Partnering for Improved Parent Mathematics Engagement

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Abstract

Although the Common Core State Standards call on parents to support professional educators' efforts for improving student academic achievement, we have yet to examine how to best support parents in achieving this goal. The present study addresses this need by examining a five-month mathematics intervention which aimed to increase awareness of the eight Common Core State Standards for the Mathematical Practices (CCSS-MP) in a culturally, linguistically, and generationally diverse group of parents. The intervention consisted of five mathematics workshops designed as part of a multilayered collaboration between a community organization and a teacher educator. One Mexican American and two African American parent–child dyads (n = 3) were video recorded solving "rich" mathematics tasks before and after the intervention. Video recordings were coded using a coding scheme developed from the CCSS-MP. Results indicated parent–child dyads engaged in more and a greater variety of the CCSS-MP after the intervention. Also, the ratio of parent to child talk related to the eight mathematical practices decreased. The results suggest that parents' mathematics assistance practices changed in such a way that allowed for their children to enact more of the CCSS-MP, which means that children were engaged more deeply in the doing of mathematics at the second time period. Implications for parent education curriculum designers are discussed.

Key Words: parent education, Common Core State Standards, mathematics learning, equity, access

Introduction

The Common Core State Standards (CCSS) identify parents as a key component in the effort to improve student achievement in the areas of mathematics and English Language Arts. However, since the implementation of the CCSS, little attention has been given to how professional educators might support parents as they learn to help their children meet the requirements of this ambitious initiative. The present study addresses this dearth of knowledge by examining a five-month mathematics intervention designed to increase parents' knowledge of the fundamental academic changes found within the CCSS for Mathematics. The intervention was designed collaboratively between a community organization and a teacher educator, and it consisted of five mathematics workshops. The study reported in this article is situated in a larger design-based research study (Brown, 1992; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003) that sought to examine parents' mathematics-related beliefs and their mathematics assistance practices before and after the intervention.

Background on Our Partnership

OSAKA (a pseudonym) is a middle school academic enrichment and support program that offers a two-year-long learning opportunity to seventh and eighth grade students of color, often from low-income households and the first in their families to pursue a college education. OSAKA draws from six different elementary/middle schools within one urban school district, which serves a racially and ethnically diverse population (83% Latino, 7% African American, 7% Pacific Islander). Situated as an outreach program of a prestigious higher education institution, OSAKA provides participating middle school students one-on-one tutoring and mentoring with college graduate and undergraduate students on Saturdays during the academic year. In the summer, a staff of college undergraduates and the OSAKA director (the second author) coordinate a five-week summer enrichment experience, held on the partnering higher education institution's campus, which includes English language arts and math courses as well as elective classes, community service opportunities, field trips, and workshops. OSAKA attempts to model a university–community partnership and approaches programming with a youth development framework.

In wanting to prepare OSAKA's instructional staff and volunteer tutors/mentors to provide rigorous mathematics learning experiences for the participants, during the 2013–14 school year, the OSAKA director sought out the support and expertise of the first author (who was at the time a doctoral student in mathematics education) to facilitate workshops on best practices in math instruction. The tutor/mentor workshops primarily focused on

pedagogical approaches related to the different types of homework/math tasks mentors would expect to see as a result of the feeder schools implementing the CCSS-M.

Because OSAKA values meaningful partnerships, the program often seeks ways to involve families as *partners in education* rather than relegating families solely to the role of *potluck contributor* (Warren, Hong, Rubin, & Uy, 2009). After the tutor/mentor mathematics workshops, the authors became aware of the fact that parents from our feeder schools had not received any information from their schools about the CCSS. Therefore, after some discussion on how to more effectively support the math education of our middle school youth and their families and on understanding this situation as an issue of access and equity, we decided that working with parents would be the next step in our partnership. Thus, the idea of developing parent mathematics workshops was born.

The project discussed in this manuscript involved multiple layers of collaborative work. On the outset, OSAKA is an example of university–community partnership. OSAKA exists as a collaboration between the university and local community schools. In the next layer, there is the partnership between community organization and teacher educator. This second layer is further conceptualized into a third layer with parents and teacher educator as partners. This final layer will be further unpacked throughout the remaining text.

Literature Review

Despite myths of parental apathy among historically marginalized groups in the United States, several studies have shown that similar to their White counterparts, African American and Latino parents typically want and expect to be involved in their children's education (Abdul-Adil & Farmer, 2006; Quiocho & Daoud, 2006; Valdés, 1996). One common theme in the literature related to African American and Latino parents is that parents reported wanting specific workshops to help them support their children at home with academic tasks (for examples, see Archer-Banks & Behar-Horenstein, 2008; Koonce & Harper, 2005; Quiocho & Daoud, 2006).

