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Introduction

The Common Core State Standards have been widely adopted by states and are currently being implemented across the United States. There are content standards, specifying skills and understandings, and, in addition to the Content Standards, there are important ideas included in Common Core about mathematical processes. These Standards for Mathematical Practice (MPs) promote a vision of student engagement in the process of doing mathematics. If Common Core is to spur a significant change in how students in this country learn mathematics, teachers must adapt these practices into their classroom in addition to the Content Standards. However, at this time, little is known about how teachers are making sense of the MPs and incorporating them into their classroom practice. As part of a larger study about novice teacher understandings of the Common Core Math Practices (MPs), this research looks at how teachers envision and align tasks with the MPs.

In order for students to actually engage in any of the MPs in a meaningful way, the teacher must provide them with an appropriate task. The tasks teachers choose ultimately lead to what mathematics students learn. Research supports the idea that choosing high-cognitive demand tasks promotes better discourse (Boston & Wolf, 2006), and greater student learning (Stein & Lane, 1996). By discussing tasks during study interviews, I gained insight into how novice teachers envision the MPs being used with students. Their choice of tasks that address the MPs sheds light on their understanding of what the MPs ask of their students. For these reasons, I approach my inquiry about novice teacher understanding of the MPs via mathematical tasks they consider as aligned with the MPs and also appropriate for use in their classrooms. The research question I ask is: *How do teachers connect task selection with the MPs? What types of tasks do teachers associate with students engaging in the MPs?*

The widespread adoption of Common Core implies that teachers should be attentive to not only the new content standards, but also the MPs. However, the promotion of reform practices does not necessarily generate significant change in classrooms. Decades after the first NCTM *Standards* documents were released, research suggests little has changed in the teaching and learning of mathematics in this country (Frykholm, 1996; Gainsburg, 2012). Regardless of what reforms are promoted on the state and national levels, teachers are the daily direct contact to students and thus decision makers in what and how reforms are actually enacted. Thus it is important to study how teachers understand intended reforms and what the reforms entail for their practice. New teachers are of critical importance to the implementation of the MPs. With large numbers of veteran teachers retiring (Fong & Makkonen, 2012), waves of new teachers entering the profession in the era of Common Core will be needed to enact these reforms.

Background

Theories of Learning

In thinking about the knowledge acquisition of students, this research is based on the perspective that learning is a social activity that occurs through activities and discourse with others. Recent ideas about how students acquire knowledge supply the rationale for why we should engage students in doing mathematics in the way the MPs depict.

Sociocultural learning theories consider how learning occurs within a group setting and views learning as an inherently social activity. This view that knowledge is obtained through activities and discourse challenges the notion that mathematical learning can be accounted for by an individualistic theory (Cobb, Jaworski, & Presmeg, 1996). Socioculturalists instead look at the quality of interactions and enculturating experiences a student has to account for their mathematical learning. Thus, in order to explain an individual's learning, socioculturalists consider the larger environment. Forman (1996), Van Oers (1996), Sfard (2001), and other socioculturalists account for student learning in terms of their participation in communities of practice. In this line of thinking, classroom activities and discourse are closely connected to the learning itself. Lave and Wenger (1991) propose the constructs of legitimate peripheral participation and communities of practice to explain how learning occurs within a group setting.

Sociocultural views are important when considering how classroom activities and discourse relate to student learning. As my study also explores the professional learning of teachers, I consider relevant theories of learning as they pertain to the novice teachers themselves. The theory of situated cognition informs my thinking about how the novice teachers acquire understanding of the MPs. From the viewpoint of situated cognition, this learning about the MPs is inherently tied to the situation in which the learning occurred. Novice teachers learned about teaching as students in a university classroom, but are expected to apply that knowledge in a very different environment and role. Situated cognition holds that "knowledge is situated, being in part a product of the activity, context, and culture in which it is developed and used" (Brown, Collins, & Duguid, 1989, p. 32). Thus, from this viewpoint, it is a challenge for pre-service teachers to take what they learned about the MPs as students and apply it when their role becomes that of the teacher. When they were pre-service teachers, their understanding of the MPs and their role in implementing them stemmed from what they learned as students themselves in a university classroom. Additionally, there can be disparity between their mathematics education coursework and their mathematics coursework. That is, they may be learning mathematics is a context very different from the ideas the are studying in their mathematics education courses. Novice teachers can seem to contradict themselves with what they profess in a teaching statement for a mathematics education course and what occurs in their instruction. Peressini, Borko, Romagnano, Knuth, and Willis (2004) use the viewpoint of situated cognition to reconcile these contradictions; "when novice teachers seem to enact inconsistent conceptions of self as teacher in different settings, our framework enables us to consider whether the inconsistencies may be due to incompatible sets of goals, values, and commitments or conflicting requirements for successful participation in these settings" (p. 81).

