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Supporting Implementation of the Common Core State Standards for Mathematics

Recommendations for Professional Development

Summary Report
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Principal Investigators:

Paola Sztajn, North Carolina State University
Karen Marrongelle, Oregon University System
Peg Smith, University of Pittsburgh

Project Manager:

Bonnie L. Melton, North Carolina State University

The William & Ida Friday Institute for Educational Innovation at the North Carolina State University College of Education

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A full report of project activities will be released with further information about the organization of the work and project participants.

Introduction

In 2010, the National Governor's Association and the Council of Chief State School Officers published the Common Core State Standards for Mathematics and to date, 44 states, the District of Columbia, and the U.S. Virgin Islands have adopted the document. These content and practice standards, which specify what students are expected to understand and be able to do in K-12 mathematics, represent a significant departure from *what* mathematics is currently taught in most classrooms and *how* it is taught. Developing teachers' capacity to enact these new standards in ways that support the intended student learning outcomes will require considerable changes in mathematics instruction in our nation's classrooms. Such changes are likely to occur only through sustained and focused professional development opportunities for those who teach mathematics.

The recommendations that follow are intended to support large-scale, system-level implementation of professional development initiatives aligned with the Common Core State Standards for Mathematics (CCSSM). They emerged from the work done under the auspices of a NSF-funded project, which provided the opportunity for experts from diverse fields to collaboratively address the challenge of providing high-quality mathematics professional development at scale to support the implementation of the CCSSM. Over the course of the project, researchers and expert practitioners worked to integrate various perspectives on this challenge into a set of design recommendations for creating, sustaining, and assessing professional development systems for practicing mathematics teachers. Generated from the coordination of research-based knowledge in different but related fields, these recommendations build on state-of-the-art research findings from mathematics education, professional development, organizational theory, and policy.

The recommendations take into account the important role teachers will play in making the standards a reality. A substantive body of research points to teachers as the most important factor in promoting mathematics learning, and the education of teachers has been deemed an essential aspect in promoting educational improvement. Thus, the recommendations proposed here make salient that attending to the professional development of practicing mathematics teachers in light of the CCSSM is a requirement for the successful implementation of the new standards.

It is important to note that these recommendations are intended to build on, rather than replicate, the features of effective professional development identified in prior research (e.g., Desimone, 2009; Elmore, 2002; Guskey & Yoon, 2009; Guskey, 2000). In particular, a recent report from the National Staff Development Council (Darling-Hammond et al., 2009) entitled, *"Professional Learning in the Learning Profession: A Status Report on Teacher Development in the United States and Abroad"* identified four basic, research-based principles for designing professional development that we understand as common professional and research knowledge that serves as the foundation on which the current recommendations are built: 1) professional development should be intensive, ongoing, and connected to practice; 2) professional development should focus on student learning and address the teaching of specific content; 3) professional development should align with school improvement priorities and goals; and 4) professional development should build strong working relationships among teachers. We hope that the recommendations that follow, in conjunction with these four basic principles, can help districts and states in creating, sustaining, and assessing professional development systems for practicing mathematics teachers that support their implementation of the CCSSM, and ultimately, the learning of all K-12 students.

NOTE: The abbreviation CCSSM-PD is used through the recommendations in order to avoid consistently reminding the reader that the recommendation is specifically about professional development that supports enactment of the Common Core State Standards for Mathematics.

1: Emphasize the Substance of CCSSM-PD

Professional development provides opportunities for practicing mathematics teachers to engage with both the CCSSM content and the CCSSM practices in a focused and integrated way.

2: Create and Adapt Materials for Use in CCSSM-PD

Professional Development materials are needed that explicitly address the mathematics content and practices of the CCSSM and provide vivid images of teaching and learning that are consistent with CCSSM.

3: Design CCSSM-PD Based on Features that Support Teacher Learning

Professional development takes into account existing knowledge about effective ways to organize learning experiences for teachers of mathematics.