Across disciplines, the literature has shown that family homework interventions result in increased levels of parental involvement, and in some cases, result in improved academic performance (Balli, Demo, & Wedman, 1998; Lehrer & Shumow, 1997; Van Voorhis, 2003). The results have been particularly encouraging in the sphere of family mathematics education. Patall, Cooper, and Robinson's (2008) meta-analysis of 14 studies of projects providing parent training for mathematics homework involvement revealed that "training parents to be involved in their child's homework results in (a) higher

rates of homework completion, (b) fewer homework difficulties between child and parent, and (c) possibly, improved academic performance among elementary school children" (p. 1039). Given these findings, we were confident that working with our families to increase their capacity to support their children with mathematics would be a worthwhile endeavor. In this section, we outline some of the existing literature supporting our workshop design and implementation decisions.

Supporting Parents to Change Their Mathematics Assistance Practices

The current research project aligns with studies that seek to help parents connect the mathematics practices in which families engage in their everyday lives and school disciplines (for examples in mathematics, see Civil, Bratton, & Quintos, 2005; Goldman & Booker, 2009; González, Andrade, Civil, & Moll, 2001; Moses & Cobb, 2001). Moll (1992) refers to this perspective as "funds of knowledge." Those engaged in this type of research base their work on the belief that parents and families already possess rich mathematical knowledge and engage in complex mathematical practices. The current study is similarly situated in that we assume that parents already engage in many mathematical practices that are supportive of their children developing productive mathematical knowledge, skills, and dispositions toward mathematics. Specifically, the current study aims to highlight the alignment between parents' current mathematics assistance practices and those mathematical practices outlined in the CCSS-M documents and to identify areas in which the mathematics education community might provide further support to parents.

In general, studies taking a "funds of knowledge perspective" in mathematics education have found a positive relationship between parent involvement in the intervention and changes in parents' mathematical behaviors. The BRIDGE project is an example of an intervention taking a "funds of knowledge" perspective with mothers who have low SES and are Latina (Civil et al., 2005). The researchers described how parents reported that, as a result of the intervention, they interacted differently with their children (and sometimes the entire family) around mathematics. Because many of the participating parents shared what they were learning in the BRIDGE project with their families at home, a new dynamic was formed in which the parents and children both learned from each other, as opposed to parents being the primary knowledge provider. Furthermore, the parents reported that through their participation they were empowered to advocate for quality mathematics instruction not only for their own children, but for children throughout their school district, and over time they took on more leadership responsibilities and even served as mentors to parent–teacher small groups during the process. The findings from this study are promising in that they empirically demonstrate that parents from

one historically marginalized community can improve their own mathematics abilities and that such experiences may lead to parents becoming more empowered with respect to mathematics and schooling, in general.

Common Core State Standards for Mathematics

In brief, the CCSS for Mathematics (CCSSM) are comprised of two types of standards: content standards and practice standards. Content standards describe what mathematics topics students will be expected to master at a specific grade level. For example, by the end of sixth grade students should:

> Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings, there was 1 beak." (National Governors Association & Council of Chief State School Officers, 2010, p. 42)

The CCSS for Mathematical Practices (CCSS-MP) define the processes and proficiencies that students of all grade levels should strive to develop in mathematics. That is, the eight practice standards describe how we "do" mathematics. For example, when a learner attempts to solve a new mathematics task, they might ask themselves *What is this problem about?* Or *Does my answer make sense?* Both of these questions relate to the first practice standard: "make sense of problems and persevere in solving them." The eight CCSS-MP are listed below in Table 1.

Table 1. Common Core State Standards for the Mathematical Practices

Standards for Mathematical Practice
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

While the eight mathematical practices included in the CCSS-MP do not comprise an exhaustive list of all of the ways in which mathematicians and mathematics educators engage in deep mathematical thinking (Bass, 2011),

they reflect the current consensus in the U.S. on the types of mathematical thinking and the dispositions that K–12 students should engage in and be engaged in within their mathematics classrooms.