Teacher learning is dependent on the setting and teachers react to different expectations in different situations. When student teachers enter the classroom, they need assistance in bridging the gap between what they learned about teaching as students and how they select tasks and orchestrate classroom discourse as teachers. Hence, I will use a situated cognition perspective in thinking about the learning of novice teachers related to the MPs.

Importance of High-Quality Tasks

In order to engage in the MPs, students need high-quality tasks to work on. Students can only be expected to learn what they are taught. If students attend mathematics class, watch a teacher do a procedure and then complete exercises of a similar nature, then this procedure, at best, is what we can expect them to learn. If we want students to move beyond procedural understanding, they need to engage with better tasks (NCTM, 2014). Reasoning and sense-making should be throughout the mathematics curriculum so students need tasks that will allow them to make meaning of new mathematical ideas. The MPs promote student reasoning and problem solving, which we cannot expect students to attain through working on procedural exercises.

Researchers have used the concept of cognitive demand as a lens for analyzing tasks. Cognitive demand refers to the potential level of thinking in which a student might engage while working on a task. Stein, Smith, Henningsen, and Silver (2000) differentiate between high and low cognitive demand tasks. Their Task Analysis Guide articulates aspects of low-level cognitive demand tasks and high-level cognitive demand tasks. Memorization tasks and procedures without connections tasks are low-level while procedures with connections and doing mathematics tasks are high-level cognitive demand.

Boston and Smith (2009) used a rubric for the cognitive demand of a task that draws from the ideas of Stein, Smith, Henningsen, and Silver (2000). The IQA Academic Rigor: Mathematics Rubric for Potential of the Task in Figure 1.1 assigns a score of one or two for low-cognitive demand tasks and a score of three or four for high cognitive demand tasks. The rubric was tested for reliability and validity in prior research by the Instructional Quality Assessment (IQA) group (Boston & Wolf, 2006; Matsumura, Garnier, Slater, & Boston, 2008). Boston and Smith (2009) used this rubric to assess the quality of tasks teachers as written and a different rubric to assess quality of tasks as enacted in the classroom.

4	The task has the potential to engage students in exploring and understanding the nature of mathematical concepts, procedures, and/or relationships, such as: • Doing mathematics: using complex and nonalgorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instructions, or a worked-out example). OR • Applying procedures with connections: applying a broad general procedure that remains closely connected to mathematical concepts. The task must explicitly prompt for evidence of students' reasoning and understanding. For example, the task *may* require students to— • solve a genuine, challenging problem for which students' reasoning is evident in their work on the task; • develop an explanation for why formulae or procedures work; • identify patterns and form generalizations based on these patterns; • make conjectures and support conclusions with mathematical evidence; • make explicit connections among representations, strategies, or mathematical concepts and procedures; and • follow a prescribed procedure in order to explain/illustrate a mathematical concept, process, or relationship.
3	The task has the potential to engage students in complex thinking or in creating meaning for mathematical concepts, procedures, and/or relationships. However, the task does not warrant a "4" because— • it does not explicitly prompt for evidence of students' reasoning and understanding; • students may be asked to engage in doing mathematics or procedures with connections, but the underlying mathematics in the task is not appropriate for the specific group of students (i.e., too easy or too hard to promote engagement with high-level cognitive demands); • students may need to identify patterns but are not pressed for generalizations; • students may be asked to use multiple strategies or representations, but the task does not explicitly prompt students to develop connections between them; and

