ABSTRACT

Title of Dissertation: PROSPECTIVE TEACHERS' NOTICING AND NAMING OF STUDENTS' MATHEMATICAL STRENGTHS AND SUPPORT OF STUDENTS' PARTICIPATION

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This dissertation is a sequential qualitative case study that describes how prospective teachers begin to use strengths-based language and support students' participation after participating in a digital learning experience on noticing and naming students' mathematical strengths. The central research question guiding this work is: **What feedback statements do prospective teachers (PTs) make before and after they receive explicit support for using strengths-based language and is there evidence of PTs' sustained learning following this support?** First, this study collected and analyzed prospective teachers' feedback statements to students before and after a digital learning experience on noticing and naming students' mathematical strengths (LessonSketch). The primary analysis used qualitative thematic coding to describe the type of language (strengths-based, mixed language, deficit-based, or uncommitted) used by six prospective teachers when making feedback statements and to qualify feedback statements. The secondary analysis followed two of the prospective teachers into field placements to determine if there was any evidence of sustained learning (as measured by PTs' reflections on learning and moves in the classroom to support students' participation). This study found that most (5 of 6) PTs moved from uncommitted or mixed language feedback statements to strengths-based feedback statements as a result of the digital learning experience. PTs went from mostly emerging strengths-based statements on the pre-assessment (20 of 28 statements) to primarily meaningful strengths-based statements on the post-assessment (22 of 28 statements). The overall finding from the secondary analysis is that while both PTs (Alicia and Marissa) showed positive shifts in their moves to support students' participation only Marissa found the practice of noticing and naming students' strengths as fundamental to her learning and teaching practice. On the other hand, both cases highlight examples of Marissa and Alicia, making specific and public feedback statements to position a student's contribution positively and assign competence to students. Finally, tensions arise when PTs evaluate students' responses for smartness while continuing to rank students' responses and emphasize correctness.

PROSPECTIVE TEACHERS' NOTICING AND NAMING OF STUDENTS' MATHEMATICAL STRENGTHS AND SUPPORT OF STUDENTS' PARTICIPATION

By

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Dedication

This dedication is to my mom, my first mathematics teacher.

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I want to thank my family and friends for their support, understanding, and love throughout my time as a graduate student, especially my brother, for housing me for all six years. Thank you to the larger Center for Mathematics Education community at the University of Maryland for your constant encouragement and support, especially Eileen for your e-mail check-ins to keep me writing and Pat for serving as my first advisor. And lastly, I want to thank Dana Grosser-Clarkson and Angela Stoltz specifically for being there since Day 1, reading and rereading drafts, and answering my phone calls - I'm so lucky to have shared so much of my time in graduate school with both of you.

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List of Abbreviations

AMTE	Association of Mathematics Teacher Educators
CI	Complex Instruction
NCTM	National Council of Teachers of Mathematics
NNSMS	Noticing and Naming Students' Mathemaical Strengths
PBTE	Practice-Based Teacher Education
PT	Prospective Teacher

CHAPTER 1: INTRODUCTION

My Story

I introduce this dissertation study with three brief stories about my prior experiences as a mathematics learner, a mathematics teacher and swim coach, and a mathematics teacher educator because I hope to acknowledge how these experiences shape my thinking and give readers insight into my professional and personal motivations behind this study.

As a K-12 mathematics student, my AP Calculus teacher once asked to share my work with the class after a quiz on the first and second derivative tests. I remember the sense of pride that I felt as the other students passed identical papers with my response to the quiz up and down the aisles of the classroom. I did not receive a perfect score on the quiz (many students did), but I carefully created and labeled tables to show my work, and my AP Calculus teacher wanted to recognize the value in me taking such a methodical and organized approach. However, this moment in class was only part of the story, for many weeks prior to that quiz I went in at lunch for help and when that was not enough; my supportive (and influential) AP Calculus teacher even agreed to spend time after school tutoring me in prior concepts as I had entered AP Calculus underprepared and without a solid foundation of the necessary algebraic techniques to succeed in the course. Her support and positive feedback were essential to my success as an AP Calculus student and influential in my choice to become a secondary mathematics teacher.

