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Overcoming a Common Storm: Designing Professional Development for Teachers Implementing the Common Core

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Abstract: *Classroom implementation of the Common Core State Standards for Mathematics (CCSSM) requires significant professional development that develops teachers' understanding of the mathematics content and practice standards. This professional development must begin with the content and pedagogical needs of the teachers it serves. This study examined elementary and middle school teachers' perceived mathematics content needs related to the CCSSM mathematics content domains, their perceived pedagogical needs, and the connection between these perceptions and statewide assessment data. K-5 teachers indicated a great need in Operations and Algebraic Thinking and Numbers and Operations on Fractions. Middle school teachers expressed a major need in better understanding modeling, statistics and probability, geometry and measurement, and proportional reasoning. Furthermore, teachers' perceived mathematics content needs aligned with their previous students' high-stakes test performance. In light of these findings, we discuss implications for designing CCSSM-related professional development.*

Keywords. *Assessment, standards, CCSSM, professional development*

1 A Context for Professional Development

Teachers are the critical instructional element in the classroom (National Council of Teachers of Mathematics [NCTM], 2000). They manage instructional norms, discourse, tasks, and tools (Franke, Kazemi, & Battey, 2007). They are also expected to deeply understand mathematics, mathematics pedagogy, and potential outcomes for students (Mewborn, 2003). Professional Development (PD) ought to support teachers to maintain effective instructional contexts and adapt to new challenges. The recent adoption of the Common Core State Standards for Mathematics (CCSSM) by 45 of the 50 states will lead to major instructional changes in K-9 classrooms (NCTM, 2010). Mathematics

content and practice standards are different from prior state standards (Chief Council of State School Officers, 2010), hence instructional materials and practices must adapt to these new expectations. Sustained PD for teachers will help them acquire the mathematical knowledge necessary to fully instantiate the intent of the CCSSM to facilitate these changes (NCTM, 2010; Wu, 2011). For these reasons, teachers need support to refine and improve their instructional practices to implement the recently adopted CCSSM (NCTM, 2010). We sought to understand elementary and middle grades teachers perceptions of needed PD as they moved toward implementing the CCSSM and considered the ways their perceptions align with high-stakes test results.

We intended to design PD for teachers focusing on the CCSSM and wanted to use teachers' perceived needs as a key rationale for its structure and content. We wondered whether teachers' perceived needs aligned with their prior students' mathematics achievement on high-stakes tests. The full breadth of mathematics content knowledge in either the elementary or middle grades CCSSM would require vastly more time than most PDs can offer. Furthermore, teachers may want help in particular pedagogical areas as they relate to the CCSSM. The feasibility of mathematics teacher educators to incorporate the many needs is strained by the typical duration and scope of PD. Noting these two constraints we sought to better understand teachers' perceived needs during this transition to CCSSM in order to design meaningful, coherent, and relevant PD for the teachers we serve in our partnering districts. Our research questions were (1) Which of the K-9 content standards did teachers perceive the greatest need for professional development? (2) What specific professional content (i.e., mathematics pedagogy) features did teachers perceive they needed the most from PD? (3) How did teachers' perceived needs align with their previous students' high-stakes test performance?

2 Method

2.1 Participants

K-9 mathematics teachers located in four different counties in the Midwest region were asked to participate in this study because their districts partnered with the authors for CCSSM-focused PD. Partnering districts provided information about the CCSSM to their teachers during the year prior to this study. Teachers were stratified in order to better group the CCSSM mathematical domains: grades K-5 (Elementary Cohort) and 6-9 (Middle Cohort). The Middle Cohort in this study included ninth-grade teachers due to statewide licensure factors. The four counties exhibit a wide range of population types including urban with low median income/high poverty and rural/agricultural with high poverty. All 469 teachers in the Elementary Cohort were asked to voluntarily participate in the survey by their administrators. Nearly one third of that cohort responded to the survey (n=148). There were 22 grades 6-9 mathematics teachers in the Middle Cohort, and all of them volunteered to complete the survey. The number of teachers participating in the survey at each grade level is found in Table 1.

2.2 Surveys

Two different surveys were created to ascertain perceived needs from teachers in Elementary and Middle Cohorts. This was done after examining the CCSSM domains and

Table 1: *Number of Participants by Grade Level*

Grade	n
K	25
1	31
2	30
3	21
4	22
5	19
6	6
7	2
8	1
9	13

determining that standards were fairly consistent for K-5 and 6-8 grade bands. One survey was designed for elementary teachers while another was developed for the middle grades cohort. Survey items asked teachers about their district, grade levels taught, and years of teaching experience. They also rank ordered their desired professional development foci (i.e., content and pedagogy). Respondents were asked to rank order the CCSSM domains from greatest need to least need. The mathematical subgroupings found on the statewide mathematics test closely aligned with the CCSSM domains (e.g., algebra, fractions, as well as geometry and measurement). Survey items are provided in the Appendix. The term modeling was used in the middle grades survey to reflect problem solving because many districts used these terms interchangeably in previous years.

