Transitioning to the Common Core State Standards for Mathematics: A Mixed Methods Study of Elementary Teachers' Experiences and Perspectives

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This mixed methods study explored elementary teachers' (n = 73) experiences with and perspectives on the recently implemented Common Core State Standards for Mathematics (CCSS-Mathematics) at a high-needs, urban school. Analysis of the survey, questionnaire, and interview data reveals the findings cluster around: familiarity with and preparation to use the standards; implementation of the standards, including incorporation and teacher change; and tensions associated with enactment of the standards. Notably, the teachers believed in the merit of the standards but were constrained by their inadequate content knowledge, limited aligned curricular resources, lack of student readiness, and a perceived mismatch with ELLs. The results illuminate the professional needs of teachers during this critical time of transition to the standards and also add to the scant research on this national-scale reform in mathematics education.

As a means of improving the mathematics education of students in the United States, teachers in 43 states are now expected to utilize the academic standards of the Common Core State Standards for Mathematics (CCSS-Mathematics) (CCSS, 2015). The CCSS-Mathematics is intended to provide more rigor and depth of the mathematics for students, while potentially requiring increased specialized content knowledge and fundamental changes in instructional practices of teachers (Schmidt, 2012). The difficulty of transitioning to the CCSS-Mathematics lies in putting the standards into classroom practice, with teachers as major forces on how this plays out (Dacey & Polly, 2012).

Given their widespread adoption, careful scrutiny of the new standards is warranted. And, as teachers are key participants in how these standards are implemented in classrooms, a close study of their perspectives is needed, particularly in light of the scant research on this national-scale reform. Accordingly, this study used mixed methods to explore elementary teachers' experiences with and views on the newly implemented CCSS-Mathematics.

Literature Review

CCSS-Mathematics Defined and Related Research

The CCSS-Mathematics represents a major overhaul of most states' preceding standards. Porter, McMaken, Hwang, and Yang (2011) determined the overlap between the CCSS-Mathematics and states' previous standards is only 20–35%. The new standards include 11 critical areas of mathematics for grades K-8 in order to provide a coherent, rigorous, and focused curriculum built around big ideas (CCSS, 2010). The standards go beyond specifying mathematical content and also include eight Standards for Mathematical Practice, with an emphasis on applying mathematical concepts and skills in the context of authentic problems and understanding concepts rather than merely following a sequence of procedures. The standards were created with strong consideration for the research base about the development of students' understandings of mathematics over time (Cobb & Jackson, 2011). As such, the topics at particular grade levels are different, with this re-sequencing reflecting research on learning trajectories (Sztajn, Confrey, Wilson, & Edgington, 2012). In addition, summative assessments have been created that align with the more rigorous and in-depth expectations (e.g., those of Partnership for Assessment of Readiness for College and Careers and the Smarter Balanced Assessment Consortium). Given these significant shifts proposed by the CCSS-Mathematics, its implementation will require a significant revamping of mathematics education in many schools, including changes in instructional practices, extensive professional development, and adoption of new curricula (Cobb & Jackson, 2011; Lee, 2011; Schmidt & Houang, 2012).

The CCSS-Mathematics is guided by Standards for Mathematical Practice describing the "expertise that mathematics educators at all levels should seek to develop in their students" (CCSS-Mathematics, 2010, p. 6) that are founded upon "processes and proficiencies" critical to mathematics education. There are eight mathematical practices, including that students should: (a) make sense of problems and persevere in solving them, (b) reason abstractly and quantitatively, (c) construct viable arguments and critique the reasoning of others, (d) model with mathematics, (e) use appropriate tools strategically, (f)

attend to precision, (g) look for and make use of structure, and (h) look for and express regularity in repeated reasoning (CCSS, 2010). Teachers are to look for and provide instruction that includes *points of intersection* between the mathematical practices and content, requiring a shift in pedagogy for many (CCSS, 2010).

There is limited inquiry specifically on the CCSS as it relates to mathematics and elementary teachers, with few studies having a related focus (Cogan, Schmidt, & Houang, 2013; EPE Research Center, 2013; McDuffie et al., 2015). For example, a survey of 599 K–12 educators focusing on the CCSS in general revealed they agreed the standards would improve their teaching but in order to better implement the standards, they needed "more planning time, better access to aligned curriculum and assessments, additional collaboration with colleagues, and a clearer understanding of the new expectations for students" (EPE Research Center, 2013, p. 3). Another related study focused on the CCSS-Mathematics with middle school teachers ($N = 366$). This mixed methods examination found that teachers: viewed the standards as providing new content for their grade level, used multiple curriculum resources and collaborated with peers to plan for instruction on the standards, and believed the new assessments would determine how the standards are implemented in classrooms. The teachers also reported familiarity with the CCSS-Mathematics, but it was uncertain if they had a clear understanding of how to interpret and enact them in classrooms.

CCSS-Mathematics and Teacher Change

Whether or not students learn the CCSS-Mathematics depends upon teachers' instructional expertise (Schmidt & Houang, 2012). The introduction of the CCSS-Mathematics requires many teachers to change what and how they teach, particularly a shift away from rote memorization toward understanding and reasoning, and therefore calls into question their readiness for implementing these standards (Griffin & David, 2014). Phillips and Wong (2012) suggest that "moving from the standards on paper to the deep changes required in practice will be a significant challenge" (p. 31). For example, many standards designated for a particular grade may be reintroduced unnecessarily over the course of several years and spanning different grade levels (e.g., 4th grade standards may be taught in classrooms from 2nd through 6th grades) if teachers continue to rely on past standards' implementation schedules (Gewertz, 2012). In addition, Schmidt and Houang (2012) suggest that many teachers view the CCSS as predominantly the same as their state's previous standards and this lack of awareness poses significant difficulties.

