A MIXED METHODS STUDY OF ELEMENTARY TEACHERS' EXPERIENCES WITH AND PERSPECTIVES ON THE CCSS-MATHEMATICS

Susan Lee Swars
Georgia State University
sswars@gsu.edu

Cliff Chestnutt
Georgia State University
cchestnutt2@student.gsu.edu

This mixed methods study explored elementary teachers' (n=73) experiences with and perspectives on the newly implemented CCSS-Mathematics at a high-needs, urban Professional Development School in a state where roll-out of the standards has been fraught with opposition. 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 and also add to the scant research in this area.

Keywords: Elementary School Education; Instructional Activities and Practices; Policy Matters; Teacher Knowledge

Purpose

As a means of improving the mathematics education of students in the U.S., teachers in 43 states are now expected to utilize the academic standards of the Common Core State Standards for Mathematics (CCSS-Mathematics) in their daily classroom instruction (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). Ultimately, the difficulty of transitioning to the CCSS-Mathematics lies in putting the standards into classroom practice, with teachers having control over how this will play out (Dacey & Polly, 2012).

For the state in which this study was conducted, the roll out of the CCSS-Mathematics was and continues to be fraught with uncertainty and opposition, contributing to a general climate of anxiety and unrest for teachers. Given this challenging context, coupled with the widespread acceptance of the CCSS-Mathematics across the U.S., careful scrutiny of these new standards is warranted. As teachers are the ultimate force on how these standards are implemented in classrooms, a close study of their perspectives is needed, particularly in light of the scant research in this area. Accordingly, this mixed methods study explored teachers' experiences with and views on the newly implemented CCSS-Mathematics, including awareness of and preparation to use the standards, integration of the standards into classroom teaching practice, and tensions associated with the standards, including affordances and constraints linked with enactment. This study adds to the much needed research base and also provides insights into the professional needs of teachers during this critical time of transition to the CCSS-Mathematics.

Related Perspectives

The CCSS-Mathematics represents a major overhaul of the standards previously used in most states adopting these new standards. The standards include 11 critical areas of mathematics for grades K-8 in order to provide a coherent and focused curriculum built around big ideas (CCSS-Mathematics, 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 follow a

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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 current 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. Given these significant shifts proposed by the CCSS-Mathematics, its introduction will require a significant revamping of mathematics education in many schools (Schmidt & Houang, 2012).

Whether or not K-12 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 and therefore calls into question their readiness for implementing these standards. 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 content as their state's previous standards and this lack of awareness poses significant difficulties. Further, 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), highlighting some of the necessary teacher competencies for teaching the CCSS-Mathematics.

Method

This descriptive study used a mixed methods research design, with data collection occurring via a survey, open-ended questionnaire, and individual interviews. Specifically, a "concurrent triangulation" (Creswell, Clark, Gutmann, & Hanson, 2003, p. 223) approach to mixed methods was used, which implies: (a) concurrent collection of quantitative and qualitative data, (b) equal prioritization of quantitative and qualitative data, and (c) integration during the analysis and interpretation phases. Both types of data were collected in an attempt to cross-validate findings within a single study.

Participants and Context

This study involved 73 teachers at a large, urban elementary school in the southeastern U.S. The school had partnered as a Professional Development School (PDS) with the researchers' University since 2005. During data collection, teachers reported demographic information, which reveals years of teaching experience ranged from 40% with 5 years or less, 25% with 6 to 10 years, and 35% with more than 10 years. The educational background of the teachers includes 68% with at least a Master's degree. The PDS perpetually faces challenges associated with a high rate of teacher turnover and also student mobility. With regard to student demographic information, the PDS is a Title I school with 95% of the students eligible for free or reduced lunch at the time of the study. The student population was highly 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. In

2002, this school was removed from the state's failing schools list and has achieved adequate yearly progress (AYP) goals for the subsequent years.

The PDS relationship included a close partnership between the University and elementary school focused on: improving the preparation of new teachers, enhancing faculty development, inquiry directed at improved practice, and increasing student achievement; one of the researchers had done significant work at the PDS across the past 8 years supporting these goals. Given this sustained, collaborative partnership, there was ready entry for this research project, as well as established rapport and trust between the researchers and PDS teachers.