4: Build Coherent Programs of CCSSM-PD

Programs of professional development provide a continuous and coherent set of experiences in which practicing mathematics teachers engage over an extended period of time.

5: Prepare and Use Knowledgeable Facilitators for CCSSM-PD

Professional development uses expert facilitation to ensure teacher learning of CCSSM at scale.

6: Provide CCSSM-PD Tailored to Key Role Groups, in Addition to Teachers

Strong programs of professional development target a variety of role groups within the education system and attend to the professional needs of each group as the system builds capacity at all levels.

7: Educate Stakeholders about the CCSSM

Members of the general public need to be apprised on how the CCSSM will impact instruction and learning in our nation's classrooms.

8: Continuously Assess CCSSM-PD

Professional development programs are regularly assessed to provide formative information for program improvement and revision and to establish the effectiveness of the programs.

9: Create CCSSM-PD Consortia

Professional development consortia are needed to oversee and improve the role professional development plays in successful implementation of the CCSSM.

RECOMMENDATION # 1 EMPHASIZE THE SUBSTANCE OF CCSSM-PD

Professional development provides opportunities for practicing mathematics teachers to engage with both the CCSSM content and the CCSSM practices in a focused and integrated way.

Elaboration:

The substance (Kennedy, 1998) or content focus (Desimone, 2009; Garet et al., 2001) of any professional development is a key component for providing teachers with opportunities to learn. Professional development designed to support the CCSSM emphasizes the mathematics content and the mathematics-specific practices identified in the standards. Such professional development targets a defined and focused set of mathematical content and practices. It makes salient how students develop mathematical ideas over time (i.e., standards progressions) and the ways in which the mathematical practices support the learning of content.

The mathematical ideas selected for initial focus in professional development are those that are treated differently in CCSSM than in previous standards (e.g., transformational geometry), ones that may be new to teachers at a particular grade level (e.g., earlier attention to unit fractions, data and statistics in middle grades, ratios and proportional relationships in grade 6) or are foundational to what is to come in later grades (operations and algebraic thinking k-5). A recent report entitled, *Gearing up for the Common Core State Standards in Mathematics* (2011) identifies five initial content domains for professional development in grades k-8 to be used as a starting point for such work. They are: (1) counting and cardinality and number and operations in base ten (grades k-2); (2) operations and algebraic thinking (grades k-5); (3) number and operations-fractions (grades 3-5); (4) ratios and proportions (grade 6-7); and (5) geometry (grade 8).

The mathematical practices presented in the CCSSM represent important habits of mind that teachers must learn to incorporate and promote in the classroom. Just like the content standards, professional development targets a few selected practices to address in depth. These practices must be embedded in discussions about content. The standards for mathematical practice are an especially critical part of professional development that supports the CCSSM because the practices define what mathematics teaching and learning should look like. Teachers need opportunities to experience specific practices as learners before they can be expected to enact them as teachers. For example, teachers need opportunities to construct viable arguments themselves so that they understand what this practice means and are in a better position to consider what this practice looks like in their own classroom.

Suggested Action Steps:

- **School Leaders:** Make teachers' experiences with CCSSM content and practices a priority, allocating time and resources for teachers to discuss and reflect on the CCSSM standards progressions, new practices, and the ways in which content and practices support each other in instruction.
- **District or State-Level Personnel:** Organize and offer professional development that is focused on a few specific content standards progressions and integrates mathematical content and practices. Over time, a broad set of content and practices can be addressed, but this should be done sequentially rather than all at once.
- **Professional Development Providers:** Design professional development that addresses specific content strands and integrates the CCSSM content and practices.

RECOMMENDATION # 2: CREATE AND ADAPT PROFESSIONAL DEVELOPMENT MATERIALS FOR USE IN CCSSM-PD

Professional Development materials are needed that explicitly address the mathematics content and practices of the CCSSM and provide vivid images of teaching and learning that are consistent with CCSSM.