3	• students may be asked to make conjectures but are not asked to provide mathematical evidence or explanations to support conclusions.
2	The potential of the task is limited to engaging students in using a procedure that is either specifically called for or its use is evident based on prior instruction, experience, or placement of the task. There is little ambiguity about what needs to be done and how to do it. The task does not require students to make connections to the concepts or meaning underlying the procedure being used. The focus of the task appears to be on producing correct answers rather than developing mathematical understanding (e.g., applying a specific problem-solving strategy, practicing a computational algorithm). OR The task does not require student to engage in cognitively challenging work; the task is easy to solve.
1	The potential of the task is limited to engaging students in memorizing or reproducing facts, rules, formulae, or definitions. The task does not require students to make connections to the concepts or meaning that underlie the facts, rules, formulae, or definitions being memorized or reproduced.
0	The task requires no mathematical activity.

Figure 1.1. IQA Academic Rigor: Mathematics Rubric for Potential of the Task. The left column are the scores assigned for corresponding task descriptions in the right column. Adapted from "Transforming Secondary Mathematics Teaching: Increasing the Cognitive Demands of Instructional Tasks Used in Teachers' Classrooms," by M.D. Boston and M.S. Smith, 2009, *Journal for Research in Mathematics Education, 40*(2), pgs. 119-156.

High cognitive demand tasks support the type of learning articulated by the MPs. Stein, Smith, Henningsen, and Silver (2000) found that high-cognitive demand tasks elicited higher levels of student thinking. Higher levels of student achievement are associated with the use of higher cognitive demand tasks (Hiebert et al., 2005; Boaler & Staples, 2008; Stein & Lane, 1996). Thus in order for students to engage in the type of reasoning and problem solving depicted in the MPs, it is essential that they are provided with high cognitive demand tasks. Additionally, research points to the importance of high quality tasks in order to engage students in high-quality discourse (Boston & Wolf, 2006; Jackson et al., 2013). High quality tasks are of high cognitive demand, but they also must be accessible to students. They have an entry point that allows all students to make progress on the task and are not of such high cognitive demand that students can't solve them. Such rich tasks provide opportunities for rich mathematical discussion about the task.

While the task itself is important, the way it gets enacted in the classroom, also affects student learning. Stein, Smith, Henningsen, and Silver (2000) created a framework illustrating the path beginning with how a task is written in the curriculum and student learning. To implement a high-cognitive demand task well, a teacher must draw on challenging practices (Henningsen & Stein, 1997). Thus teachers must not only select high-cognitive demand tasks, but also implement the tasks in ways that require the students to sustain high-level thinking.

Implementing High Cognitive Demand Tasks is Challenging

While high-cognitive demand tasks are an essential aspect of the vision for mathematical learning outlined by NCTM and CCSSM, such tasks were not commonplace in US classrooms after the release of the Standards documents. Prior to Common Core, students were more likely to work on procedural exercises in mathematics classrooms (Hiebert et al., 2005; Silver, Mesa, Morris, Star, & Benken, 2009). Even when submitting lesson plans for National Board Certification, intended to be exemplars of an applicant's teaching for understanding, teachers did not consistently provide high-cognitive demand tasks (Silver, 2000; Silver, Mesa, Morris, Star, & Benken, 2009). Thus the NCTM reform movement did not translate into the regular use of high cognitive demand tasks even by the most credentialed teachers in the US. More study is required to understand how teachers select high-quality tasks to align with Common Core.

Even when teachers do select high cognitive demand tasks, the classroom implementation of the task can lead to a significant decrease in the demand on the students. The TIMSS Video Study (Hiebert et al., 2005) revealed that in contrast to higher achieving nations, the cognitive demand on US students frequently decreased during the implementation of high cognitive demand tasks. Jackson, Garrison, Wilson, Gibbons, and Shahan (2013) studied middle-school teachers implementing a reform curriculum, Connected Mathematics Project (2013). Although many tasks started out as high cognitive demand, the majority did not end in a high quality mathematical discussion. Henningsen and Stein (1997) found that high quality tasks frequently turned into students working on procedures without connections to the underlying mathematics, unsystematic exploration, or no mathematical activity when implemented. As the cognitive demand of tasks tends to decrease with implementation, this study focuses on the tasks teachers choose as a best-case scenario for the cognitive demand required of students.