At the time of data collection, the teachers were mid-way into their second year of implementation of the CCSS-Mathematics. The department of education for the state in which the PDS is located adopted the standards in 2010, and the roll-out included 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 (doe.k12.ga.us, 2014).

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 and at the PDS site.

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, 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 Common Core. 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.

After completing the survey, all participants completed the open-ended questionnaire intended to illuminate the survey items; the questionnaire contains eight multi-part questions. Six randomly selected teachers participated in individual, semi-structured interviews, and the interview protocol was identical to the open-ended questionnaire. The interviews ranged from 30 minutes to 1 hour in duration.

Data Analysis

Data from the surveys were analyzed using individual response analysis by examining the scores for each item; data from the interviews and open-ended questionnaires were analyzed using constant comparative methodology (Lincoln & Guba, 1985). Specifically, the researchers individually analyzed the qualitative data through line-by-line open coding which generated numerous categories. Categories represented observed phenomenon found in the data (Strauss & Corbin, 1998). Researchers met and discussed the categories to reach consensus on meanings related to the categories. This discussion and analysis of all interview and questionnaire data resulted in a coding manual representing the relationships within codes. The researchers then engaged in data reduction by recoding interviews and questionnaires using the coding manual for guidance in comparing and refining codes. Coded categories were collapsed and renamed until themes were identified. The

analysis of the survey data was triangulated with the themes from the qualitative data sources, resulting in final themes on teachers' experiences with and perspectives on the CCSS-Mathematics.

Results

Familiarity with and Preparation to Use the Standards

Teachers reported relative familiarity with the CCSS-Mathematics. 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. And, though mid-way thru the second year of implementation of the CCSS-Mathematics, 25% reported no professional development on the standards. Of the 75% indicating professional development experiences, 56% reported three days or less, while 29% indicated over five days. When asked to describe the format, teachers indicated the most frequent as "collaborative planning time with colleagues", with the next two frequent as "structured, formal setting (seminars, workshops, conferences)" and "Professional Learning Communities". 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 qualitative data illuminated these data, and notably there was an emphatic call for more professional development:

> 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 be 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 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.

Teachers proffered professional development should involve: "modeling of lessons", "unpacking the standards", and understanding differences between "same lesson taught using CCSS-Mathematics and not CCSS-Mathematics".

In addition, when considering preparation, teachers had varied responses based on different groups of students. Mean scores reveal teachers felt least prepared to teach students with disabilities and most prepared to teach low-income students. The qualitative data show preparation for teaching varying groups of students as a concern: "I don't necessarily feel that I am prepared to successfully reach all of my students and prepare them for math understandings."

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% indicated incorporation into some areas of teaching but not other areas, while 57% reported full incorporation into teaching. 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" and "Use appropriate tools strategically". The least incorporated were: "Construct viable arguments and critique the reasoning of others" and "Look for and make sure of structure".

In regard to implementation, teachers reported the new standards necessitate a change in their instruction. For example, 73% strongly agreed or agreed the standards require them "to do things

differently as a teacher of mathematics". On a similar item, 68% strongly agreed or agreed the standards necessitate them "to change their classroom teaching practices". Threaded across statements about changing teaching practice is the placement of students at the center—valuing and emphasizing students' thinking, reasoning, representation, and explanation, with less teacher direction. Reported changes 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"; "It's 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". 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." 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 kind of 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.

This shift away from teacher as central during instruction is also described as, "Now they're the owner of what is being said. . . I enjoy it more because I have given more responsibility to the child." Interestingly, teachers reported more inclusion of student explanation, but of the eight Standards for Mathematical Practice, the one focusing on students constructing arguments was reported on the survey as the least incorporated.

Tensions Associated with the New Standards

The teachers identified tensions with their perceptions of the new standards and enactment. The teachers overwhelmingly believed the standards would improve their instruction and benefit student learning. But, they identified several challenges for implementation, and these competing affordances and constraints generated tensions for teachers.

Tension #1: Affordances for Teachers and 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% strongly agreed or agreed. A teacher stated, "I feels like to me that the new standards are just good teaching." However, the teachers identified several constraints with incorporating them into classroom teaching practices. These tensions can be linked to: lack of *mathematics knowledge for teaching* (MKT) and inadequate curriculum materials.