For my first job, I was a teaching assistant for the swim lessons program at my community pool, and now more than 15 years later, I continue to coach a summer swim team. Every Tuesday morning during the competitive phase of the season we gather for my favorite activity when the swimmers sit politely in a circle ready to clap as coaches call out swimmers' names and time improvements and hand out ribbons denoting the number of seconds dropped. In our swim team newsletters, we congratulate winners and record breakers alongside the time improvements, but for those moments in practice when everyone is clapping, it is solely about effort and hard work. I spent five years as a secondary mathematics teacher, and in the classroom I also looked for creative ways to support students to participate and recognize effort and hard work: I used a ticket system to reward students for participation and effort and drew tickets at the end of each quarter for homework passes, erasers, and snacks. While I now try to avoid, or at least balance, extrinsic rewards with intrinsic rewards when teaching, I continue to think about how to recognize and support students' diverse ways of participating and make a note of their improvement and hard work.

As a graduate student, I taught several mathematics methods courses before the conception of this study, and those teaching experiences influenced my development of this study. One pivotal moment resulted after the prospective teachers in one of my methods courses read chapters from Jo Boaler's work *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages and Innovative Teaching* and participated in a class session focused on equity and access. At the time, it was also my first reading of the book, and like my students, I felt Jo Boaler's words spoke to me as a teacher and learner of mathematics. Anecdotally, I started to hear my prospective teachers speak differently about their students and look more carefully for potential issues of status and participation in their classrooms. Seeing these changes led me to reorganize the methods class to foreground concepts of equity and access and spend more time on these topics. After making these changes, I wanted to study and document them, and the result is this dissertation.

Introduction

How prospective mathematics teachers develop a vision of teaching and utilize their knowledge, strategies, and resources for the complex and contingent practice of teaching is a central issue for mathematics teacher education and research. In general, prospective mathematics teachers are expected to quickly learn about mathematics concepts, instructional practices, and teaching resources and integrate and feature this expertise during planning, instruction, and assessment. However, given the time constraints of most teacher preparation programs, prospective teachers may not be "accomplished novices," let alone experts, and are often left underprepared and with few resources to support their continued professional development (Hiebert, Morris, & Glass, 2003, p. 205). This means mathematics teacher preparation programs and teacher educators must be strategic about what prospective mathematics teachers learn and how they engage prospective mathematics teachers in this learning. Moreover, prospective mathematics teachers need resources and experiences that position them to continue to hone their practice and professional vision once they have entered the teaching profession.

Meanwhile, prospective mathematics teachers often balance the teaching internship, final teaching portfolios, and coursework with the aim of learning how to actually teach and to do so in a way that is ambitious. Ambitious teaching means prospective mathematics teachers must attend to aspects of equity, access, and inclusion to create learning opportunites for all students (Kazemi & Waege, 2015), use groupworthy tasks to attend to (and address) status and participation issues in the classroom (Cohen & Lotan, 2014), and do so by utilizing multiple resources and core teaching practices (Lampert, Boerst, & Graziani, 2011). Thus, teaching ambitiously requires teachers to consider and understand all students' thinking and adjust their instruction and practice appropriately to promote learning (Anthony, Hunter, & Hunter, 2015). In general, there is a call for teacher preparation programs to prepare teachers for teaching "that is more socially and intellectually ambitious than the current norm" (Lambert et al., 2013, p. 226). This call stems from our education system "underperforming in terms of both what it produces and for whom; it is a system that has never guaranteed or delivered high-quality education to all students" (Ball & Forzani, 2011, p. 17). In summary, ambitious teaching is often an unrealized ideal that aims for excellent teaching as well as equitable experiences for students in classrooms and schools.

With the aim of preparing teachers to teach more ambitiously, there is a current trend of moving traditional teacher preparation closer to the work of teaching and the practices that make up that work (Zeichner, 2012). This practice-focused curriculum "would not settle for developing teachers' beliefs and commitments; instead, it would emphasize repeated opportunities for novices to practice carrying out the interactive work of teaching and not just to talk about that work" (Ball & Forzani, 2009, p. 503). Focusing on practice is not simply learning about ambitious teaching - prospective mathematics teachers need opportunities to carefully examine and practice the work of teaching with direct attention to issues of equity and access (Ball & Forzani, 2009; AMTE 2017). This means using examples of teaching to create experiences for prospective mathematics teachers to notice around, engage in, and investigate practices of teaching that include opportunities to study, observe, practice, analyze, and reflect on and around those practices.