The CCSS-Mathematics proposes that teachers focus on fewer "big" mathematical ideas so students will: build conceptual understanding, achieve procedural skill and fluency, and learn how to transfer what they know to solve problems in and out of the mathematics classroom (Phillips & Wong, 2012). In order to develop these student understandings, Ewing (2010) contends:

> Teachers must have deep and appropriate content knowledge to reach that understanding; they must be adaptable, with enough mastery to teach students with a range of abilities; and they must have the ability to inspire at least some of their students to the highest levels of mathematical achievement. (para. 6)

This assertion highlights some of the necessary teacher competencies for teaching the CCSS-Mathematics. One competency, teacher content knowledge, is significant as teachers need deep and broad knowledge of mathematics to be effective in their teaching (Hill, 2010). Multiple efforts have attempted to define the exact mathematical knowledge needed for teaching (Ball & Forzani, 2010; Ball, Thames, & Phelps, 2008; Hill, 2010), and researchers have recently proposed a "specialized content knowledge" (SCK) characterized as "mathematical knowledge needed to perform the recurrent tasks of teaching mathematics to students" (Ball et al., 2008, p. 399).

Research Questions

This inquiry was guided by the following research questions:

1. What are elementary teachers' familiarity with and preparation for teaching the CCSS-Mathematics?
2. What are elementary teachers' views on integration of the CCSS-Mathematics into their classroom teaching practices?
3. What tensions do elementary teachers identify with implementation of the CCSS-Mathematics?

Method

This study used mixed methods, specifically "concurrent triangulation" (Creswell, Clark, Gutmann, & Hanson, 2003, p. 223) of quantitative and qualitative data. This approach implies: (a) concurrent collection of both types of data, (b) equal prioritization of both types of data, and (c) integration during the analysis and interpretation phases.

Participants and Context

This study involved 73 teachers at a large, urban elementary school in the southeastern U.S. Years of teaching experience ranged from 40% with 5 years or less,

25% with 6–10 years, and 35% with more than 10 years. The educational background of the teachers included 68% with at least a master's degree. Ninety-five percent of the students were eligible for free or reduced lunch (Georgia Department of Education, 2014). The student population was diverse, including 69% Hispanic, 22% African American, 5% Asian, and 4% Caucasian. Seventy-two percent of the students were non-native English speakers, and the English as a Second Language (ESL) program served 55% of the student population.

At the time of data collection, the teachers were midway into their second year of implementation of the CCSS-Mathematics. The standards were adopted in 2010, with roll-out including communication and administrator training during 2010–2011 and teacher training during 2011–2012. Initial classroom implementation of the standards was expected in fall 2012, with full implementation in fall 2014. For the district in which the school is located, the CCSS-Mathematics is implemented as the Academic Knowledge and Skills (AKS) Curriculum, which is aligned with the state adopted Common Core Georgia Performance Standards (CCGPS). The professional development received thus far on the CCSS-Mathematics, as reported by the teachers, is described in the results section.

Data Collection

Quantitative data were collected via a survey, and qualitative data were collected via an open-ended questionnaire and individual interviews. Participants completed the survey and open-ended questionnaire on the same day during their grade level Common Planning Time. All interviews were conducted within two weeks of this initial data collection at the convenience of the interviewees.

All teachers completed a survey focused on their experiences with and perspectives on the CCSS-Mathematics, as well as an open-ended questionnaire designed to provide insights into the survey items. At the time of this study, there were no published surveys or questionnaires addressing teachers' perspectives on the CCSS that emphasized mathematics. The survey includes 22 items (see Appendix A), some of which are multi-part. Some of the items were written by the researchers, and some were modified items from EPE Research Center's (2013) national survey of teacher perspectives on the CCSS. The domains of the survey items cluster around: teachers' reported experiences with the standards, including familiarity with, preparation for, and implementation of them. Additional items focus on teachers' perspectives on the standards, including the potential of the standards to influence or change their instructional practices and students' learning as well as mathematics education in general. The survey also contains five demographic items.

After completing the survey, all participants completed the open-ended questionnaire intended to illuminate the survey items; the questionnaire contains eight multipart questions (see Appendix B). Six randomly selected teachers participated in individual, semistructured interviews; the interview protocol is identical to the open-ended questionnaire. The interviews ranged from 30 minutes to one hour in duration.

Data Analysis

Data from the surveys were analyzed using individual response analysis by examining the descriptive statistics for each item; data from the interviews and open-ended questionnaires were initially analyzed by applying a priori codes of "familiarity," "preparation," "implementation," and "teacher change" to the comments of the teachers. Through this process an additional code emerged: "tensions." Researchers then used constant comparative methods (Lincoln & Guba, 1985) to generate more refined categories within these codes. Specifically, researchers individually analyzed the qualitative data through open coding, which generated numerous categories and subcategories representing observed phenomena found in the data (Strauss & Corbin, 1998). Researchers periodically met and discussed the subcategories to reach consensus on their meanings related to the categories. This recursive process of discussion and analysis of all interview data initiated development of a coding manual that was used in subsequent analyses. The researchers then engaged in data reduction by recoding data using the coding manual for guidance in comparing and refining categories. Coded categories were collapsed, renamed, and triangulated with the findings of the survey data, resulting in final themes of: familiarity with and preparation to use the new standards; implementation of the new standards, including incorporation and teacher change; and tensions associated with enactment of the new standards.