The inclusion of both content *and* practice standards in the CCSS-M marks an important shift in the history of U.S. mathematics education reform in which explicit attention has been given at the federal policy level to students experiencing a more expansive view of what mathematics is (the nature of mathematics) and what it might mean to teach and learn mathematics (the nature of mathematics teaching and learning). The CCSS-MP reflect a multidimensional view of the nature of mathematics, as students are expected to leave their K–12 mathematics classrooms with an understanding that mathematics is about more than numbers, symbols, rules, and procedures. Those who hold a multidimensional view of the nature of mathematics understand it to be about the relationship between concepts and ideas just as much as it is about the mathematics concepts or ideas themselves (Ernest, 1989; Skemp, 1976). The CCSS-MP also reflect a multidimensional view of mathematics teaching and learning in that teachers and children are expected to deeply engage in mathematics reasoning and mathematical communicating rather than blindly following predigested rules and procedures. This view of teaching and learning has its roots in situated (Greeno, 2011; Lave & Wenger, 1991; Newman, Griffin, & Cole, 1989) and sociocultural (Rogoff, 1990) perspectives on mathematical development. Those with a multidimensional view of mathematics teaching and learning expect teachers and students to be actively making sense of the mathematics emerging from their shared learning experiences rather than just seeking to determine if an answer to a problem is correct or encouraging memorization and following math rules with little to no understanding (Boaler, 1998).

Parent Involvement in the Era of Common Core

With its increased emphasis on communication, critical thinking, problem solving, and analytical thinking over rote memorization, the CCSS-M may require many parents to interact with mathematics in ways very different from their own mathematics education experiences (Jackson & Remillard, 2005; Jay, Rose, & Simmons, 2017). From recent headlines, we know that there are both parents and teachers who have become frustrated with this reform initiative (for an example, see Heitin, 2014). Such frustration is at least partially attributable to widespread misinterpretations about the intent of the CCSS-M (Sun, 2016). When one considers the schooling experiences of parents from historically marginalized communities who, due to discriminatory tracking practices in America's public schools (Oakes, 1990), often have never experienced mathematics in the multidimensional ways envisioned by mathematics

educational reformers (Boaler, 2002), the opportunities for misunderstandings and misinterpretations of the CCSS-M are even more likely. Thus, while classroom pedagogies aligned to the desired implementation of the CCSS-M have the potential to empower students from marginalized communities, parents' disparate experiences with these pedagogies and ways of thinking about mathematics may serve to compound the inequalities in mathematics achievement between students from marginalized communities and their counterparts. However, to our knowledge, until now there have been no interventions that explore parents' assistance practices in direct relationship to the current mathematics reform. Given the recent Phi Delta Kappan/Gallup poll finding that 55% of public school parents had not heard of the Common Core initiative (Maxwell, 2013), starting the discussion with parents about the CCSS-M seems particularly salient. We were guided by the idea that an effective way to initiate the mathematics reform conversations with parents is with the CCSS-MP because this set of standards are grade level neutral and, to some extent, can be engaged in by parents with their children without the need of high levels of mathematical content knowledge.

Research Questions

The current study aimed to answer the following research questions:

- Which of the eight Common Core State Standards for the Mathematical Practices did parent–child dyads engage in before and after a community-based intervention?
- How did parents and their children engage in mathematics differently after the community-based intervention?

Intervention Description

During the 2014–15 school year, we developed five workshops for parents. During the workshops, we sought to make explicit for and with parents the connection between the workshop activities and the transferable mathematics skills, knowledge, and dispositions that would support them in assisting their children with school-based mathematics tasks. The workshops were designed to help parents of middle school children to shift their thinking beyond their enjoyment with specific workshop math activities to a deliberate focus on a few fundamental ways of doing and learning mathematics that could be transferred to novel tasks (such as those that their children will inevitably come home with as a result of the shift to the CCSS). In other words, we hoped to help parents understand (and at times experience) the ways in which the mathematical practices transcend the particular mathematical content that they were learning to mathematical ideas beyond the workshops (Selling, 2016).

Parents played an integral role in determining the time, location, and content of the workshops. Consistent with previously identified best practices for working with parents of color, parents were polled at the beginning of the project and on an ongoing basis in order to identify specific workshop dates and times (Quiocho & Daoud, 2006). Parents were also consulted about the math content of the workshops. For example, the decision to start with fifth grade CCSS-M content standards was guided by parents' interest in learning more about the Order of Operations. So, although Order of Operations is a fifth grade standard, our choice to include it in the workshops was directly related to parents' expressed interests.

All five workshops were between 1.5–2 hours long at various times of the day. With the exception of Workshop 1 (which served as an introduction to the idea of academic standards and the CCSS, in particular), all workshops followed a similar format. Participants played family-friendly games during the first 30 minutes of each workshop. Next, we reviewed the mathematical topics and ideas from previous workshops. During the final portion of the workshop, participants were introduced to new mathematical content. Workshops 2 and 3 focused on Order of Operations (as requested by parents), and Workshops 4 and 5 focused on Growth Patterns.