Mathematical knowledge for teaching (MKT) is multi-faceted and includes in part common content knowledge and SCK for teaching mathematics (Hill & Ball, 2009). The teachers identified a struggle with the mathematical content in the new standards. Sample interview comments include: "One area I struggled with was math. . . now with the CCSS-Mathematics standards I have to go deeper, and I do not feel comfortable;" and "I am having to relearn math to be able help my students." The teachers also reported a struggled with what has been defined as SCK for teaching mathematics, which includes in part, teachers' abilities to analyze and interpret students' mathematical thinking and ideas. Teachers' struggling to understand children's invented solutions strategies was commonplace, as a teacher stated, "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," and with another reporting, "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."

Another constraint identified by the teachers was a lack of curricular resources aligned with the new standards. The teachers recognized the need for changes in their curriculum, as 88% 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, one of the top choices (44%) was "access to curricular materials aligned to the standards". The qualitative data supported this: "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."

Tension #2: Affordances for Students and Constraints. The teachers largely held a positive view of the new standards, with notable beliefs about the benefits for students and their learning. They believed the CCSS-Mathematics provides a positive direction for mathematics education, as 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". On a similar item, "The CCSS-Mathematics is more of a positive step than a negative step in mathematics education in the U.S.", 80% 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, as on the item, "The CCSS-Mathematics will improve my students' learning", 34% strongly agreed and 44% of agreed, though 16% reported "I Don't Know".

The interview and survey data offer insights into benefits for students. The teachers appreciated 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," 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." Another teacher stated:

> 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.

Though teachers believed in the value and emphasis of the new standards for students, there were associated constraints related to enactment that generated tensions for teachers, including lack of student readiness and a perceived mismatch of the standards with 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. Interestingly, 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. One teacher aptly stated, "It's almost like we're going back, undoing and unteaching what they have been taught." 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." Another teacher stated, "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." 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." 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 misfit of the CCSS-Mathematics with ELLs. When asked about their preparation to teach the new standards to different groups of students, ELLs had the second to lowest mean score. In particular, this school has a large ELL population, and teachers voiced concerns with the emphasis on communication and explanation as posing difficulties: "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." 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."

Conclusion and Discussion

Though the state adoption and implementation of the CCSS-Mathematics has been highly contentious, becoming a political issue and encountering parental opposition, notably, the teachers held decidedly positive views on the standards. They believed the standards improve their teaching of mathematics and benefit their 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… teachers are just so tired of change". Despite this revolving door of standards, such a hopeful view 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. Allowing time for teacher change is crucial, particularly with the uncertainty about forthcoming assessments, and the rapidly approaching third year for when assessment scores are consequential seems premature.

Several constraints were identified. As indicated by others (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 mathematical knowledge for teaching is undisputable. Professional development for teachers should provide ways of concurrently building SCK while studying children's thinking, with one such option being the professional development materials from the Cognitively Guided Instruction (CGI) Project (Carpenter, Fennema, Franke, Levi, & Empson, 1999; 2014). CGI is an approach to teaching and learning mathematics that focuses on teachers using knowledge of children's mathematical thinking to make instructional decisions, which can simultaneously develop SCK. In addition, concerns about using the new standards with specific groups of students should be noted and in this particular study, teachers did not feel prepared to do so with students with disabilities and also ELLs, which are prevalent at this PDS site. The implications for the new standards differentiated for the learning needs of different groups of students must be considered and addressed. In addition, lack of student readiness was of concern, linked with their past experiences as learners of mathematics. Student explanation was one such challenge, with teachers needing ways to develop classroom norms for

engaging in discourse and social mathematical norms that help students understand what constitutes a good mathematical solution and explanation. Guidelines such as these could help students to persevere when solving problems and forming mathematical arguments. In sum, the findings of this study illuminate both the tremendous potential for positive change provided by the CCSS-Mathematics and accompanying barriers. As teachers are ultimately the deciding factors on how the standards play-out in classrooms, this close study of their perspectives can hopefully provide insights into ways of better quipping them for teaching the standards and in turn benefiting students' learning.

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