Results

The findings are clustered around three major themes, with associated subthemes, including: familiarity with and preparation to use the new standards; implementation of the new standards, including incorporation and teacher change; and tensions associated with enactment of the new standards, including both teacher- and student-oriented affordances and constraints. Quantitative data and qualitative data are presented to support these themes, with illustrative examples from the data sources intended to provide a detailed, accurate presentation of the findings. In

addition, tables with quantitative findings are provided for each theme.

Familiarity with and Preparation to Use the Standards

Teachers reported relative familiarity with the CCSS-Mathematics (see Table 1). On the item, "Please rate your overall level of familiarity with the CCSS-Mathematics," only 22% reported they were very familiar, while 67% indicated they were somewhat familiar. When asked about familiarity with the "state/district academic standards in mathematics prior to the CCSS-Mathematics," only 29% reported very familiar, with 52% reporting somewhat familiar. When combining these two response categories, it seems the teachers were slightly more familiarity with the CCSS-Mathematics than their previous standards, which could possibly be explained by the number of novice teachers (40%), including first year, at the school. Also, when considering familiarity, the majority of teachers recognized the dissimilarities between their current and previous standards, as on an item asking teachers to consider differences, "The CCSS-Mathematics is different than my previous state/district academic standards in mathematics," 63% strongly agreed or agreed.

Though midway through the second year of implementation of the CCSS-Mathematics, 25% of teachers reported no professional development or training on the standards (see Table 1). Of the 75% indicating professional development experiences, 56% reported three days or less as the amount of time spent in such, while 29% indicated over five days. When asked to describe the format for professional learning, teachers indicated the most frequent as "collaborative planning time with colleagues" (54%), with the next two frequent as "structured, formal setting (seminars, workshops, conferences)" (13%) and "Professional Learning Communities" (13%). Given these accounts, on the item, "To what extent do you agree with the following statement? Overall, my professional development and training on the CCSS-Mathematics have prepared me to teach the CCSS-Mathematics," only 7% strongly agreed, with 65% agreeing and 20% disagreeing. The interview and questionnaire data confirmed and illuminated the data from those lacking professional development, as illustrated by this teacher:

> It's particularly challenging because there's been no support or staff development… I know myself and many teachers who are doing everything we can to reach our students. But, we don't necessarily feel that we really know what we are preparing them for and how to best prepare them… The most important thing I would say that I need or would like to have is some preparation and some support, which I don't and am not getting from my school and school system. And, I don't know if that's because it's not available or they're in the

Table 1

Survey Items with Reponses Related to Familiarity with and Preparation to Use the Standards

Please rate your overall level of familiarity with the Common Core Standards for Mathematics **(CCSS-Mathematics)**.
Very Familiar (22%) Somewhat Familiar (67%) Slightly Familiar (10%) Not Familiar (1%)
Please rate your overall level of familiarity with your state/district academic standards in mathematics **prior** to the CCSS-Mathematics.
Very Familiar (29%) Somewhat Familiar (52%) Slightly Familiar (11%) Not Familiar (8%)
To what extend do you agree or disagree with the following statement?
The CCSS-Mathematics is different than my previous state/district academic standards in mathematics.
Strongly Agree (10%) Agree (53%) Disagree (15%) Strongly Disagree (4%) I Don't Know (18%)
Have you received any professional development or training related to the CCSS-Mathematics?
Yes (75%) No (25%)
Approximately how much time, overall, have you spent in professional development or training on the CCSS-Mathematics?
Less than 1 day (18%) 1 day (8%) 2– 3 days (30%) 4–5 days (15%) More than 5 days (29%)
Please indicate how the CCSS-Mathematics professional development and training you have received has been provided. Check all that apply.
Collaborative planning time with colleagues (54%)
Structured, formal setting (seminars, workshops, conferences) (13%)
Job embedded training or coaching (10%)
Professional Learning Communities (13%)
Online webinar or video (10%)
Other (0%)
To what extent do you agree with the following statement? Overall, my professional development and training on the CCSS-Mathematics have prepared me to teach the CCSS-Mathematics.
Strongly Agree (7%) Agree (65%) Disagree (20%) Strongly Disagree (2%) I Don't Know (6%)
On a 5-point scale (where 5 is "very prepared" and 1 is "not prepared at all"), how prepared are you to teach the CCSS-Mathematics to the following groups of student?
Your whole class (Mean Score = 4.1, Standard Deviation = .74)
ELL students (Mean Score = 3.6, Standard Deviation = .92)
Students with disabilities (Mean Score = 2.8, Standard Deviation = 1.10)
Low-income students (Mean Score = 3.8, Standard Deviation = .89)
Academically at risk students (Mean Score = 3.6, Standard Deviation = .80)

> same boat that we are because they don't know either. But, this is an area that's going to have to be addressed if the implementation of this program is going to be successful (Participant #2, Interview, 12/2/2013)

Teachers proffered professional development should involve: "modeling of lessons" (Participant #15, Questionnaire, 11/22/2013) "unpacking the standards" (Participant #63, 11/22/2103), and understanding differences between "same lesson taught using CCSS-Mathematics and not CCSS-Mathematics" (Participant # 49, Questionnaire, 11/22/2013).

In addition, when considering preparation, teachers had varied responses based on different groups of students (see Table 1). On the item, "On a 5-point scale (where 5 is "very prepared" and 1 is "not prepared at all"), how prepared are you to teach the CCSS-Mathematics to the following groups of students?", teachers felt least prepared to teach students with disabilities (mean score = 2.8, standard deviation = 1.10) and most prepared to teach low-income students (mean score = 3.8, standard deviation = .89). The interview and questionnaire data show preparation for teaching varying groups of students was a concern, with a teacher asserting, "I don't necessarily feel that I am prepared to successfully reach all of my students and prepare them for math understandings" (Participant #4, Interview, 12/03/2013).