Each workshop focused on a different subset of mathematical practices (see Table 2). Through the design, implementation, and reflecting process of the design-based research project, the first author has found that the first and third CCSS-MP ("make sense of problems and persevere in solving them" and "construct viable arguments and critique the reasoning of others," respectively) are great practices to start with and pair well with the other six practices.

Sample Workshop Activities

In the following section, we describe a few of the activities used in the workshops and discuss how they were used with families. More details can be found in a previously published manuscript (Mangram, 2016).

Whole group playing of reasoning games. A key activity during four of the five workshops was exploring the mathematical practices through the process of playing family-friendly games. One of the primary goals of including game playing in the workshops was to help foster parents' understanding that mathematics thinking can be developed outside of school activities (for similar examples of parents and mathematics game play, see Kliman, 2006). The success of the games in these workshops highlights the potential of using game play to introduce parents to the mathematical practices independent of parents' computational proficiency.

Table 2. Goals, Activities, and the Mathematical Practices Foregrounded in Each Workshop

	Central Goals	Key Activities	Mathematical Practices in the Foreground
Workshop 1	Familiarize Participants with CCSS	CCSS Presentation Video-based Discussion Explore Smarter Balanced (new CCSS standardized test) Pilot Tests	N/A
Workshop 2	Develop the mathematical knowledge necessary to support children learning order of operations.	Play Reasoning Game (Mastermind) Evaluating expressions involving four arithmetic operations	MP's 1, 3, 5, 6 and 7
Workshop 3	Develop the mathematical knowledge necessary to support children learning order of operations involving exponents.	Play Reasoning Game (Wuzzit Trouble) Evaluating expressions involving four arithmetic operations and exponents	MP's 1, 4, 6 and 8
Workshop 4	Develop the knowledge of students and mathematics to identify and address common errors Develop the mathematical knowledge necessary to support children learning to generalize	Evaluating expressions involving four arithmetic operations and exponents Error Analysis Growth Pattern Task-Perimeter	MP's 1, 2, 4, 7 and 8
Workshop 5	Develop the mathematical knowledge necessary to support children learning to generalize	Play Reasoning Game (Dominoes) Error Analysis Number Talk Growth Pattern Task- Mosaic	MP's 1, 4, 7 and 8

Mastermind™ game. The first game we played was Mastermind. In brief, Mastermind is a code-breaking game in which one player creates a code consisting of four colored pegs, and the other player attempts to "break" the code by successive guessing and receiving feedback on their choices. In the second workshop (the first mathematics-focused workshop), parents and children

worked in teams to play the game. We consider Mastermind an appropriate choice for an initial foray into the CCSS-MP because it does not use numbers or anything resembling calculations; therefore, players can engage in the CCSS-MP without the added burden of needing to be proficient or comfortable with school mathematics. Specifically, playing Mastermind™ can help learners develop the first and third CCSS-MP since game players have to develop a problem-solving plan (MP1) and reason inductively about the data (MP3). In other words, it can be played by people with a variety of mathematics backgrounds and levels of mathematics proficiencies. It is also one of the family games recommended by the mathematics education organization Youcubed, founded by Professor Jo Boaler at Stanford University (www.youcubed.org).

In order to build rapport and to foster interdependence, we played the game as a whole group rather than playing as individuals (which is how the original game is conceived). Participants were split into two teams; one team worked with the research assistant (RA) as the code makers, and the other team worked with the facilitator as the code breakers. The facilitator's team took turns proposing the color sequence we would use on our next move. The RA's team took turns determining the correct combination of key pegs that would reflect the correctness of the guessed pattern.

During the closure of this activity, we debriefed the activity by recalling some of the questions that the facilitator asked of the research assistant's team during the playing of the game. The debrief also included an introduction to the CCSS-MP. During this segment, the facilitator hung a poster of the CCSS-MP and passed out a handout summarizing the CCSS-MP. We then discussed how the game connected to the first and third CCSS-MP.

Dominoes. In the final workshop, Workshop 5, participants played a variation of Dominoes called "All Fives." This activity was chosen because playing Dominoes is one of the favorite pastimes of the participant who seemed to be having the most trouble reconciling what he refers to as "new math" with the ways in which he was accustomed to engaging in mathematics. We thought it would be a great way to engage him by highlighting his expertise, while at the same time developing all participants' number flexibility. Namely, to earn points, participants would have to both compose and decompose numbers in order to get multiples of five. The playing of Dominoes in an academic context can be considered a culturally sustaining pedagogy (Paris, 2012), as Dominoes is a fairly common practice among males in the African American community. Therefore, playing Dominoes in a mathematics classroom setting can serve to bridge the divide between cultural knowledge and domain knowledge (Nasir, Hand, & Taylor, 2008).