2.3 Data Collection

Teachers' perspectives on mathematics content and pedagogical needs were collected via an anonymous survey. Two surveys were sent to district administrators (e.g., superintendents, curriculum coordinators, and principals) to disseminate to grades K-5 and 6-9 teachers of mathematics in their district. Thus, all teachers in the targeted districts were part of the viable sample. Teachers volunteered to complete the survey, thus our sample included only volunteers. Respondents were encouraged to complete the survey during a two-week window.

District-level data consisting of third- through eighth grade students' statewide high-stakes mathematics test performance were collected. Students may or may not have been enrolled in a survey respondents' classroom. These data allowed us to examine the degree to which teachers' perceived needs matched students' performance on statewide mathematics assessment from the prior academic year. After surveys were analyzed, results were shared with curriculum coordinators to gather their perceptions about the findings.

2.4 Data Analysis

The following approach was used to determine an overall score for the two questions focusing on mathematics content and professional needs based on the percentage of participants selecting that rank. First, the ratio of responses to total responses was calculated for each content and pedagogical domain and each rank order. This ratio was multiplied

by 100 to determine the percentage of participants indicating that response. Next, the percentage was multiplied by its rank order (e.g., six for definite need, five for great need, four for some need, ..., one for no need) and these values for a particular content or professional needs domain were summed to determine an overall score. Readers interested in the survey data are encouraged to review Matney, Bostic, and Brahier (2011).

3 Results

3.1 Perceived Needs of the K-5 Elementary Cohort

3.1.1 Content

Teachers indicated that the two most important areas for content development were Operations & Algebraic Thinking and Numbers & Operations - Fractions. The domain of Measurement and Data was a close third choice. These needs align with students' statewide test performance in that they represent content choices in which former students of these teachers have been shown to struggle. Approximately 18% of third-grade students in these districts failed to meet the state required proficiency. However, the fourth- and fifth-grade failure rates were much higher; 24% and 42%, respectively. The students' failure rate on the overall exam increased with the level of mathematical sophistication on the state assessment in the areas of algebra and fractions.

3.1.2 Pedagogy

The overall professional needs score gave a strong sense that teachers desired PD aimed at designing and enacting instruction that (a) encouraged students' reasoning and sense making and (b) improved their facility with instructional strategies that support students' conceptual development of ideas found in the CCSSM. Teachers perceived a need for better understanding of the CCSSM as the highest. The next two highest choices of student reasoning and conceptual development support teachers' first choice since they were closely associated with the CCSSM and were pertinent to understanding its implementation through the Standards for Mathematical Practice.

3.2 Perceived Needs of the 6-9 Middle Cohort

3.2.1 Content

Teachers overwhelmingly asked for PD focusing on modeling, which was woven throughout the CCSSM. Statistics and probability as well as geometry and measurement were also suggested as areas of great need. The statewide high-stakes test results from the previous year indicated that approximately 15% - 29% of grades 6-8 students were not proficient on data-related tasks and 14% - 46% of grade 6-8 students did not meet passing criteria on geometry and measurement tasks. Modeling tasks were embedded throughout the assessments as word problems that require making sense of text, creating suitable models, and solving the task. Thus, no data were available from statewide assessments indicating students' modeling or problem-solving performance.

3.2.2 Pedagogy

Middle school teachers clearly valued PD focused on some professional topics more than others. Teachers were most interested in learning about ways to help students reason and make sense of mathematics. Their second pedagogical need from PD focused on instructional strategies to promote students' conceptual development of ideas found in the CCSSM.

4 Implications for CCSSM PD

K-5 and 6-9 teachers had different content-specific needs. K-5 teachers indicated a need for PD focused on topics typically taught during later elementary years, such as algebraic thinking and operations with fractions. Middle school teachers expressed a clear need for a better understanding of modeling. Modeling impacts one's understanding and ability to solve word problems, which is embedded throughout nearly every content strand. The CCSSM content standards frequently reference applying one's knowledge to solve real-world problems, which requires modeling. Finally, participants tended to respond in ways that were similar to their students' outcomes on statewide high-stakes tests.

Statewide high-stakes mathematics tests involved progressively more sophisticated mathematics content as grade levels increase. For the Elementary Cohort the two lowest content needs were Counting and Cardinality and Numbers and Operations in Base 10, which are in large part completed by third grade. Students performed the best on the third-grade state assessment with 82% meeting state proficiency while fourth- and fifth-grade state proficiency rates were 76% and 58% respectively. This indicated that students' ability to demonstrate proficiency with lower elementary grade ideas matches the teachers ranking these as low priorities.

On the other hand, the highly requested content topics are deeply developed during the latter elementary and middle grades. These topics were also given richer treatment on the statewide assessment in grades four and five. Only 14.9% and 12.8% of the participants surveyed were fourth- and fifth-grade teachers respectively. The vast majority of the teachers (i.e. 72.3%) in the Elementary Cohort taught primary elementary grades yet they still recognized the need for PD focusing on preparing students for intermediate elementary content. Thus, elementary teachers' perceived needs for PD about CCSSM content domains aligns with their students' prior performance on statewide assessments.