Elaboration:

Professional Development materials that support the CCSSM target specific content and/or practices and provide opportunities for teacher learning that are grounded in practice; that is, the everyday work of teaching is the object of ongoing investigation and thoughtful inquiry (Ball & Cohen, 1999; Smith, 2001). Such materials include: assessment items, video and narrative exemplars of students using the mathematical practices in pursuit of learning key content, sets of related tasks that promote learning of specific mathematical ideas and show a trajectory of how knowledge builds over time, and samples of student solutions to specific tasks, as well as students' misconceptions, highlighting the range of strategies that students might use to solve a particular task.

Practice-based professional development materials provide opportunities for teachers to enhance their understanding of both CCSSM content and practices. Teachers develop new levels of awareness and knowledge through engagement with these professional development materials and learn to examine their current instructional practices and curricular materials in light of the new ideas represented by the CCSSM.

Suggested Action Steps:

- **District or State-Level Personnel:** Collect artifacts from teachers (e.g., tasks, lesson plans) and classrooms (e.g., video, student work samples) that highlight aspects of the CCSSM that can be used locally in connecting professional development with teachers' practices.
- **Authors of Professional Development Materials:** Create indices that identify the ways in which the mathematical content and practices from CCSSM are made salient in existing materials.
- **Funding Agencies and Publishers of Professional Development Materials:** Allocate funds for the development of new, or the adaptation of existing, materials for use in professional development settings that promote the CCSSM.
- **Funding Agencies:** Allocate funds for research on the enactment and effectiveness of these professional development materials in support of the CCSSM within various settings.

RECOMMENDATION # 3: DESIGN CCSSM-PD BASED ON FEATURES THAT SUPPORT TEACHER LEARNING

Professional development takes into account existing knowledge about effective ways to organize learning experiences for teachers of mathematics.

Elaboration:

Substantial evidence has been amassed about features of professional development that make certain initiatives more effective (e.g., Darling-Hammond et al., 2009; Garet et al., 2001; Guskey & Yoon, 2009). These features include: professional development should be intensive, ongoing, and connected to practice; professional development should focus on student learning and address the teaching of specific content; professional development should align with school improvement priorities and goals; and professional development should build strong working relationships among teachers. Whereas two of these features were highlighted in recommendations #1 and #2 due to their importance (emphasis on substance of professional development and connections to teaching practices), the design of professional development that supports the CCSSM takes into account all other features that relate to the ways in which professional development promotes teacher learning, such as: offering a substantial number of professional development hours; spreading these hours over time; aligning the professional development goals with school improvement priorities; attending to student learning; and fostering strong working relationships among teachers.

Features of effective professional development do not prescribe the means through which professional development is delivered. Using a variety of delivery mechanisms to make professional development available to teachers assures that such initiatives fit a myriad of teacher schedules and working conditions. Combinations of summer and year-round work, face-to-face and virtual meetings, job-embedded and course-based activities, within-school and outside-of-school experiences, allow professional development to be compatible with teachers' time and availability.

Recent research indicates that although necessary, these features alone many not be sufficient to impact instruction (Garet et al., 2010; Garet et al., 2011), suggesting that professional development in support of the CCSSM also incorporates practices the field has begun to see as promising, such as attention to discourse (Chapin, O'Connor, & Anderson, 2009; Smith & Stein, 2011), development of high-leverage practices (Grossman et al., 2009; Lampert et al., 2010), student thinking (Carpenter et al., 1989), formative assessment (Wiliam & Thompson, 2007), and cognitively challenging mathematical tasks (Smith & Stein, 1998). These professional development opportunities offer teachers feedback on their own knowledge, instruction, and their students' progress.

Suggested Action Steps:

- **Teachers:** Examine whether the professional development experiences you choose in support of CCSSM attend to important features of effective professional development. Let school leaders know of professional development that does not adhere to these features and does not provide you with opportunities to learn about the mathematics content and practices of CCSSM.

- **School leaders:** Select only professional development options that are in line with known features that support teacher mathematics learning.

- **District and State-Level Personnel:** Allocate funds only to professional development opportunities that incorporate known features that support teacher learning.