In this game, players attempt to be the first to play all of their tiles (dominoes) and also to make the open ends of the layout add up to 5 (or a multiple of five). We played as a whole group. The facilitator began the activity by asking whether participants had any experience playing Dominoes. Since everyone in the group had played Dominoes, we moved into explaining the rules of this particular version of the game, and the facilitator explained the symbol notation we would be using to keep score. As we played, the facilitator interjected to ask participants questions such as "What were you hoping you would have?" to make participant thinking visible to others. Once we played one round, we concluded the activity by debriefing our mathematical moves. At this time, the facilitator asked participants to take out their CCSS-MP card (provided in Workshop 4) to help us to connect our mathematical moves to the CCSS-MP, namely two components of the first CCSS-MP: "evaluate progress and revise thinking" and "persevere in solving problems."

Error analysis. Another key workshop activity was the inclusion of "error analysis tasks" for parents. The error analysis tasks situate parents' learning of the mathematical practices within the context of parent–child work. Parents are often asked by their children to assist with mathematics homework once the child has made an error or has gotten stuck. However, parents in the study had no experience with rehearsing or exploring strategies for supporting their child to find their own error or getting unstuck before they are expected (by the child or themselves) to do so in-the-moment. By providing parents an opportunity to practice support strategies collaboratively, the error analysis tasks assist parents to become more aware of a variety of productive approaches to helping children with mathematics homework.

Our error analysis tasks were designed to help parents identify and address some of the common errors learners make when using the Order of Operations to evaluate expressions. Participants were provided with sample child work and asked to determine whether an error occurred and to think about what they might say or do to help their child locate and address the error without taking the cognitive work of the problem-solving away from the child.

Methods

Recruitment Activities

Adult participants were recruited in a variety of ways. Initially, the first author made formal presentations about the project to families of OSAKA at the end-of-year celebration and the new family orientation held in the Spring and Summer of 2014, respectively. In addition to the formal presentations, the second author introduced potential participants to the first author at the

end-of-summer celebration, through email and mail via OSAKA's quarterly newsletter, and at various community events. Some participants also contacted the first author as a result of the conversation they had with family members and the second author. The children participants were recruited in a similar manner; however, we did not talk to children without their parent first expressing an interest in the project.

Participants

Although the workshops were originally conceived as workshops for parents, several parents brought their children; therefore, these workshops became family math workshops. The number of people attending any workshop ranged from 4 to 11. Most of the children who attended the workshops were current students of OSAKA; however, three of the child participants were former OSAKA students, and one student was the family member of a current OSAKA student. The adult participants varied in their relationships to the OSAKA students. In attendance were grandparents, sisters, fathers, mothers, and aunts. With the exception of Workshop 1, there were an equal number of native-Spanish and native-English speakers at each workshop. Also, a nearly equal mix of African American and Mexican American parents attended the sessions. The majority of workshop participants were females. Through the recruitment activities described above, we learned that not all adults attending OSAKA events were biological parents. Hence, the term "parent" is used in the study to designate any adult living in the child's home who identifies as the adult primarily responsible for assisting the child with academic tasks such as homework. Various subsets of parents participated in the different components of the larger project. The analysis discussed in this article includes data regarding three focal parents, one identifying as male and two identifying as female (n = 3; two African American parents, one Mexican American parent). The focal parents represent a sample of convenience, a subset of the workshop participants who were willing to participate in all aspects of the larger research study data collection. The focal parents represented a variety of home language and education levels. One parent was bilingual and could speak and write both Spanish and English fluently. Two parents spoke English only. One parent graduated college with a degree in mathematics, and the other two parents graduated from high school. They ranged in age from 19–63 years. All focal parents attended at least 4 workshops.

Data Sources

The first author conducted observations of the three focal parent–child dyads (children were entering Grades 6 and 7) working on three mathematics

tasks before the first workshop and after parents' participation in the fifth workshop. Observations were video recorded. During the observations, parents and children worked on three tasks including two proportional reasoning tasks and one growth pattern task. Tasks used in the pre- and postworkshop observations were identical in content, with the exception of a change in the numerical values. The modifications were intended to discourage the solving of tasks directly from memory. Previous research has shown that modifying the numeric values in a task, even slightly, can have significant impact on the cognitive demand and mathematics potential of the task (Baldinger, Borko, Jacobs, Koellner, & Selling, 2011); therefore, every attempt was made to make only minor changes so that the mathematics potential of the tasks remained the same.