Change is Possible

Silver and Stein (1996) studied middle school teachers as part of the QUASAR project and found they were able to shift their teaching practices drastically by engaging students in high quality tasks. This problem-solving curriculum centered around mathematical thinking enabled urban students to make large gains in mathematical understanding (Silver & Stein, 1996).

Henningsen and Stein (1997) studied the way in which teachers implemented high cognitive demand tasks. They outlined practices that correlated with sustained cognitive demand for students such as appropriate time for student exploration and sustained pressure for explanation and justification (1997).

Boston and Smith (2009) found that professional development could enable teachers to use these practices to maintain the cognitive demand of tasks (2009). When compared to a control group, teachers participating in professional development chose more high cognitive demand tasks and were less likely to make decisions in enacting them that led to a decrease in cognitive demand for students (Boston & Smith, 2009). The work of Taylor demonstrates how professional development can enable teachers to make better use of their curriculum (2013).

Through a professional development course about the Mathematics Curriculum Assessment and Adaptation process, teachers learned a way to more effectively use their curriculum. The study demonstrated that teachers not only were able to make immediate use of the process, but continued to use it after the course was complete (Taylor, 2013).

Methodology

My research approach drew from Seidman's (2006) concept of in-depth phenomenological interviews as well the ideas of task-based interviews common in mathematics education (Goldin, 1997). I used a purposeful sample of eight first and second-year secondary mathematics teachers for this study. All teachers completed the credential process in the spring of 2012 or 2013 and were employed as full-time classroom mathematics teachers at the time of the study. They had all learned about Common Core during their teacher preparations. Each teacher was interviewed four times and each interview was about an hour long.

I collected three broad categories of data. First, there was interview data from teacher responses to my questions about their understanding of the meaning of the MPs and the types of tasks that aligned with the vision of Common Core. A second source of data was discussion of examples that I shared with the teachers. These vignettes, videos, and mathematical tasks I provided enabled teachers to articulate how they saw students engaging in the MPs and how the tasks teachers provided connected to particular MPs. The final source of data was tasks teachers shared with me. Over the course of the study, each participant was asked to share three tasks from their classrooms. I requested tasks that they felt had engaged their students in one or more of the MPs. This method of investigating tasks that the novice teachers provided as a lens into their instruction, rather than observation, is similar to the technique used by Silver et al. (2009) in their study of lesson plans submitted for National Board Certification. Asking the teachers to bring artifacts from their class to the interviews allowed me to better understand how they were connecting the MPs with classroom tasks as I could both see the artifact and inquire about their decision to use it.

In order to address my research question, I analyzed my data in multiple ways. My initial data analysis included transcribing, memoing, locating key chunks of text, and initial coding. Through this initial analysis, I gained a broad sense of my data before I looked at the specific research question. At this point, I investigated further the data related to how teachers talked about task selection and the MPs. I collected all relevant text with memos and codes. I re-read and modified codes, compared across teachers, looked at all instances of a code together, re-read data, and connected codes into themes describing how teachers depicted the connections between tasks and student engagement in the MPs.

A key aspect of my data analysis was the use of the IQA Academic Rigor: Mathematics Rubric for Potential of the Task (Boston & Smith, 2009) to evaluate the tasks teachers shared with me. The MPs promote a vision of students engaging in mathematics with understanding, thus it makes sense to look at the potential cognitive demand of the tasks discussed during interviews. I used Boston and Smith's (2009) rubric for analyzing the cognitive demand of tasks that the novice teachers shared with me as examples from their classes of addressing the MPs. On this rubric, scores of 1 and 2 are low-cognitive demand tasks while scores of 3 and 4 are high-cognitive demand tasks. Thus if a task was written in a way that some might argue was a modeling problem, but it really required no more from students than using a "procedure that is specifically called for or its use is evident based on prior instruction, experience or placement of the task" (Boston & Smith, 2009, p. 155), it was classified as a 2, or low-cognitive demand task. Many times teachers gave context to a situation but were essentially asking students to practice a skill they had been taught recently and knew they were expected to use, and such tasks were assigned a score of 2. However, tasks that required students to apply a skill in a new context where using that skill was not immediately obvious were scored as high-cognitive demand.