- **Publishers of Professional Development Materials:** Make available professional development materials in support of the CCSSSM that take into account key features of effective professional development and include facilitators' manuals with suggestions on how to organize the professional development accordingly.

- **Funding Agencies:** Allocate funds for research on what makes professional development effective so that the field can strengthen and use knowledge about what is required in professional development. Require that the design and implementation of the professional development you fund in support of CCSSM make clear use of known features that support teacher learning and are focused on mathematics.

RECOMMENDATION # 4: BUILD COHERENT PROGRAMS OF CCSSM-PD

Programs of professional development provide a continuous and coherent set of experiences in which practicing mathematics teachers engage over an extended period of time.

Elaboration:

Programs of professional development provide opportunities for teachers to engage with CCSSM content standards progression and practices over an extended period of time. Such programs warrant that the collection of professional development experiences in which teachers engage provide an overall consistent message about what the CCSSM is and how it should be incorporated into instruction to improve mathematics teaching and learning. In addition to ensuring that each professional development initiative emphasizes substance, uses materials that are tightly connected to teaching practices, and incorporates features that support teacher learning, a program of professional development takes into account teachers' experiences across all initiatives, making sure the set of experiences is coherent.

A current problem with professional development is that available opportunities are frequently fragmented and episodic, including both high- and low-quality work, strong and weak learning opportunities, generic and content-focused activities, appropriately and poorly focused learning experiences, in part because professional development is supported and coordinated through many different types of organizations. Offering isolated professional development opportunities that are not articulated into a coherent program ignores the need for teachers' experiences in professional development to logically build on one another so that teachers can accumulate knowledge over time (Cobb & Smith, 2008). A purposeful articulation across many professional development initiatives makes sure that available options are not only high quality and focused, but also appropriately sequenced and connected to create meaningful long-term professional development paths in support of CCSSM.

Suggested Action Steps:

- **School Leaders:** Clarify and communicate school improvement priorities in relation to the CCSSM so that programs of professional development can be designed to align with such priorities.
- **Professional Development Providers:** Offer sets of extended professional development opportunities that support the development of teacher knowledge base for teaching a particular slice of mathematics over time.
- **District or State-Level Personnel:** Select professional development opportunities for teachers that are focused and sustained over a period of time, and that build on one another in coherent ways. Do not fund on-off professional development that is not tied to the goals established for your professional development program.
- **Professional Organizations:** Disseminate information regarding the need for teachers to engage in programs of professional development opportunities that are aligned with CCSSM and are combined in coherent ways to support teacher knowledge growth over long period of time.

RECOMMENDATION # 5: PREPARE AND USE KNOWLEDGEABLE FACILITATORS FOR CCSSM-PD

Professional development uses expert facilitation to ensure teacher learning of CCSSM at scale.

Elaboration:

Successful facilitation of professional development requires expertise (Banilower, Boyd, Pasley, & Weiss, 2006; Elliott et al., 2009), and professional development participants are far more likely to achieve the targeted learning goals when skilled and knowledgeable providers facilitate the professional development. Expert facilitators for professional development that supports the CCSSM are at a minimum well-versed on the CCSSM content standards progression and practices, as well as on how to build learning environments that take into account teachers' needs and are supportive of teacher learning as highlighted in previous recommendations. Further, expert facilitators are knowledgeable about leadership, adult learning, successful innovations, and are up-to-date on research results about best practices in mathematics education. Expert facilitation can come from within the system or from outside the system, but requires an understanding of the ambient professional development (Wayne et al., 2008) that is in place.

The capacity problem for developing expertise in professional development facilitation is large (Cohen & Ball, 1999; Sztajn, Ball, & McMahon, 2006) and one that needs to be addressed to support the implementation of CCSSM at scale. Working to develop facilitation capacity requires the identification and adequate preparation of a whole new cadre of professionals within the educational systems who can lead successful professional development for all teachers.