Implementation of practice-based teacher education (PBTE) can vary, but a unifying feature of these experiences is a "systematic focus on developing [prospective teachers'] abilities to successfully enact" a set of core instructional practices (Zeichner, 2012, p. 378). These core instructional practices make up the work of ambitious teaching and include practices such as: anticipating students' responses prior to the lesson (Smith & Stein, 2011; Smith, Bill & Hughes, 2008), posing purposeful questions to elicit and build on student thinking (NCTM, 2014; Grosser-Clarkson, 2016), orchestrating classroom discourse and leading a discussion (Ghousseini, 2015; TeachingWorks, 2018), and interpreting student work and providing feedback to students (NCTM, 2014; TeachingWorks, 2018).

While many PBTE programs are emphasizing core instructional practices there are also growing criticisms of this movement: A significant critique of PBTE and core instructional practices is an overemphasis on teaching routines and moves without foundational commitments to equity (Philip et al., 2018). Thus a practice-based approach to teacher education can result in a decentering of justice, "reductive definitions of practice and improvisation," and a decontextualization of teachers and their students that either replicates or ignores "systems and hierarchies of power in classrooms and society" (Philip et al., 2018, pp. 2-9). Moreover, teacher education programs with courses on diversity, equity, and access typically focus on theory, reflection, and prospective teachers' beliefs and these courses are not integrated with teaching methods courses emphasizing core practices (Kavanagh, 2017). On the other hand, Kavanagh (2017) sees potential in core instructional practices as "conceptual tools for supporting novices in the development of a vision of high-quality teaching that is content rich, rigorous, and meaningful to students, and if taken up by educators focused on social justice, aimed at interrupting inequitable disparities between social groups" (p. 166). This means teacher educators using core instructional practices must "(re)emphasize the social, cultural, political, and situated dimensions of teachers' practices" to truly (and necessarily) value the "diversities and complexities" central to teaching and centering justice by "making questions of justice - Justice for whom? And according to whom? - the precondition for practice" (Philip et al., 2018, pp. 9-10).

In response to this separation of core practices from issues of equity and access, there is a need for scholars and practitioners to work together to develop approaches that center social justice and recognize the relational and situational aspects of teaching while utilizing a practice-based approach to teacher education focused on core practices (Kavanagh, 2017). For example, Jilk (2016) uses video club with practicing teachers to notice and name students' mathematical strengths and investigate issues of status and participation in the classroom whereas Cohen and Lotan (2014) focus on using groupworthy tasks and instructional strategies such as assigning student roles to disrupt these issues of status and participation. More generally, core instructional practices centered on social justice and equity can include “interrupting prejudice,” “leveraging empowering cultural patterns and interrupting marginalizing cultural patterns,” empowering students, and “integrating content representing nondominant groups” (Kavanagh, 2017, p. 168).

For this dissertation work, the focal core instructional practice centered on equity and access is *noticing and naming students’ mathematical strengths* (NNSMS). When teachers make an effort to notice and name students’ strengths and resources, they position students as competent learners and doers of mathematics (Cohen & Lotan, 1997; Jilk, 2016) and in turn, this supports students in developing positive mathematics identities (Martin, 2000). Focusing on students’ strengths also broadens conceptions of what counts as doing mathematics (Crespo & Featherstone, 2012) and helps students to view their classmates as intellectual resources by conveying to students what ideas and whose ideas are important and valuable (Boaler, 2008). This work positions the practice of NNSMS as an entry point for mathematics teachers (especially prospective teachers) to the practice of assigning competence (Cohen & Lotan, 1997). Assigning competence (see Cohen & Lotan, 1997) is defined as naming an intellectual strength in a student(s)’ contribution that is being used to make progress on a task or further students’ understandings in a public setting. In terms of equity and access, assigning competence is a strategy for interrupting or countering issues of status and participation at the classroom level because teachers can use assigning competence to counteract unproductive, narrow, and yet widespread beliefs about who can be smart and what counts as mathematical strengths (Horn, 2012; Jilk, 2016; Bannister, Kalinec-Craig, Bowen & Crespo, 2018).