There was a noticeable increase in the number of students not meeting proficiency on high-stakes tests from sixth- to seventh- and eighth grade. The districts' average sixth-grade below-proficiency score was 21% whereas 35% and 34% of seventh- and eighth-grade students on average did not meet proficiency on their high-stakes mathematics tests. A cursory inspection of the data suggested some tentative association between students' proficiency scores and the content areas teachers requested. The average below-proficiency score related to geometry and measurement increased as grade levels increased from grades six through eight (i.e., content is more complex): 19%, 31%, and 32% respectively. Data and analysis below-proficiency average scores were more consistent across sixth-, seventh- and eighth-grade: 21%, 24%, and 24%. Curriculum coordinators remarked that modeling was woven throughout the high- stakes tests in the form of word problems that drew on a variety of mathematics domains. For example, one coordinator shared that statistics tasks typically require students to read a problem's stem, interpret a table and graph, and make

judgments about appropriate procedures and conclusions. Thus, middle grades teachers' expressed desire for PD focusing on instruction that supports students' problem solving and reasoning and sense making within the context of statistics, probability, geometry, and measurement aligned with their previous students' high-stakes test results.

5 Summary

K-9 teachers had similar perceived professional needs for PD. That is, both cohorts wanted PD focused on understanding the CCSSM, helping students to reason and make sense of mathematics, and to explore instructional strategies focused on students' conceptual development. These needs aligned with the CCSSM, which indicated that positive problem-solving behaviors are necessary to learn mathematics deeply. The adoption of new standards also provided teacher educators an opportunity to support instructors teaching the new standards, and there is a fervent perceived need for PD focusing on these topics. Furthermore, teachers' needs for CCSSM-focused PD aligned with their students' prior high- stakes test performance. This alignment suggested that teachers were aware of what they need when it comes to CCSSM-focused PD. It seems reasonable to assume that teachers would say they need to know more about areas where their students' struggle. This manuscript provides evidence demonstrating that this idea is not a mere assumption. Instead, it is a research finding with supporting data. A subsequent implication from the alignment between teachers' needs and students' high-stakes test performance is that teachers may be using assessment data to enhance themselves. It stands to reason that teachers use high- stakes test data to improve their mathematics instruction and in turn, students' outcomes on these measures.

Teacher educators developing CCSSM-focused PD must consider teachers' perceived pedagogical and content-area needs. There was clearly a demand from teachers to learn more about ways to support students' reasoning and sense making, which included teaching strategies that support student- centered, inquiry-focused instruction. As a result of this work, we crafted a grant-funded PD program for K-9 teachers and are currently implementing PD focused on these teachers' content and pedagogical needs.

6 Appendix

All teachers responded to the following questions.

1. In which school area do you teach?
2. How many years of mathematics teaching experience do you have?
3. What grade level are you currently teaching?
4. A grant is being written to provide professional development for teachers of mathematics. How likely would you be to participate: Definitely Interested count me in, Greatly Interested depends on some factors but very likely, Somewhat Interested I would need to think about it, Probably Not Im not sure I have the time or interest to participate at this time, No count me out.

The following additional items were found on the survey for elementary teachers.

1. Rank the following K-5 Common Core Mathematics Content Standard areas IN ORDER, where "1" is the Standard you feel that you need the MOST and "6" means you need the LEAST help in implementing that standard: Counting and Cardinality, Operations and Algebraic Thinking Operations, Numbers and Operations in Base 10, Numbers and Operations - Fractions, Measurement and Data, Geometry.

2. Rank the following 7 areas of mathematics professional development IN ORDER, where "1" is the topic of MOST interest/value to you and "7" means you currently have the LEAST need for help in that area: Enhancing or deepening my understanding of the Common Core, Helping students to reason and make sense of mathematics, Use of technology in teaching mathematics, Improving instructional strategies for student conceptual development, Collaboration with other mathematics teachers, Web Sites useful for planning and teaching mathematics, Diagnostically assess students' understanding in order to plan lessons or interventions.

The following additional items were found on the survey for secondary teachers.

1. Rank the following K-5 Common Core Mathematics Content Standard areas IN ORDER, where "1" is the Standard you feel that you need the MOST and "6" means you need the LEAST help in implementing that standard: Ratios and Proportional Reasoning, Geometry, Statistics and Probability, Number System/Number and Quantity, Algebra, Functions, Modeling.

2. Rank the following 7 areas of mathematics professional development IN ORDER, where "1" is the topic of MOST interest/value to you and "7" means you currently have the LEAST need for help in that area: Using technology in mathematics, The Common Core State Standards, Supporting students to reason and make sense of mathematics, collaborating with other mathematics teachers, Instructional Strategies

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