The three observation tasks are considered "rich" (i.e., multidimensional) mathematical tasks, which means that there should be many opportunities for parents and children to engage in a variety of the CCSS mathematical practices. Together, the set of tasks were suitable for this study's goals for two primary reasons: (1) together the mathematical content of this group of tasks reflects nearly two-fifths of the Grade 6–8 CCSS math content standard domains; and (2) the mathematics tasks were fairly challenging for each child, so that there is an authentic reason for the parent to provide assistance.

Data Analysis

The video recording data of parents and children working on math tasks was qualitatively coded using Studiocode. Each video clip captured the entire interaction between the parent and child related to one of the three assigned mathematical tasks. These video clips were then divided into talk turns. As the unit of analysis, the talk turn allowed for differentiation between who was doing the talking and how long they held the floor (Wetherell, Taylor, & Yates, 2001). A talk turn was determined by the beginning and ending of a verbalization made by one of the participants in the conversation. A talk turn can end naturally when a speaker has completed his/her thought, or it can end by the beginning of another speaker's verbalizations (e.g., an interruption). Next, after all video clips were divided into talk turns, each of these turns was coded as being either a CCSS-MP or a non-practice move. This stage was essential as it was necessary to be able to distinguish child/adult verbalizations that were associated with the CCSS mathematical practices from other types of math talk. For example, a talk turn in which the child conducts arithmetic calculations without any reference back to the meaning of the arithmetic operation symbol would be coded as a non-practice move. Finally, the talk turns coded as CCSS-MP were then also coded with the specific CCSS-MP and its related component using a coding scheme modified from Selling (2014), developed

from the descriptions of the practices in the CCSS-MP documents. Table 3 displays an example of one CCSS-MP and its corresponding components.

Table 3. Example of CCSS-MP and Related Components

CCSS Mathematical Practice (Code)	Components of Mathematical Practice (Subcode)*
MP3 – Construct viable arguments and critique the reasoning of others	Use stated assumptions, definitions, & established results to construct arguments
	Make and test conjectures/*strategies*
	Analyze situations by considering cases
	Recognize and use counterexamples *(including mathematical inconsistencies)*
	Justify conclusions and/*or solution pathways*
	Reason inductively about data
	Consider/determine domain in which argument applies
	Critique the reasoning of others
	Ask useful questions to clarify the reasoning of others
	Interpret or make sense of another's reasoning
	Express agreement or disagreement with another's reasoning
	Offer alternative strategy/*solution*
	Respond to the critique/questioning of others

*The italicized wording indicates language added to Selling's (2014) CCSS-MP coding scheme.

Inter-Rater Agreement Process

The inter-rater agreement process was conducted in two phases. In the first phase, the first author and another mathematics education expert came to agreement on a random subset of the videos (n = 3). First, we met to collaboratively code and discuss one of the longer videos together. Next, we independently coded two other videos. After independently coding each of the two videos, we met to discuss any coding discrepancies and to update the codebook. Once we agreed on the coding of all three videos and the codebook, the first author coded the remaining videos.

Second, to further verify the accuracy of the coding, a random subset of 20% (n = 4) of the videos were rated for agreement by a different mathematics education expert who had not been a part of the original code modification or coding processes. We agreed on 99.6% of all codes.

This coder was trained by watching a video clip with codes already assigned. He was asked to take note of instances in which he disagreed with a code or thought that another code could also be applied. After watching the video clips and taking notes, the first author and the additional rater met to discuss discrepancies. The first author updated the codebook one final time to reflect these discussions.

Results and Discussion

Changes in CCSS-MP Engagement

Figure 1 depicts the frequency of talk turns coded with each of the eight mathematical practices during the preworkshop and the postworkshop observations. The frequency counts include both parent and child talk turns at both time periods.