Tasks challenging students to explain and draw connections between mathematical concepts were scored as 4s.

I worked with a second researcher in order to score the tasks, however, there were two challenges in scoring the tasks the teachers shared with me. First, some of the tasks were incomplete. Four tasks were described to me, but I was never given access to a written version of the actual task in the form it was given to students. The second researcher and I agreed that we were able to score three of those tasks based on the transcribed descriptions, but felt we did not have enough information to accurately score the remaining task. A second challenge was that some of the tasks lacked directions. This is interesting in and of itself, but for my purposes, we had to rely on what the teacher told me they did with the task as opposed to the exact oral or written directions the students received in class. In these situations we had to rely on the teacher descriptions and we were walking a fine line between the task as printed and the implementation of the task (Stein et al., 2000). Whenever possible, we maintained a focus on the task itself. The second researcher and I scored all tasks separately with a 75% inter-reader reliability. There were only two tasks in which we disagreed about the cognitive demand of the task (a score of 2 versus a score of 3). All differences were resolved in discussion.

Results

All eight teachers in the study held the MPs in high regard. The teachers frequently associated the MPs with classroom discussion, use of high-quality tasks, reasoning and sense-making, and student-centered learning. When talking about tasks that will engage students with the MPs, teachers were focused on challenging tasks as opposed to procedural ones. They also felt that the MPs meant they should be using more real-world and open-ended tasks with students. However, the teachers struggled to identify tasks that were weak in terms of the tasks' likelihood of engaging students in the MPs and did not consistently select high cognitive demand tasks to share with me. They were able to recognize tasks that somehow looked different from a standard exercise, but were not adept at judging the quality of such tasks.

Math Practices Imply Challenging Tasks, Not Procedural Tasks

In thinking about task selection, the main idea the teachers expressed was that students should be working on challenging problems in order to engage in the MPs. Felicity felt that the biggest shift indicated by the Common Core and the MPs was towards "teaching students to think and to use math to solve problems." She then talked about how it isn't so hard to teach a student to follow a procedure to solve for x, but much more challenging to help students think about and apply mathematics. Similarly, for Zoë the biggest shift was the use of "big problems" in order to engage students in the MPs. She describes big problems as non-routine, time-consuming tasks that involve mathematical discussion. Bernadette also associated engaging students in MPs with more challenging problems when she discussed giving more difficult questions in her warm-up in order to address the Common Core.

Elsie, Claire, and Maizy also connected engaging in the MPs with working on challenging tasks. When asked about how she had interacted with the MPs since she began teaching, Elsie jumped to describing good tasks she learned about. I also asked teachers if they felt they had engaged in the MPs themselves as students. Claire associated having been challenged in HS with having engaged in the MPs. Maizy said she engaged in the practices in a college class because they were given problems that they had not already been taught how to do. For these teachers being asked about the MPs led quickly to them talking about challenging tasks.

This idea that the MPs indicate students working on complex tasks permeated the interview data. Donna claimed that the MPs should influence her instruction in part by her "giving them a problem that's a little out of their reach, but they should be able to do it with the tools that they have been given and kind of work things out." Elsie also thought that the MPs should influence instruction by promoting the use of hard problems. She felt that students should not be "babied," but instead supported and encouraged to persevere. Maizy described one of the vignettes I gave as being well aligned with Common Core because the students were working on a task without a clear solution path.