Suggested Action Steps:

- **District or State-Level Personnel:** Consider the expertise in mathematics teaching and learning of the professional development providers and facilitators, both from within and from outside the system. Support the development of a cadre of mathematics professional development leaders within the educational system.

- **Professional Development Providers:** Identify the knowledge and expertise used in facilitating professional development that supports the CCSSM and make such knowledge available to provide for the preparation of a new cadre of mathematics professional development providers.

- **Publishers of Professional Development Materials:** Include in professional development materials information that purposefully targets the needs of new professional development facilitators.

- **Funding Agencies:** Allocate funds for research on features of effective professional development facilitation and how to prepare mathematics professional development facilitators at scale to address the capacity problem.

RECOMMENDATION # 6: PROVIDE CCSSM-PD TAILORED TO KEY ROLE GROUPS, IN ADDITION TO TEACHERS

Strong programs of professional development target a variety of role groups within the education and system attending to the professional needs of each group as the system builds capacity at all levels.

Elaboration:

Because the CCSSM represents changes in both what mathematics is taught and how it is taught, professional development needs to build capacity at various levels within the educational system. Offering professional development in support of the CCSSM that includes various key role groups in the system (e.g., department chairs, instructional leaders, school administrators, superintendents) ensures that all professionals in the system understand the new content and practices in the CCSSM and share a vision for mathematics instruction in the system. Professional development experiences conducted with a diverse group of professionals fosters coherence and aligns expectations within the system for supporting teaching and learning in light of the CCSSM.

Different professionals in the system also have different needs, and role-specific professional development opportunities target the demands of specific groups. Such targeted professional development for professionals others than teachers assures that those functioning in different capacities within the system are properly prepared to support the implementation of CCSSM. For example, professional development for principals helps them know what content teachers need to be teaching and what to look for when they observe classrooms (Nelson, 1998; Spillane, 2005). Professional development for superintendents helps them understand the need for coherence across the system in supporting teacher learning of the CCSSM (Cobb & Smith, 2008). When the goals and content of professional development across all targeted role groups are aligned with the what each group needs to support the CCSSM, the system can support teachers in changing instructional practices, as well as hold them accountable for doing so.

Suggested Action Steps:

- **District or State-Level Personnel:** Consider the professional development needs of various key role groups and provide targeted mathematics professional development to all groups in support of the CCSSM.

- **Funding Agencies and Publishers of Professional Development Materials:** Allocate funds for the development of different professional development materials that target the needs of various school professionals such as instructional leaders, principals, and other administrators. These materials should inform all professionals about the CCSSM and consider role-specific needs related to the CCSSM implementation,

RECOMMENDATION # 7: EDUCATE STAKEHOLDERS ABOUT THE CCSSM

Members of the general public need to be apprised on how the CCSSM will impact instruction and learning in our nation's classrooms.

Elaboration:

Mathematics teaching will be transformed as the CCSSM is implemented. Those who understand how teaching will look different as the CCSSM becomes a reality in our nation's classrooms need to educate parents, politicians, school boards, businesses partners, industry representatives, and other interested parties about what to expect from mathematics teaching that supports the implementation of CCSSM. It is also important to inform stakeholders of the reasons why new content standards progressions and practices are proposed in the CCSSM and why teaching approaches being used in classrooms are likely to be more effective in supporting student learning.

In particular, parents need to understand what their children are working on in school and be positioned to better support children's learning (Civil & Bernier, 2006). Educating stakeholders outside the educational system such as politicians, business partners, or industry representatives makes sure they are informed of expected changes and can advocate for the CCSSM with their own constituents.

Suggested Action Steps:

- **District of State-Level Personnel:** Work with others to educate state policymakers and legislators about the CCSSM and the policy and fiscal needs for professional development for teachers at all levels.

- **Professional Organizations:** Take the lead in developing ways to communicate to parents, policy makers, school board members, and other stakeholders to advocate for research-based teaching mathematics practices that support the CCSSM and explain why these practices are more likely to lead to improved student learning outcomes.