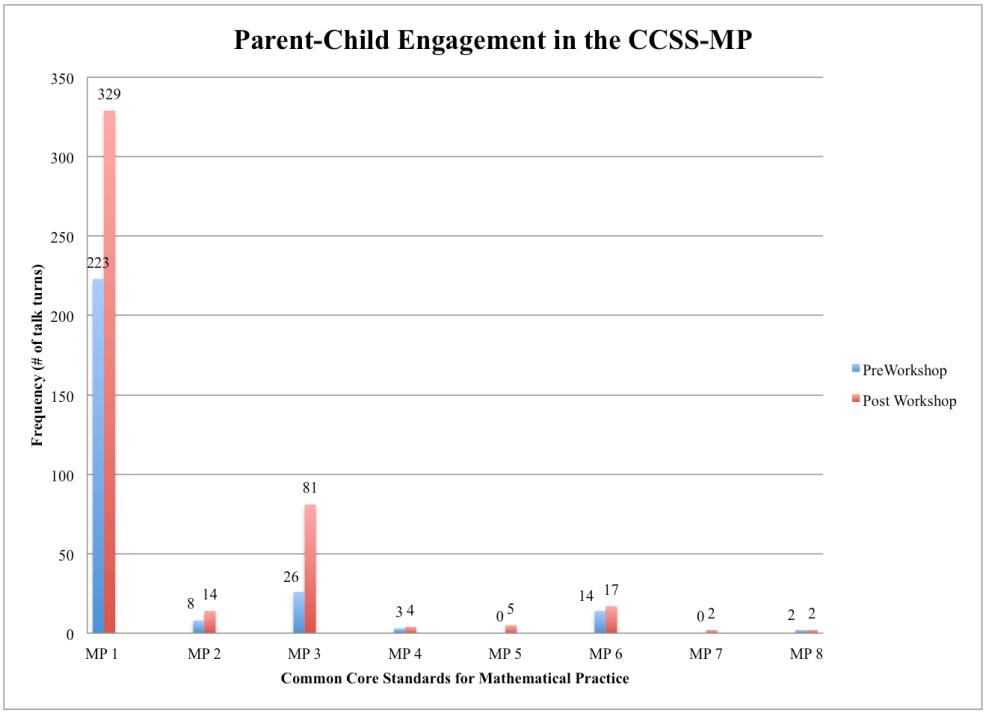

Figure 1. Parent–child engagement in the eight CCSS-MP.

There are three particularly notable findings related to Figure 1. First, prior to the workshop there was some alignment between parents' mathematics assistance practices and the CCSS-MP. Specifically, prior to the workshops, parents and children engaged in six of the eight CCSS-MP. In contrast, after

the workshops, there is evidence that all of the CCSS-MP were engaged in. Second, with the exception of the eighth CCSS-MP, the number of talk turns associated with each of the CCSS-MP was greater during the postworkshop observations than the preworkshop observations. Third, we notice that at the two time periods, both parents and children engaged in the first CCSSM practice, "make sense of problems and persevere in solving them," and the third CCSSM practice, "construct viable arguments and critique the reasoning of others," at greater frequency than all the other practices combined. Given the numerical differences we are noticing in the pre- and postworkshop observations, one question we might pose is whether these numeric differences are, in fact, statistically significant. However, due to the small number of participants in this portion of the study, inferential statistical tests could not be run.

Although the changes in the frequency in some of the practice standards are rather small, which is one of the primary limitations of the study, they are to be celebrated given the sample size. Therefore, any numerical increases in the frequency of each CCSS-MP and also the greater variety of components of the same CCSS-MP suggest that how parents and children engaged with mathematics before and after the workshops was substantively different. For example, much of the frequency increase in the third mathematical practice, "construct viable arguments and critique the reasoning of others," is attributed to an increase in the component "justify conclusions and/or solution pathways" (see Table 4). This code was used when any member of the dyad justified (or encouraged the justification of) a specific problem-solving approach to their partner. Such a change indicates that the parent–child dyads had begun to have the expectation that one must have a reason for using a specific strategy or making a particular calculation. Frequency changes such as the one we discussed support the assertion that parent–child dyads appear to be gradually shifting from doing mathematics one-dimensionally (i.e., emphasis on the one right answer or one approach) to engaging in the mathematics in more multidimensional ways, as is the intent of the CCSS-M.

Table 4. Comparison of Talk Move Frequency for CCSS-MP3

CCSS-MP 3: Construct Viable Arguments and Critique the Reasoning of Others			
Component	PreWorkshop Totals	PostWork-shop Totals	Difference
Interpret or make sense of another's reasoning	0	1	1
Justify conclusions and/or solution pathways	13	36	23
Offer alternative strategy/solution	1	14	13
Recognize and use counterexamples	0	4	4
Respond to the critique/question-ing of others	1	3	2
Non-Specific	10	14	4
Total	26	81	55

Parent Versus Child Engagement in the CCSS-MP

In this section, we present data addressing who is actually engaging in the eight mathematical practices. Table 5 summarizes the number of adult and child talk turns labeled as one of the eight CCSS-MP at both time periods. These values represent the sum of all adult and child talk turns in the three "rich" mathematics tasks.