Table 2

Survey Items with Responses Related to Implementation of the Standards: Incorporation and Teacher Change

To what extent have you incorporated the CCSS-Mathematics into your classroom teaching practice?
Fully incorporated into my teaching (57%)
Incorporated into some areas of my teaching, but not others (39%)
Not at all incorporated into my teaching (1%)
I don't know (3%)
To what extent have you incorporated the following Standards for Mathematical Practice in the CCSS-Mathematics into your classroom teaching practice?
a. Make sense of problems and persevere in solving them (Fully = 40%)
b. Use appropriate tools strategically (Fully = 56%)
c. Construct viable arguments and critique the reasoning of others (Not at all = 70%)
d. Look for and make use of structure (Not at all = 56%)
To what extent do you agree or disagree with the following statement?
The CCSS- Mathematics requires me to do things differently as a teacher of mathematics.
Strongly Agree (26%) Agree (47%) Disagree (17%) Strongly Disagree (0%) I Don't Know (10%)
To what extent do you agree or disagree with the following statement?
The CCSS- Mathematics requires me to change my classroom teaching practice.
Strongly Agree (17%) Agree (53%) Disagree (21%) Strongly Disagree (4%) I Don't Know (5%)

Implementation of the Standards: Incorporation and Teacher Change

When considering implementation of the standards, the data reveal two subthemes: incorporation into teaching practices and changes in teaching practices. On the item, "To what extent have you incorporated the CCSS-Mathematics into your classroom teaching practice?," 39% of teachers indicated incorporation into some areas of teaching but not other areas, while 57% reported full incorporation into teaching (see Table 2). Teachers were also asked about their incorporation of the eight Standards for Mathematical Practice into their classroom instruction. The data show the two most included as: "Make sense of problems and persevere in solving them" (40% of teachers fully incorporate) and "Use appropriate tools strategically" (56% of teachers fully incorporated). The least incorporated were: "Construct viable arguments and critique the reasoning of others" (70% of teachers not incorporate at all) and "Look for and make sure of structure" (56% of teachers not incorporate at all).

In regard to implementation, teachers reported the new standards necessitate a change in their instruction (see Table 2). For example, 73% strongly agreed or agreed the standards require them "to do things differently as a teacher of mathematics." On a similar item, 70% strongly agreed or agreed the standards require them "to change their classroom teaching practice." Threaded across statements about changing teaching practices is the placement of students at the center—valuing and emphasizing students' thinking, reasoning, representation, and explanation, with less teacher direction. Reported changes in instruction include: "moving away from teaching a standard algorithm to having the students explain their work, and they're working more with manipulatives and coming up with models" (Participant #1, Interview, 12/2/2013), and "It's [CCSS-Mathematics] so much more in-depth. And, it's definitely trying to get them to do, not just like know, for instance, the formula for area, but all the different ways to get area" (Participant #5, 12/4/2013). A teacher described her changes in instruction as: "We didn't have discussions. It was more so, it's wrong… Where now, I'm like, how they did get that, and they can explain it" (Participant #2, Interview, 12/2/2013). Similarly, another teacher described her shift in teacher practice as:

> More student-centered than teacher-related. . . I've had to back up a little bit because the students are kinda exploring and finding different strategies to use. So, that's a different practice for me. I kinda want to give them something but have to back off and say well, if that strategy worked for them or they're finding strategies that maybe I didn't know, then I give them the freedom to explain or teach it to the class. (Participant #3, Interview, 12/4/2013)

This shift away from teacher as central during instruction is also described as, "It's not just giving them a concept. I'm more giving them ideas, where I don't teach them. If that makes sense" (Participant # 5, Interview, 12/4/2013), and "Now they're the owner of what is being said, which a lot of that wasn't given to us. I enjoy it more because I have given more responsibility to the child and not to myself" (Participant #6, Interview, 12/3/2103). Interestingly, though the teachers clearly emphasize student explanation, of the eight mathematical practices, "construct viable arguments and critique the reasoning of others," was reported as the least incorporated. Perhaps lacking when students are explaining their mathematical thinking is the critique of their peers, which none of the teachers mentioned.

Tensions Associated with the New Standards

The teachers identified tensions with their perceptions of the new standards and implementation of them. Almost all teachers believed the standards would improve their instruction and benefit student learning. Coupled with these affordances, they identified several challenges for enactment, and these competing affordances and constraints generated tensions for teachers, that are characterized as either teacher-oriented or student-oriented.

Tension #1: Affordances for teachers and teaching-oriented constraints. The teachers believed the new standards would make them better teachers of mathematics. On the item, "To what extent do you agree or disagree with the following statement? The CCSS-Mathematics will help me improve my classroom teaching practice," 83% of teachers strongly agreed or agreed (see Table 3). A teacher asserted, "It feels like to me that the new standards are just good teaching." However, the teachers identified several instruction-oriented constraints with incorporating them into classroom practices. These tensions can be linked to lack of "mathematical knowledge for teaching" (MKT) and inadequate curriculum materials.

