. Course II shared details of the Common Core and directed teachers' attention to any needed changes in their instruction. Course III fostered the participants' leadership and mentoring skills so they could establish a department-wide model grounded in quality management processes. This sequence allowed us to document teachers' learning and the evolution of their practice.

3.2. Data Collection and Analysis

We generated project data both quantitatively and qualitatively. Quantitative data was generated through participant responses to pre- and post-project questionnaires. Qualitative data included a document analysis of the various high school mathematics curricula, the University of Wisconsin System mathematics placement exam, and the non-remedial, college, entry-level mathematics curriculum. We also conducted a text analysis of the participants' online postings and videotaped course sessions.

We held focus groups, where teachers discussed the strengths and challenges of quality management integration and curriculum articulation, the utility of these processes in content area teaching, and their perceptions of its impact on student learning. We also interviewed the participants' associated school administrators to establish department and/or school-wide changes. We recorded every interview and focus group session.

Interviews were transcribed verbatim and edited to produce a narrative of each participant's response. Information from the other data sources was added to each narrative. These narratives underwent a constant comparative analysis (Creswell, 2008) to identify themes. We resituated themes in the data and looked for connections and negative examples to build credibility and trustworthiness in the evidence.

4. Findings and Interpretations

Three major findings emerged from our analysis of the generated data. First, having teachers learn quality management tools and processes and use those skills to articulate and align curriculum appears to reveal structural, curricular, and instructional gaps in student learning. Furthermore, developing teachers' leadership talents pushes them to seek institutional and stakeholder-based support to address gaps and identified learning needs. Second, the existing mathematics course sequence in these large, high-poverty, urban high schools do not adequately prepare students for the gate-keeping placement exam that allows them to enroll in credit-bearing college courses. Third, structural, curricular, and instructional barriers challenged teachers' professional prowess as they tried to address identified gaps between high school mathematics courses and the knowledgebase assessed on the college placement exam. Finally, these findings, taken together, direct attention to two, interrelated, problems: (1) high school students in this high-poverty, urban school district are not prepared for post-secondary mathematics coursework and (2) attempts to help teachers address the problem with targeted professional development are challenged by structural issues.

Our interpretation of these findings offers four insights. First, teachers' use of quality management tools and methods to align curriculum, supported with leadership and mentoring skills development, appears to build instructional capacity. In other words, quality management tools seem to help teachers formulate a cogent series of learning opportunities so students acquire the mathematics knowledge and skills needed to enter credit-bearing, college courses. Fostering teachers' leadership skills allows them to advocate for these curricular changes.

Second, these teachers felt empowered with their new skills and actively sought leadership roles. We believe this is because they took a macro view of the outcomes explicated in an aligned PK-16 curriculum. In this study, teachers used quality management tools to analyze their professional practice and build validation arguments for their work. This validation increased the confidence they had in their curricular vision. Capitalizing on this vision, however, required the input from vertical and horizontal stakeholders.

Third, this study expands our understanding of disconnects between the teaching and learning vision of mathematics written into the Common Core and this particular system-wide college mathematics placement exam. Central in this disconnect is the notion that "mathematical understanding", which underlies procedural competence, is not captured in an exam that only assesses algorithm competence.

Finally, these findings, taken together, direct attention to two, interrelated, problems: (1) high school students in this high-poverty, urban school district are not prepared for post-secondary mathematics coursework and (2) attempts to help teachers address the problem with targeted professional development are challenged by structural issues. Both findings underscore the fact that mathematics education is a "critical public policy issue in the U.S. [in which] the pressures facing students and schools are compounded by increasing expectations for college attendance after high school" (Daun-Barnett & St. John, 2012, p. 1). At the same time, the findings also suggest quality management tools provide processes for navigating a course for student learning through this storm of new standards and various school and district structural issues.

5. Conclusions and Implications

In conclusion, the findings of this study shed light on the question posed by Cobb and Jackson (2011) as to "whether [the Common Core Standards in Mathematics] can feasibly be implemented in schools and districts across the country" (p. 185). The issue, as this study suggests, is larger than schools and districts. For students attending schools in this high-poverty urban district, who are primarily students of color, the college placement exam holds tight the gate to studies at four-year institutions of higher education. As such, it behooves us to examine the potential, long-term advantages offered by an aligned mathematics curriculum so that students can successfully complete a post-secondary degree. This situation demands that all PK-16 stakeholders, particularly those with the research skills to coordinate a broad and rich study, examine how the educational system can take on the storm of issues surrounding these new reforms.

Porter et al. (2011) conclude that "The Common Core standards are somewhat more focused in mathematics…[but] they are different from what U.S. teachers report they are currently teaching" (p. 114). We believe the findings shine a spotlight on the magnitude of these differences and the effect on high school mathematics teachers and the students in one Wisconsin urban school district identified for improvement. While the immediate effect on teachers might be remedied with intensive professional development, the long-term effect on

subsequent cohorts of students seeking access to post-secondary schooling is acutely problematic. We can only speculate on how other placement exams affect students' access to a post-secondary education. More importantly, the study's findings push us to consider how we evaluate the role of any placement exam in assessing the 21st century mathematical concepts outlined by the CCSS.

The findings of this study suggest three areas for future research. First, and perhaps of most immediate concern, is the need for research that studies how college placement exams might better represent both the Standards for Mathematical Practice. Second, future research might examine how students who move through a better-articulated mathematics curricular sequence fare in their college course taking. Finally, the creation of a PK-16 mathematics curriculum demands research that explores which combination of school, district, and university stakeholders can broker the "boundary objects" (Cobb, McClain, Lamberg, & Dean, 2003) needed to build a seamless set of learning opportunities for student success.

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