Finally, assigning competence is not to be conflated with praise as assigning competence refers to responsive feedback that is public, relevant, and specific in terms of the intellectual strengths required by the mathematics task (Bannister, Kalinec-Craig, Bowen, & Crespo, 2018).

Because assigning competence is a difficult practice for even experienced teachers to learn (see Jilk, 2016) and assigning competence occurs within a complex and contingent classroom space, it is important for mathematics teacher educators to decompose core instructional practices such as assigning competence into teachable components. Grossman, Compton, and colleagues (2009) focus on how to approximate aspects of instructional practice by identifying and targeting teachable components of core instructional practices and by utilizing representations of practice to reduce complexity and support prospective mathematics teachers' learning and development. This is especially important for prospective mathematics teachers as they are in the "formative stages" of learning how to "privilege students' mathematical ideas over their own" (Bannister, Kalinec-Craig, Bowen, & Crespo, 2018, p. 15). While prospective mathematics teachers' engagement in authentic classroom scenarios remains a valued, integral part of methods instruction, it is also helpful to create opportunities for learning and practice that help mathematics teacher educators moderate some of the complexities of teaching (Bannister, Kalinec-Craig, Bowen, & Crespo, 2018).

To examine how prospective mathematics teachers learn about and begin to notice and name, students mathematics strengths this study assumes it is critical to articulate what prospective mathematics teachers are learning and how prospective mathematics teachers are using this core instructional practice (if at all) during practice-based course experiences as well as in field placements. The purpose of this study is to describe how prospective teachers (PTs) begin to use strengths-based language and support students' participation after participating in a digital learning experience on NNSMS. Specifically, this research will look at the type of language and quality of prospective teachers' feedback statements as well as prospective teachers' learning integral to NNSMS by analyzing PTs' assignments from a secondary mathematics methods course with practice-based learning opportunities and classroom transcript data from PTs' teaching internship during and after the methods course. The central research question guiding this work is: **What feedback statements do prospective teachers (PTs) make before and after they receive explicit support for using strengths-based language and is there evidence of PTs' sustained learning following this support?** A sequential qualitative case study was used to operationalize this research question. The sub-questions for the first portion of the study are intended to describe the type of language (strengths-based, mixed language, deficit-based, or uncommitted) used by six prospective teachers when making feedback statements and to qualify feedback statements as emerging, developing, or meaningful by examining the type of language, mathematical evidence, justification of evidence, and teacher reasoning strategy for each statement. The sub-questions for the second portion of the study address how PTs begin to support students' participation and evidence of sustained learning (as measured by PTs' reflections on learning and moves in the classroom to support students' participation).

PTs are uniquely and purposefully positioned as learners and teaching interns during their time in a teaching preparation program. Thus, broader considerations for this work are how do prospective mathematics teachers learn about and practice core instructional practices in teacher preparation courses and then implement these core instructional practices during their teaching internships. In terms of preparing prospective mathematics teachers to learn about and do the work of teaching this study uses a situated learning perspective that recognizes teachers learn in a variety of contexts including but not limited to in the classroom as well as through professional development (Borko, 2004) such as work in teacher education courses. This includes taking into account the PTs as well as the social systems in which they participate and allows for a "dual focus" on prospective mathematics teachers' experiences in the teaching internship and specific teacher preparation courses (Borko, 2004, p. 7).

The primary significance of this study is its contributions to the qualitative body of literature in the United States on PBTE for prospective mathematics teachers and the implications of these contributions on mathematics teacher preparation. These contributions include describing what prospective mathematics teachers learn given a set of practice-based course experiences and whether or not there is any sustained learning for two PTs. Also, by looking at patterns across a set of two PTs, it is possible to articulate differences in terms of how particular course-based experiences supported aspects of prospective mathematics' teachers learning and use of noticing and naming students' mathematical strengths and more generally, moves to support students' participation and highlight tensions that arose. Finally, this study aims to bridge "the divide between theory and practice in teacher education [that] is best exemplified by the historical separation between university-based coursework and fieldwork in local K-12 schools" (Grossman, Hammerness, & McDonald, 2009, p. 275) by linking practice-based course experiences to the teaching internship for prospective mathematics teachers by providing opportunities for PTs to reflect on and about their own practice. Using a case-study approach allows for rich data collection, including when and how prospective mathematics teachers notice and name students' mathematical strengths as well as how often and how well.