MKT is multifaceted and includes in part "common content knowledge" of mathematics and "specialized content knowledge" (SCK) for teaching mathematics (Hill & Ball, 2009). The teachers identified a struggle with the mathematics in the new standards, describing a difficulty they were facing as limited content knowledge. Sample interview comments include: "One area I struggled with was math, even when I went to college it was my worst subject and now with the CCSS-Mathematics standards I have to go deeper, and I do not feel comfortable" (Participant #3, Interview, 12/4/2013); and "I am having to relearn math to be able help my students" (Participant #27, Questionnaire, 11/22/2013). The teachers also identified a struggled with what has been described as SCK for teaching mathematics. The SCK for teaching mathematics includes, in part, teachers' abilities to analyze and interpret students' mathematical thinking and ideas and use multiple representations of mathematical concepts (Hill, 2010; Thames & Ball, 2010). Teachers' struggling to understand, interpret, and respond to children's invented solution strategies was a common expression. For

Table 3
Survey Items with Responses Related to Tensions Associated with the New Standards

To what extent do you agree or disagree with the following statement? The CCSS- Mathematics will help me improve my classroom teaching practice. Strongly Agree (30%) Agree (53%) Disagree (7%) Strongly Disagree (0%) I Don't Know (10%)
To what extent do you agree or disagree with the following statement? The CCSS-Mathematics requires new or substantially revised curriculum materials and lesson plans. Strongly Agree (18%) Agree (60%) Disagree (14%) Strongly Disagree (0%) I Don't Know (8%)
To what extent do you agree or disagree with the following statement? The CCSS-Mathematics will improve mathematics education in the U.S. Strongly Agree (26%) Agree (47%) Disagree (7%) Strongly Disagree (1%) I Don't Know (19%)
To what extent do you agree or disagree with the following statement? The CCSS-Mathematics is more of a positive step than a negative step in mathematics education in the U.S. Strongly Agree (29%) Agree (49%) Disagree (3%) Strongly Disagree (0%) I Don't Know (19%)
To what extent do you agree or disagree with the following statement? The CCSS-Mathematics will improve my students' learning. Strongly Agree (34%) Agree (44%) Disagree (6%) Strongly Disagree (0%) I Don't Know (16%)
On a 5-point scale (where 5 is "very prepared" and 1 is "not prepared at all"), how prepared do you think your students are to master the CCSS-Mathematics? Mean Score = 3.2, Standard Deviation = .89

example, a teacher described her challenge to understand her students' reasoning as, "And half the time, I've seen something, I'm like, 'How did you do that?' And, then I have to look at it, and I'm like, 'Oh, okay'" (Participant # 5, Interview, 12/4/2013), and another reported, "I had a hard time conceptualizing how different thinkers think different ways. In the hardest part of my lesson I was trying to connect all those different ways of learning and the way that different thinkers think. As I think about math in a very different way than Johnny or Billy Bob might" (Participant #1, Interview, 12/2/2013).

Another constraint identified by the teachers was a lack of resources, specifically curricular resources, aligned with the new standards (see Table 3). The teachers recognized the need for changes in their resources, as 78% strongly agreed or agreed that the CCSS-Mathematics requires "new or substantially revised curriculum materials and lesson plans." In addition, of the options that would help teachers to be better prepared to teach the new standards, 44% of them reported "access to curricular materials aligned to the standards." The interview and questionnaire data support this, as a teacher declared:

> Teachers have not been given any curriculum materials, anything that aligns with the standards, and there really isn't much out there that is aligned. . . So, the challenge here is that teachers like myself are doing the best we can to learn these new standards. Not only are we having to learn new standards, but we are having to create everything we are doing and hoping that we are understanding. (Participant #2, Interview, 12/2/2013)

Another teacher stated, "The people making the decisions need to know that teachers need to be given support and resources if they are going to change the standards. And, we can't fix bad teaching by changing the standards" (Participant #4, Interview, 12/3/2013), with another reporting, "[I am] having to find [curriculum resources] and create a lot" (Participant #43, Questionnaire, 11/22/2013).

Tension #2: Affordances for students and student-oriented constraints. During this key time of transition to the CCSS-Mathematics, the teachers largely held a positive view of the new standards, with notable beliefs about the benefits for students and their learning. The teachers by and large believed the CCSS-Mathematics provides a positive direction for mathematics education in general. For example, on the item "The CCSS-Mathematics will improve mathematics education in the U.S.," 73% strongly agreed or agreed, with 19% reporting "I Don't Know" (see Table 3). On a similar item, "The CCSS-Mathematics is more of a positive step than a negative step in mathematics education in the U.S.," 78% strongly agreed or agreed, with 19% indicating "I Don't Know." Further, the teachers perceived the new standards to be of benefit to their own students. For example, on the item, "The CCSS-Mathematics will improve my students' learning," 34% strongly agreed and 44% agreed, though 16% reported "I Don't Know."

The interview and survey data offer confirmation for and insights into the teachers' perceptions of the benefits for students. The teachers appreciate the emphasis in the new standards on mathematics as a sense-making activity, including a focus on conceptual understanding, explanation and justification, and connections. For example, a teacher asserted, "I think that it's preparing them to be better thinkers when it comes to math" (Participant #4, Interview, 12/3/2013), with another stating, "I call them [students] microwaves because they want the answer now, but Common Core forces them to work it out and really just dig into it. . . It will have a great impact on deepening their knowledge and really getting them to understand why math is math" (Participant #2, Interview, 12/2/2013). Another teacher elaborated:

> It will help students' learning because instead of just telling them to do it, they know why they're doing it. Why it's important. When things become more meaningful, it seems more real to them and their brains can connect the concepts better than when they are just memorizing. . . This is why the area formula is what it is. And, wondering things like perimeter or area and how they can connect and see how it all works together. It's not all isolated incidents that have no meaning in relation to each other. . . Students have to be able to explain why math is the way that it is. Students have to explain why formulas are the way they are. Students can explain why we do math the way that we do and not just use rote memorization to solve problems. I really like how it's supposed to make students think more critically. (Participant #6, Interview, 12/3/2013)