The idea that challenging tasks were needed to engage students in the MPs also frequently arose when teachers talked about textbooks. Bernadette, Felicity, and Zoë all said their textbooks were full of procedural problems and thus not supportive of Common Core implementation. In order to better assist her in implementing the MPs, Zoë said "the textbook would have to come with open-ended questions instead of just example after example, it would have to, it would have to have those deep examples that could let us like dive into discussion with." Felicity talked about how a good Common Core textbook would have more application problems in addition to skills practice. Thus teachers in the study saw that the tasks their textbooks provided students impacted engagement in the MPs.

The Tasks the Teachers Shared

Recall that each teacher was asked to share three tasks that they had used or were planning on using that would engage students in one or more of the MPs. The scores for these tasks on Boston and Smith's IQA Academic Rigor: Mathematics Rubric for Potential of the Task (2009) are provided in Table 1.1. Scores of 1 and 2 indicate low-cognitive demand tasks while scores of 3 and 4 are high-cognitive demand tasks. Seven of the eight teachers associated engaging students in the MPs with providing students with challenging, non-procedural tasks. The teachers frequently used the terms challenging and complex to describe tasks, but I believe they are talking about high cognitive demand.

Table 1.1.
Scores of Tasks Teachers Shared

teacher	task 1 score	task 2 score	task 3 score

Amelia	2	2	2
Bernadette	4	2	2
Claire	2	2	?
Donna	2	1	3
Elsie	3	3	4
Felicity	4	4	4
Maizy	2	2	2
Zoë	3	2	2

Teachers were not sharing simply any problem their students had worked on that week, but examples of the kinds of tasks they would use to engage their students in the MPs. Considering the teachers' claim that students needed challenging tasks in order to engage in the MPs, and that I had specifically asked for tasks that engaged students in the MPs, I expected to see only high-cognitive demand tasks. However, more than half the tasks were classified as low cognitive demand (scores of 1 and 2). Additionally, tasks teachers shared did not improve over the course of the interviews, even though we looked at tasks that I brought to them and discussed the MPs in greater detail which could have been a learning opportunity. When the teachers talked abstractly about the types of problems that were implied by the Common Core and the MPs, they were clearly enthusiastic about implementing challenging tasks with students. However, the actual tasks they shared from their classrooms were not consistently of high cognitive demand.

Real-Life Tasks

In addition to challenging, teachers frequently described tasks that engaged students in the MPs as ones that contained real-life situations. While all eight teachers associated real-life problems with MP4, teachers also described real-life tasks as part of the larger idea of the Common Core and the MPs. Claire felt strongly that teaching students to apply mathematics to real world situations is an important idea implied by the MPs. Felicity also talked about how the Common Core brought her attention to the teaching of application problems and how she strived to have students apply their knowledge to new situations. Like Claire, she claimed that solving real world problems is what will actually matter for students later on and thus it is essential to work on problem solving skills in her classroom.

Teachers were sure that they should be using real life problems in order to meet the expectations of the Common Core, but there were some inconsistencies when they began to talk about how they interpret what is meant by real-life problems. Bernadette wanted real-life problems to be something in which students “can connect the math with a situation where they would actually need to use the math to solve” as opposed to situations where they would never actually need to use mathematics. She argued that indirect measurement problems using shadows to determine a height are less real for students. Amelia also brought up the example of such indirect measurement problems, but she felt that they were “real” if the students themselves were outside taking measurements as opposed to an example a teacher drew on the board. Even though Bernadette initially said that real-world problems should be tasks students would actually use mathematics to solve, later she enthusiastically described a volume problem determining if meatballs would cause a pot to overflow as real-life. Thus Bernadette’s thinking about what constituted real-life seemed inconsistent. Felicity thought about real-life problems as contextualized situations that the students can use mathematics to make sense of. She contrasted this idea with a standard list of word problems from the end of a unit. Felicity described a real-life task she gave her algebra students that required them to make sense of different pieces of evidence using mathematics and then construct an argument about someone’s guilt or innocence. She also felt that a task I showed her involving students mathematically describing a pattern of buttons was a good real-life problem. Interestingly, Claire describes this same buttons task as an example of modeling, but not a real-life problem.

So the teachers in this study were not all in agreement about exactly what constituted a real-life problem.