This study found that most PTs can make meaningful strengths-based feedback statements, and this study provides an analytical framework for how to measure the quality of strengths-based feedback statements. This study also highlights the intersections of other core instructional practices with NNSMS and assigning competence and how some practices such as monitoring students' work can be leveraged with this practice whereas other practices such as evaluating students' work for correctness may be in tension with assigning competence. Finally, this study shows how essential it is to study PTs' use of core instruction practices during methods courses as well as into field experiences to capture a broader picture of teachers' learning as the two PTs in the case study had similar experiences in the digital learning experience, but the classroom case studies highlight probable differences in their learning.

Overview of the Document

To situate this study, Chapter 2 contains a review of the relevant literature on teacher support of students' participation including foundational literature on complex instruction and ambitious mathematics teaching as well as a synthesis of empirical studies on assigning competence and noticing and naming students' mathematical strengths. The remainder of Chapter 2 conceptualizes practice-based teacher education for this study by highlighting two key components: Core instructional practices and pedagogies of practice. Chapters 3 and 4 detail the methods and methodology for this sequential qualitative study and provide the context of the study, including an overview of the secondary mathematics methods course and relevant course assignments. Chapter 5 addresses research question one as it presents the results from the digital learning experience on NNSMS, including the type of language and quality of each feedback statement. Chapters 6 and 7 highlight two PTs' moves to support students' participation and assign competence as well as any evidence of sustained learning from the methods course and digital learning experience. Chapter 6 shows Alicia's use of strengths-based language that values and evaluates students' contributions and her diverse ways of supporting students to participate. Chapter 7 depicts Marissa's learning progression in terms of her moves to support students' participation and her understandings of assigning competence. Chapter 8 situates the findings from Chapters 5, 6, and 7 in the literature and offers scholarly and practical implications as well as future directions.

CHAPTER 2: LITERATURE REVIEW

This chapter explores research that is foundational to this study including literature on complex instruction which is an approach to teaching centered on implementing groupworthy tasks and utilizing equitable teaching practices to support students' participation and disrupt issues of status as well as literature on practice-based experiences in teacher education with an emphasis on core instructional practices. More specifically, this review will define assigning competence and noticing and naming students' mathematical strengths (NNSMS) by drawing on literature which situates teaching and learning within broader societal contexts that send cultural messages about what counts as mathematics and who is capable of mathematics. The next section is a discussion of teacher learning with a theoretical perspective that foregrounds the social and contextual nature of learning. This section also attends to research on the decomposition of pedagogical practice and how mathematics teacher educators can design courses and course experiences to approximate and represent aspects of practice inherent to teaching mathematics.

Equitable Mathematics Teaching Practices

Teaching for equity and access means supporting opportunities for all students to learn mathematics and create and develop their mathematical knowledge meaningfully. This is reflected in recent policy documents and professional learning guides as they focus on ensuring "all students are ready for success after high school" (Common Core State Standards, 2010) as well as "mathematical success for all" (NCTM, 2014). Equitable mathematics teaching is shaped by "what counts as math," "pedagogical practices," and "relational practices [that] address the relationships students build with others" (Horn, 2012, p. 10). For new and prospective teachers (PTs), the Association of Mathematics Teacher Educators (AMTE) calls for "well-prepared beginning teachers" to use an equity-based pedagogy by planning and structuring learning "to provide access, support, and challenge to learning mathematics" and by "considering students' individual needs, cultural experiences, interests, and prior mathematical knowledge" (2017, p. 13). Equitable mathematics teaching practices can include drawing on students' knowledge, establishing classroom norms for participation, positioning students as capable, "monitoring how students position each other," "attend explicitly to race and culture," "recognizing multiple forms of discourse and language as a resource," "pressing for academic success," "attending to students' mathematical thinking," and "drawing on students' funds of knowledge" (Bartell et al., 2017, pp. 11-12). However, the field of mathematics education research has struggled to account for the ways in which mathematics education perpetuates issues of status and reproduces oppressive norms and failed to recognize how equitable mathematics teaching requires moving beyond implementing new curriculum or using specific teaching practices (Chao, Murray, & Gutierrez, 2014) and this includes research on teacher noticing (see Louie, 2018).