Though teachers believed in the value and emphasis of the new standards for students, there were student-related constraints for enactment that generated tensions for teachers, including lack of student readiness and a perceived mismatch of the standards with English Language Learners (ELLs). The teachers believed students were not ready for the new standards, with gaps in content and skills linked with past ways of learning mathematics. When considering student preparation to learn the standards, on a scale of 5 as "very prepared" and 1 as "not

prepared," the findings reveal a mean score of 3.2, thus the perception that students had mediocre preparation (see Table 3). One teacher aptly stated, "It's almost like we're going back, undoing and unteaching what they have been taught" (Participant #1, Interview, 12/2/2013). Another declared, "A lot of my students have been working with algorithms for the most part since they have been in school. It's difficult to try to go back and teach them really why the algorithm works, just understanding why they're doing it" (Participant #4, Interview, 12/3/2013). Another teacher elaborated on the struggles of students with providing explanations:

> Students have a hard time explaining how they got the answer. They just say things like I know that $3 + 3 = 6$... It's hard for them to grasp the words to communicate what they understand. They have been so used to just memorizing facts it's very confusing for them. Students have to able to do it and explain their thinking as opposed to just answering or recalling facts. (Participant #3, Interview, 12/4/2013).

One teacher identified particular challenges with students in the upper grades, as she noted that with younger children:

> It's easier because you're teaching them what we would consider the proper way and they can go from there... The higher the grade level the harder it will be because they've learned a certain way and now they have to learn a new way... Because they have to go backwards, it tends to frustrate them. (Participant #6, Interview, 12/3/2013)

This teacher went on to propose a phasing in of the CCSS-Mathematics, starting with the primary grades: "A line should have been drawn to like, okay, phase one, implement K–2 and then phase two, 3–5, instead of everybody getting it at the same time. Instead of boom, you're in 5th grade, but you need to learn how to do this."

In addition, the teachers had salient concerns about the mismatch of the CCSS-Mathematics with the needs of ELLs. When asked about their preparation to teach the new standards to different groups of students, ELLs had the second to lowest mean score. This school in particular has a large ELL population, and teachers voiced concerns with the emphasis on communication and explanation in the new standards that would pose challenges for students: "Out of my 29 students, I have 26 ELLs, and it's very challenging for them... Definitely with the Common Core, across the board it is always explaining why" (Participant #1, Interview, 12/2/2013). Teachers also lamented multi-step tasks or word problems involving several parts that require higher levels of reading comprehension from ELLs, with one teacher asserting she has "learned to break the tasks or the activities down for them, and I find that works" (Participant #2, 12/2/2013)

Discussion and Implications

The findings of this study provide insights into the experiences of a specific group of elementary teachers transitioning to the CCSS-Mathematics and offer considerations for ways of supporting teachers; the results also confirm, extend, and challenge the extant literature. Notably, the teachers in this study held decidedly positive views on the standards. They believed the standards are a positive step and improvement for mathematics education in the U.S. If the intent of the CCSS-Mathematics is actualized, for the first time students across the U.S. in grades K–8 will have generally been taught the same content (Schmidt & Burroughs, 2013). It has been argued this common content will help address two persisting problems in the U.S.: middling quality of mathematics learning and unequal opportunity in schools. With only 26% of 12th grade students in the U.S. reaching the threshold for proficiency in mathematics on the National Assessment of Educational Progress (National Center for Education Statistics, 2010), the need to improve educational quality was a chief impetus for the CCSS initiative. The new standards are intended to be of high quality, helping to increase and level expectations for students in states with previous standards of lesser quality, while addressing inequalities in the opportunity to learn challenging mathematics content (Schmidt & Burroughs, 2013).

The teachers' optimism about the new standards was not exclusive to the national scale, they also believed the standards improve their own teaching of mathematics and benefit their own students' learning, with this perspective linked in part with the emphasis on mathematics as a sense-making activity. This optimism is remarkable, considering this is the third set of academic standards for K–12 education in this state across the past 10 years, as one teacher lamented:

> We have had three or four sets of standards and each time we are told these will be around for a long time only to see them changed every few years. This can be very frustrating for teachers... We have many really great teachers that have been teaching for a long time, and they are feeling overwhelmed with another change. This is unfortunate because I think the new standards

> are potentially good, but many teachers are just so tired of changing. (Participant #2, Interview, 12/2/2013).

Despite this revolving door of standards, such a hopeful view about the new standards can go a long way with adequate teacher preparation and aligned curricular resources—of which, in general, teachers in this study seemed to need more. In addition, allowing *time* for teacher change is crucial, particularly with the uncertainty about forthcoming assessments, and the rapidly approaching time (i.e., year 3) for when assessment scores are consequential, which was perceived as premature by these teachers. And, though the teachers called for more professional learning, they generally held a degree of familiarity with the new standards and most recognized that the new standards are different from the previous standards. Others have argued this not to be the case for many teachers and therefore a challenge for CCSS-Mathematics implementation, as a number of teachers believe the new standards are the same as their preceding ones (Schmidt & Houang, 2012). Fortunately, this was not the case for the teachers in this study.