Teachers in the study associated CCSSM with the use of real-world tasks. Such tasks needed to be more than a psuedocontext problem in which contextual knowledge is unrelated to answering the question. They were less sure if real-life problems should be something that students see in their world and would actually use mathematics to solve or if a real context the teacher created/brought to them was sufficient.

Open-Ended Tasks

In addition to characterizing tasks that engage students in the MPs as real-life, six teachers also talked about using open-ended questions. Amelia, Bernadette, Claire, Elsie, Felicity, and Zoë all said that using open-ended tasks is part of implementing the Common Core and the MPs. While there was support for the idea of open-ended questions, it was less clear how teachers defined this term. Amelia talked about how it is hard to have textbook open-ended questions when the answers are in the back of the book and Bernadette mentioned using questions with more than one correct answer, but very few questions in the tasks these teachers provided were open-ended. Elsie and Claire both described open-ended tasks while answering questions over the course of our interviews. The one teacher that provided me with concrete open-ended tasks was Felicity. For example, one of her tasks required her discrete mathematics students to apply what they had learned in a graph theory unit to design the organizational structure, sales routes, floor plan, and staffing of a start-up business. Felicity had designed the project herself and she was one of the two teachers that gave me three high cognitive demand tasks. Thus while teachers claimed open-ended tasks were crucial for addressing the MPs, there was less consistency among the group both around what made a task open-ended and selecting such tasks for use in their classrooms.

Math Practices Happening with Low Cognitive Demand Tasks

While teachers claimed that the MPs implied students working on challenging tasks, they did not identify tasks that were not of high cognitive demand. In general, the teachers claimed the tasks I asked them to look at, read about in vignettes, or watch students working on in videos were all good tasks. In this section, I will describe how teachers talked about two low cognitive demand tasks and what this indicates about how teachers relate tasks to the MPs. During one of the interviews, teachers were asked to review four tasks, only two of which would be considered high-cognitive demand using the RQI rubric. One of the low-cognitive demand tasks used playing cards to model simplifying radicals. Similar to the "get out of jail" idea (where students learn that a number can get out from under a radical as long as it has a partner), students can take cards out of their hand that are pairs (or later trios or foursomes). This is compared to using perfect square factors to rewrite a radical expression. Students are then asked to apply this technique in some exercises. Participating teachers were asked if they thought this was a good task, using their own criteria for what constituted a good task. All eight teachers thought this was a good task and all rated it first or second in terms of how likely (of the four tasks I showed them) they would be to use it with students. Claire said, "I really liked task C. I was going to ask you where you got it because I am actually teaching radicals in a couple of weeks and I would love to use something like this. So I would definitely use task C." Even Felicity who selected high cognitive demand tasks herself claimed of this task, "I really liked that one." Each of the participants claimed that this task would engage students in two to six of the MPs. In fact, for each MP, there were at least three teachers that claimed this task would enable students to engage in it.

The second low-cognitive demand task that was included among the four tasks was a procedural geometry task. Students were required to use the lengths given in two diagrams to determine the volume of a spice container and a pipe. As opposed to the playing cards problem, all eight teachers recognized this as a less engaging task. They described it as “basic,” “straightforward,” and requiring “not much thought.” However, when I asked about opportunities and constraints for engaging students in the MPs with this task, teachers listed off MPs that the task addressed. Five of the teachers claimed this task would involve MP1: Make sense of problems and persevere in solving them. Claire and Zoë both talked about modeling. In fact, four teachers connected three or more of the MPs with this task. Amelia, Claire, Elsie and Felicity all said this task was more limited in terms of student engagement in the MPs. Felicity claimed, “this one’s too easy to not be engaged in,” and was the most skeptical about its feasibility for engaging students in the MPs. So half the teachers at least commented that this task was not as conducive to engaging students in the MPs, but then claimed it would or could engage students in many different practices.

The data about these two tasks shows that 1) the teachers did not necessarily recognize low cognitive demand tasks and, 2) even when they acknowledged a task wasn’t very good, they still attribute MPs to it. So even though they said that in order for students to engage in the MPs they needed challenging tasks, the teachers did not point out a poorly designed tasks and also claimed a procedural task would engage students in several MPs.