This research joins a growing body of mathematics education research (e.g. Ball, Ben-Peretz, & Cohen, 2014; Ghousseini & Herbst, 2016; Ball, Sleep, Boerst, & Bass, 2009; Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010) that is based on the premise that PTs need deliberate opportunities to learn to teach ambitiously. Ambitious teaching calls for teachers to "teach in response" to what students think, say, and do when problem solving and doing mathematics while also setting high expectations for all students (Kazemi, Franke, & Lampert, p. 11, 2009). This type of teaching is a more ambitious approach than the current standard as it requires teachers to attend to and respond to all students' thinking to deepen students' understanding of concepts and to increase students' engagement in solving relevant complex problems (Mcdonald, Kazemi, & Kavanagh, 2013; Lampert & Graziani, 2009; Thompson, Windschitl, & Braaten, 2013). To prepare prospective teachers to teach ambitiously there are assumptions made that this involves a consistent, yet flexible set of core instructional practices that are learnable and teacher educators can teach the skills and knowledge necessary for prospective teachers to learn about and be able to do these practices (Lampert & Graziani, 2009).

Complex Instruction

One specific approach to advancing an equity agenda in PreK-12 classrooms is Complex Instruction (CI) (Cohen & Lotan 1997; 2014) as "it aims to disrupt typical hierarchies of who is smart" by promoting equal-status interactions amongst students and recognizing students' diverse abilities and ways of contributing in a collaborative learning environment (Cohen & Lotan, 2014; Jilk & Erickson, 2017, Sapon-Shevin, 2004, p. 3). CI recognizes that everyone has strengths and something to contribute and everyone has ways to improve and something to learn (Cohen & Lotan, 2014; Jilk & Erickson, 2017). There are three principles of CI, when enacted together, support students' participation and learning in mathematics classrooms: A curriculum organized around big [math] ideas that challenges students and affords multiple points of entry, participation norms for inclusive group work, and interventions to disrupt status hierarchies in the classroom (Cohen & Lotan, 1997; 2014). In classrooms, these hierarchies are formed and reinforced and can affect students' access, participation, and learning (Cohen & Lotan 1997; Jilk & Erickson, 2017) as students "who are perceived as more competent are assigned high status and tend to participate and learn more" (Jilk & Erickson, p. 14, 2017). The practice of assigning competence has its foundations in CI because "supporting the mathematical learning of all students means supporting the participation of all students" (Horn, 2012, p.12).

Assigning Competence to Students

Providing feedback to students "helps focus students' attention" on specific aspects of their work given the feedback is specific, focused on the mathematical task, and supportive of "students' perceptions of their own capability" to learn and do mathematics (TeachingWorks, 2018). One instructional practice that provides a specific and intentional way to provide feedback and support student participation is the practice of assigning competence. Assigning competence is defined in this study as publicly naming a specific "intellectual strength" a student is using "to move the groupwork forward or further the team's mathematical understanding" and connects to students' learning (Cohen & Lotan, 1997; Jilk, 2016, p. 191). With the practice of assigning competence, "the public dimension is important as other students learn about the broad dimensions that are valued, the intellectual dimension ensures that the feedback is an aspect of mathematical work, and the specific dimension means that students know exactly what the teacher is praising" (Boaler, 2008, p. 172). However, a significant difference between giving feedback or praising students versus assigning competence is that assigning competence intends to disrupt issues of status and participation in a classroom to create a more equitable learning space for all students.