Table 5. Comparison of Adult to Child CCSS-MP Talk Turns

		Count	Count Adult:Child	Total Time (min.)	Total Time Adult:Child
Pre	Adult	90	1.57894737	00:10:49	2.5714286
	Child	57		00:04:12	
Post	Adult	199	1.28387097	00:24:31	1.6657609
	Child	155		00:14:43	

As Table 5 indicates, in the preworkshop observations, parents made nearly 58% more CCSS-MP talk turns than the children. In contrast, in the postwork-shop observations, the ratio of parent to child CCSS-MP talk turns decreased. Similarly, the ratio of total minutes that parents engaged in the eight CCSS-MP decreased from preworkshop to postworkshop. Moreover, as indicated in Table 5, both parents and children engaged in the CCSS-MP for a longer peri-od of time in the postworkshop. Taken together, these results provide evidence

that the children in the study had more opportunity to engage in mathematical practices after their parents attended the math workshops. These results suggest that parents' mathematics assistance practices changed in such a way that allowed for their children to engage in more of the CCSS-MP, which means that children were engaged more deeply in the doing of mathematics at the second time period, after their parents attended the workshops.

Implications

In addition to providing specific workshop activities for those interested in engaging parents in the CCSS-MP, the research on these workshops provides insight into how parent workshops might be organized around a few key mathematical practices. Given that those who work in parent education are often responsible for organizing learning activities across multiple disciplines, the finding that parents and children engaged in MP1 and MP3 most frequently provides a basis for exploring whether there are what some teacher education researchers are calling "core practices" or "high leverage practices" (Ball & Forzani, 2009; Forzani, 2014; Grossman & McDonald, 2008) across disciplines for parent education. Considering the centrality of the first and third mathematical practices to solving a range of mathematics tasks, we might ask ourselves, "Are sense making and argumentation two practices that transcend mathematics and would be broadly applicable to the work of parents?" For example, one of the first mathematical practice components the parents in this study engaged in was to support their children to "plan a solution pathway," which also has direct application to the metacognitive reading strategy in English Language Arts (ELA), "develop a plan before reading" (Fogarty, 1994). Cheuk (2013) and Lee, Quinn, and Valdés (2013) have already begun this work by identifying areas of overlap in the CCSS for mathematics and ELA and the Next Generation Science Standards (NGSS). One such area of overlap identified by the researchers is the practice "engage in argument from evidence." Although listed as the seventh NGSS standard, it has convergence with the CCSS math and ELA practice standards. Parent educators should consider whether these areas of overlap are appropriate when the learners are parents hoping to support their child's learning and whether there are other areas of overlap in additional content areas.

Previous studies such as the practitioner inquiry project described by Mistretta (2017) have demonstrated that parent-centered approaches to parental engagement can lead to greater mathematics understanding on the part of the parent and better understanding of family circumstances and capabilities on the part of the practitioner. Similarly, the present study provides insights into

how design thinking might be used in a parent-centered approach to working with parents to facilitate greater mathematics learning. In our project, we partnered with parents to determine the content and the logistical components of the workshops (e.g., time, location, etc.); however, this type and level of parent engagement need not be limited to mathematics education. We envision that this design-based approach can be applied to many areas of parent education (not just academic disciplines). The main element needed with this approach is a funds of knowledge perspective (Moll, 1992). We approached this work with the assumption that parents were already highly engaged and desirous of doing mathematics with their children, and our assumptions were confirmed through our work with families. We believe that having an eye open for parents' strengths rather than their deficits can help professional educators design learning opportunities that are more responsive and respectful to the families we seek to support.

Conclusion

As much as this article reports on some of the outcomes associated with a specific mathematics intervention for parents, it is also a story of how educators from different spheres partnered with parents to provide quality educational experiences for their community. Such a multilayered partnership story can contribute to shifting the dominant narrative about families living in low-income communities to a narrative of hope by demonstrating what is possible in these settings when community stakeholders are creative about how they might attend to the needs and interests of the people they serve. Finally, this story provides evidence for the argument that, with sustained support, parents and their children from historically underserved communities can achieve greater mathematical proficiency. The argument for more sustained support is backed by teacher professional development literature (Darling-Hammond & McLaughlin, 1995), and we would like to extend this call to parent development as well. The question now becomes, given such promising early results, how can diverse groups of stakeholders be supported to work with parent–learners in an ongoing and sustained manner to enact meaningful change?

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