Conclusions and Implications

The participants had many reform-minded ideas about the types of tasks they should use with students, but did not consistently select tasks that aligned with their vision. There was a strong sentiment among the participants that the MPs implied a classroom where students were working on challenging tasks as opposed to more procedural ones. However, as demonstrated through the teaching artifact aspect of my data collection and analysis, the teachers had difficulty in differentiating between higher and lower-cognitive demand tasks. They identified the procedural task that I showed them, but were enthusiastic about another low-cognitive demand task that was not so clearly an exercise. Additionally, more than half the tasks the teachers shared with me were of low cognitive demand. They shared tasks that looked different from worksheets with exercises, but still required no more from students than applying a procedure that was specifically called for. While some participants may have been working hard to find and implement good tasks, they were not necessarily strong evaluators of tasks and may not have been implementing any high cognitive demand tasks. The teachers were able to talk abstractly about good tasks, but when it came to the concrete selection of tasks, they did not consistently select high cognitive demand activities for students to work on. Elsie and Felicity each shared three high cognitive demand tasks, while no other teacher provided me with more than one such task. Similar to other research analyzing the tasks teachers select as exemplars of their teaching (Silver, 2000; Silver, et al., 2009), the teachers in this study did not consistently choose high-cognitive demand tasks. Furthermore, this perceived but unjustified belief that they were aligning with CCSSM is similar to research on NCTM reforms (Frykholm, 1996; Ferrini-Mundy & Schram, 1996).

Implications for Teacher Education

CCSSM have only recently replaced individual states' mathematics standards and it remains to be seen how they will affect classroom practice. To date, there is not a significant amount of research, particularly not about the MPs, and thus this study adds to the knowledge base as these latest standards begin to be in effect. The novice teachers in this study were enthusiastic and supportive of the MPs. Their experiences in teacher preparation had left them excited about implementing these practices with students. This excitement about the MPs should be leveraged into helping pre-service teachers develop a deeper understanding of the MPs and how to select tasks that will engage their students in the practices.

Teachers in this study clearly understood the importance of the tasks they selected and agreed that engaging students in the MPs required providing them with challenging tasks. These novice teachers left teacher preparation with a message about the importance of high quality tasks, but without the ability to find and evaluate them. Research suggests that high cognitive demand tasks are associated with improved student learning (Stein et al., 2000; Stein & Lane, 1996; Hiebert et al., 2005; Boaler & Staples, 2008) and one of the keys to improving classroom practice as stated in NCTM's *Principles to Actions* (2014) is that teachers "implement tasks that promote reasoning and problem solving." Thus, helping teachers develop better task selection abilities is essential to translate CCSSM into high quality mathematics for all students. Pre-service teachers should spend time evaluating tasks and discussing the mathematics students could potentially learn from engaging in different tasks. Assignments that require pre-service teachers to search the internet for tasks and activities, evaluate them, and bring them to class, can lead to in-class discussions about how to evaluate tasks and what sites seem to have high-quality tasks. This type of work while under the supervision of the university could enable teachers to be more successful at choosing high-quality tasks for their students.

Similar to previous studies (Esnor, 2001; Borko, et. al., 2000; Gainsburg 2012; Frykholm, 1996), my work points to the difficulties teachers face as they try to take their university learning and implement it in their own classrooms. Better connections between the methods course, the seminar, and the on-site work regarding the MPs would enhance the traditional student teaching experience. The university supervisor should support pre-service teachers in making use of what they learned about the MPs in their methods course. Cooperating teachers should be carefully selected and understand the university's expectations of the student teacher engaging students in the MPs. In collaboration with the university supervisor, the cooperating teacher must aid the student teacher in translating more abstract understanding of mathematical tasks and the MPs into day-to-day practice in the classroom. The theory of situated cognition points to the importance of new teachers developing this knowledge in the actual setting in which it will be used—the secondary classroom (Brown et al., 1989; Borko et al., 2000). Teachers participating in this study frequently reported limited interaction with the MPs during their teacher preparation program.

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