Several constraints, both teaching- and student-oriented in nature, were identified by the teachers. As suggested in the literature (Schmidt, 2012), content knowledge, particularly SCK, was a barrier for enactment. Teachers struggled to understand, interpret, and respond to children's thinking and invented solution strategies. The importance of well-developed SCK is key. When teachers encounter an unexpected response or thinking strategy from students, teachers must make an instant decision about its soundness and significance and choose their response accordingly. The true success of the implementation of the CCSS-Mathematics will be determined in the countless minute-by-minute decisions that teachers are making during instruction so that they capitalize on teachable moments in ways that support students' mathematical understanding and reasoning (Griffin & Ward, 2014). Professional development should prepare teachers for this continuous act of decision-making in a way that is responsive to and builds on children's thinking and understandings (Philipp, 2008; Philipp et al., 2007). Analyzing and interpreting students' mathematical thinking and ideas, a key component of SCK (Hill, 2010; Thames & Ball, 2010), should be a central component of professional learning focused on the CCSS-Mathematics.

The teachers also had significant concerns about teaching certain groups of students the new standards. At the school, 95% of students are eligible for free or reduced lunches, and the teachers felt most prepared to teach low-income students, which characterizes a large portion of their student body. The survey data show they felt least prepared to teach students with mathematics disabilities. This concern is voiced in the literature by others who contend that teaching the content-rich standards can be daunting: research shows that students with varying levels of mathematics disability often lack the most basic mathematics skills (Mulcahy, Maccini, Wright, & Miller, 2014; Powell, Fuchs, & Fuchs, 2013; Saunders, Bethune, Spooner, & Browder, 2013). It has been proposed that students with mathematical disabilities should learn skills aligned with their grade level content in the CCSS-Mathematics, while continuing to work on foundational skills such as knowledge of numbers, counting, number combinations, and operations needed to complete many mathematics problems.

Additionally, the teachers voiced concerns about the perceived mismatch of the CCSS-Mathematics with the needs of ELLs, whom are prevalent at this school. However, the literature asserts the CCSS-Mathematics affords opportunities for language development, that is, ELLs can produce explanations and presentations and participate in classroom discourse as they are learning English. Specifically, mathematics instructions for ELLs should:

> 1) treat language as a resource, not a deficit, 2) address much more than vocabulary and support ELLs' participation in mathematical discussions as they learn English, and 3) draw on multiple resources available in classrooms—such as objects, drawings, graphs, and gestures—as well as home languages and experiences outside of school (Moschkovich, 2012, p. 18)

Further, regular and active participation—not only reading and listening but also discussing, explaining, writing, representing, and presenting—is critical to the success of ELLs in mathematics (CCSS, 2015). In general, the findings of this study suggest the implications of the new standards for all students, particularly those with specific or special learning needs, must be considered and addressed.

Lack of student readiness was also a concern, linked with students' past experiences as learners of mathematics. In general, student explanation was one such challenge, with teachers needing support for ways of orchestrating classroom discourse in mathematics. Mathematics discourse, particularly the practice of students reasoning aloud or explaining their thinking, is often a new experience for students in classrooms that emphasize communication of mathematical thinking. Socialization into this type of learning environment often takes considerable time for some students as they adjust to revised classroom norms amenable to rich discourse (Hufferd-Ackles, Fuson, & Sherin, 2004; Yackel & Cobb, 1996).

In sum, the findings of this study illuminate the realities of CCSS-Mathematics implementation for this group of elementary teachers, revealing tremendous potential for positive change provided by the new standards and accompanying barriers. As teachers are ultimately the deciding factors on how the standards play out in classrooms, this close study of their perspectives provides insights into ways of better equipping them for teaching the standards and in turn benefiting students' learning. Certainly, aligned curricular resources and relevant professional development are vital. The findings of this study suggest that for teachers to be better prepared to teach the CCSS-Mathematics, professional learning should focus on: building mathematical knowledge for teaching; developing abilities to interpret, analyze, and respond to children's thinking; learning ways of facilitating productive classroom discourse in mathematics; and addressing the needs of a variety of learners via the CCSS-Mathematics, particularly ELLs and students with mathematics disabilities. The teachers in this study suggested observations of enacted CCSS-Mathematics aligned lessons, plus time spent unpacking the new standards, as particularly useful. The CCSS-Mathematics has much to offer students, teachers, schools, and mathematics education in general, and now is the time to provide teachers crucial preparation and support to assure success of the new standards.

A Research to Practice article based on this paper can be found alongside the electronic version at http://wileyonlinelibrary.com/journal/ssm.

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Appendix A: Survey

Please answer the following questions.

1. Do you currently teach mathematics?
   ☐ Yes ☐ No
2. What is your gender?
   ☐ Female ☐ Male
3. What grade level do you currently teach? Check all the grade level bands that apply.
   ☐ Kindergarten-2nd grades ☐ 3rd–5th grades
   ☐ Other (please indicate):
4. How many years have you been a classroom teacher?
   ☐ 0–5 years ☐ 6–10 years ☐ 11–20 years ☐ over 21 years
5. What is your highest level of educational attainment?
   ☐ Bachelor's Degree ☐ Master's Degree
   ☐ Educational Specialist Degree ☐ Doctoral Degree

For the following questions, please think about the new AKS in Mathematics adopted this school year that are based on the Common Core State Standards for Mathematics (CCSM-Mathematics), which are called the Common Core Georgia Performance Standards in Georgia.