- **Funding Agencies:** Allocate funds for researchers and developers to communicate the results of their work to public audiences and to include experts on communication and dissemination in efforts to launch information campaigns.

RECOMMENDATION # 8: CONTINUOUSLY ASSESS CCSSM-PD

Professional development programs are regularly assessed to provide formative information for program improvement and revision, and to establish the effectiveness of the programs.

Elaboration:

Professional developers incorporate assessment and evaluation practices into their work so that regular, cyclic patterns of feedback shape the refinement of professional development materials and programs. Consistent with current emphasis on evidence-based practices and programs, mathematics professional development needs to provide evidence of effectiveness and the use of data-driven decision making. Assessments of professional development are tied to specific professional development goals and evaluation includes a formative component, providing feedback for improving professional development and targeting support to teachers in order to improve their knowledge, practice, and student learning.

Similar to design experiment cycles that have informed mathematics curriculum development and improvement (e.g., Cobb, Confrey & diSessa, 2003), formative assessment cycles support the improvement of professional development. Formative assessment focuses on professional development curriculum, the impact of professional development on teacher practice, the impact on teacher beliefs, and facilitator development.

Suggested Action Steps:

- **School Leaders:** use interim assessments tied to CCSSM to inform teachers about what is working for them instructionally and inform professional development providers about needed adaptations.
- **District or State-Level Personnel:** Select professional development programs that have specific and clear goals and objectives; be aware of the variety of assessment instruments that measure how the goals and objectives are met and the limitations of each instrument; use the evidence you gather about participation in professional development to locally improve your programs of professional development for practicing mathematics teachers.
- **Assessment Developers:** Develop instruments that provide both formative and summative assessment information on what teachers and other key role groups learn from their participation in professional development related to the CCSSM. Identify observable changes in teacher classroom practice such as coherence with respect to standards progressions or integration of mathematical practices, and develop instruments to analyze classroom practice in light of the CCSSM.
- **Funding Agencies and Publishers of Professional Development Materials:** Allocate funds for the development of measures and instruments for assessing what teachers learn and use from their participation in professional development related to the CCSSM.

RECOMMENDATION # 9: CREATE CCSSM-PD CONSORTIA

Professional development consortia are needed to oversee and improve the role professional development plays in successful implementation of the CCSSM.

Elaboration:

In parallel with the creation of the assessment consortia (SMARTER Balanced Assessment Consortium and Partnership for Assessment of Readiness of College and Careers), through the competitive Race to the Top Assessment funding competition, there is now a need to create similar professional development consortia. They set the stage for the next generation professional development in mathematics, coordinated by consortia of states. The professional development consortia could also serve as clearing-houses for mathematics professional development materials, programs, and providers in order to support states and districts in making decisions about mathematics professional development in support of the CCSSM. The creation of professional development consortia addresses the current lack of certification for professional development providers and these consortia can work with professional organizations to develop models of instruction that is aligned with the CCSSM. The professional development consortia can help facilitate the sharing of information between assessment developers and professional development providers, contributing to a streamlined system of mathematics education.

The initial scope of work for these professional development consortia includes, but is not limited to: (1) overseeing the creation of a clearinghouse (or clearinghouses) for professional development materials that are aligned with the CCSSM, are of high quality, and can be used in the professional development of mathematics classroom teachers, instructional-leaders, school administrators, and other key role groups; (2) setting quality standards for mathematics professional development materials in support of the CCSSM; (3) providing recommendations for the development of state- and district-wide mathematics professional development programs and exemplars of such programs; (4) developing a certification system for well-prepared mathematics professional development providers and develop a pipeline of such providers; (5) supporting and expanding research around the role of professional development related to the CCSSM, including not only the continuation of efficacy trials around professional development offered by the developers on small scale, but also effectiveness studies that generate new knowledge about providing professional development at scale; and (6) documenting the effects of the professional development changes to the professional development system.

Suggested Action Steps:

- **Funding Agencies:** Develop competitions to fund CCSSM Professional Development Consortia.

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