1. Please rate your overall level of familiarity with the Common Core Standards for Mathematics (**CCSS-Mathematics**).
   ☐ Very Familiar ☐ Somewhat Familiar
   ☐ Slightly Familiar ☐ Not Familiar
2. Please rate your overall level of familiarity with your state/district academic standards in mathematics prior to the CCSS-Mathematics.
   ☐ Very Familiar ☐ Somewhat Familiar
   ☐ Slightly Familiar ☐ Not Familiar
3. To what extent do you agree or disagree with the following statement?
   My curricular materials are aligned with the CCSS-Mathematics.
   ☐ Strongly Agree ☐ Agree ☐ Disagree
   ☐ Strongly Disagree ☐ I Don't Know
4. Have you received any professional development or training related to the CCSS-Mathematics?
   ☐ Yes ☐ No
5. Approximately how much time, overall, have you spent in professional development or training on the CCSS-Mathematics?
   ☐ Less than 1 day
   ☐ 1 day
   ☐ 2 to 3 days
   ☐ 4 to 5 days
   ☐ More than 5 days
6. Please indicate how the CCSS-Mathematics professional development and training you have received has been provided. Check all that apply.
   ☐ Collaborative planning time with colleagues
   ☐ Structured, formal setting (seminars, workshops, conferences)
   ☐ Job embedded training or coaching
   ☐ Professional Learning Communities
   ☐ Online webinar or video
   ☐ Other (please indicate): _____
7. To what extent do you agree with the following statement? Overall, my professional development and training on the CCSS-Mathematics have prepared me to teach the CCSS-Mathematics.
   ☐ Strongly Agree ☐ Agree ☐ Disagree
   ☐ Strongly Disagree ☐ I Don't Know
8. On a 5-point scale (where 5 is "very prepared" and 1 is "not prepared at all"), how prepared are you to teach the CCSS-Mathematics to the following groups of student?

	5	4	3	2	1
Your whole class	☐	☐	☐	☐	☐
ELL students	☐	☐	☐	☐	☐
Students with disabilities	☐	☐	☐	☐	☐
Low-income students	☐	☐	☐	☐	☐
Academically at-risk students	☐	☐	☐	☐	☐

9. Which of the following would help you feel better prepared to teach the CCSS-Mathematics? Check all that apply.
   ☐ Information about how the standards will change my instructional practice
   ☐ Information about how the standards will change expectations for the students
   ☐ Access to curricular materials aligned to the standards
   ☐ Access to assessment aligned to the standards
   ☐ More planning time
   ☐ More time for collaboration with colleagues
   ☐ More information about how the CCSS-Mathematics are different than previous standards
   ☐ Other (please indicate): _____

10. On a 5-point scale (where 5 is "very prepared" and 1 is "not prepared at all"), how prepared do you think your students are to master the CCSS-Mathematics?

    5 (very prepared) ☐ 4 ☐ 3 ☐ 2 ☐ 1 (not prepared at all) ☐

11. To what extent have you incorporated the CCSS-Mathematics into your classroom teaching practice?
    ☐ Fully incorporated into my teaching
    ☐ Incorporated into some areas of my teaching, but not others
    ☐ Not at all incorporated into my teaching
    ☐ I don't know
12. To what extent have you incorporated the following eight Standards for Mathematical Practice in the CCSS-Mathematics into your classroom teaching practice?
    a. Make sense of problems and persevere in solving them
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    b. Reason quantitatively and abstractly
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    c. Construct viable arguments and critique the reasoning of others
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    d. Model with mathematics
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    e. Use appropriate tools strategically
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    f. Attend to precision
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    g. Look for and make use of structure
       ☐ Fully ☐ Partially ☐ Not at all
       ☐ I Don't Know
    h. Look for and express regularity in repeated reasoning
       ☐ Fully ☐ Partially ☐ Not at all ☐ I Don't Know
13. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics requires me to do things differently as a teacher of mathematics.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
14. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics will improve my students' learning.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
15. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics will improve mathematics education in the U.S.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
16. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics will help me improve my classroom teaching practice.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
17. To what extend do you agree or disagree with the following statement?
    The CCSS-Mathematics is different than my previous state/district academic standards in mathematics.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
18. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics requires me to change my classroom teaching practice.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
19. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics requires new or substantially revised curriculum materials and lesson plans.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
20. To what extent do you agree or disagree with the following statement?
    The CCSS-Mathematics is more of a positive step than a negative step in mathematics education in the U.S.
    ☐ Strongly Agree ☐ Agree ☐ Disagree
    ☐ Strongly Disagree ☐ I Don't Know
21. To what extent do you agree or disagree with the following statement?

The CCSS-Mathematics requires me to change how I plan for teaching.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ I Don't Know

22. Overall, how would you rate the quality of the CCSS-Mathematics relative to your state/district academic standards in mathematics prior to the CCSS-Mathematics?

☐ CCSS-Mathematics is of higher quality.

☐ CCSS-Mathematics and previous standards are about the same quality.

☐ Previous standards are of higher quality.

☐ I don't know.

Appendix B: Open-Ended Questionnaire/Interview Protocol

For the following questions, please think about the new AKS in Mathematics adopted this school year that are based on the Common Core State Standards for Mathematics (CCSM-Mathematics), which are called the Common Core Georgia Performance Standards in Georgia.

1. Is the CCSS-Mathematics requiring you to change as a teacher of mathematics? If so, how? If not, why?
2. How do you think the CCSS-Mathematics will impact your students' learning?
3. Have you made changes in your classroom planning as a result of the CCSS-Mathematics? If so, how? If not, why?
4. Have you made changes in your classroom teaching practice as a result of the CCSS-Mathematics? If so, how? If not, why?
5. Tell me some things you like about the CCSS-Mathematics and why. Tell me some concerns you have about the CCSS-Mathematics and why.
6. What would help your understanding and implementation of the CCSS-Mathematics?
7. In general, do you believe the CCSS-Mathematics will improve mathematics education in the U.S.? If so, how? If not, why?
8. Anything else you want to add about the CCSS-Mathematics?