Equity-based practices such as assigning competence integrate teaching practices such as focusing on student learning and building on students' responses with practices such as building relationships with students, believing in students' competence, and attending to students' interactions with each other (Horn, 2012). For prospective mathematics teachers, this means learning about students' experiences, being able to identify students' resources and strengths, and applying this knowledge to teaching to be ready to "challenge policies and practices grounded in deficit-based thinking" (AMTE, 2017, p. 22). Specifically, prospective mathematics teachers must consider students' needs and strengths, cultural background, personal interests, and prior knowledge (Leonard, Brooks, Barnes-Johnson, & Berry, 2010; AMTE, 2017), and see and position students as mathematical resources and authors of ideas (Crespo & Featherstone, 2012; Jilk & Erickson, 2017). Engaging in equity-based teaching practices, expanding what counts as mathematics, and valuing students' mathematical contributions (even when incorrect) can lead to teachers and students developing a sense that all students have something valuable to contribute to the mathematical conversation (Boaler, 2008). Assigning competence to a student with low-status in the classroom can lead to two sources of positive expectations: The students gain positive expectations from displaying competence on the task as well as positive expectations held by other students for competence from being successful for that particular task, but often it is most difficult to change the expectations students have for themselves (Cohen & Lotan, 2014). If a teacher publicly assigns competence to a low-status student, other students often believe that evaluation, and once this assessment is accepted, it is likely to lead to more participation of and give more influence to the low-status student in the future (Cohen & Lotan, 2014). To assign competence, teachers must observe low-status students and notice what low-status students are contributing as well as create opportunities for low-status students to participate (Cohen & Lotan, 2014). Overall, assigning competence and recognition of the multiple and diverse ways students contribute in the classroom lead to higher rates of participation by low-status students, and more equal-status interactions which can narrow the participation gap in classrooms (Cohen & Lotan, 1995; 2014). As Gloria Ladson-Billings writes, "students treated as competent are likely to demonstrate competence" (1997, p. 703).

Practicing mathematics teachers use assigning competence to bring the group's attention to a particular student's idea (Boaler & Staples, 2008), to encourage students to explain their mathematical ideas, to take ownership of the mathematics, and to develop a sense of their own capability to do mathematics (Battey, Neal, Leyva, & Adams-Wiggins, 2016), and to value students' partial understandings and sophisticated ways of thinking (Johnson, 2017). More generally, teachers should consider mistakes a regular part of sense-making and doing mathematics (Stigler & Hiebert, 1999) and aim to develop a broader acceptance of student contributions which should signal to students a broader conception of mathematics and doing mathematics (Horn, 2012). At Railside School, Boaler named assigning competence as one of seven practices of complex instruction coupled with detracked classrooms that led students to perform significantly better on mathematics achievement tests (2006). A case study of two practicing teachers found that both their classrooms "expanded collective notions of competence, and were successful in supporting students to demonstrate their mathematical learning" (Johnson, 2017, p. 111). While this research on when and why practicing mathematics teachers assign competence to students provides a conception of what this practice looks like in mathematics classrooms, these studies provide little evidence as to how practicing and prospective mathematics teachers can learn to do this practice indicating a need for additional research.

However, not all types of praise or positive feedback count as assigning competence and the content of the feedback, who receives the feedback, and when are all important when making this distinction. Positive feedback that is personal and focuses on the student rather than the student's contribution, sets low expectations for students, and is unspecific or focused on behavior can be detrimental to student outcomes and students' identities (Hattie & Timperley, 2007). For example, Mueller and Dweck (1998) found that when fifth-graders were asked to solve mathematics problems, students given effort-based praise were more likely to show a willingness to try new approaches and demonstrated more resilience than students given praise that focused on their ability. Praise of students (rather than students' contributions) is counterproductive and may have negative consequences on students, and while almost all students like to receive praise, some students do not prefer loud public praise (Hattie & Timperley, 2007). Moreover, positive feedback including feedback specific to the task is often infrequent in the classroom and this makes documenting feedback in the classroom difficult (Bond, Smith, Baker, & Hattie, 2000).

For all teachers, it is challenging to notice strengths as teachers often focus on deficits, are trained to identify students' mistakes, and teachers may have a narrow view of what counts as mathematics (Jilk, 2016). For prospective mathematics teachers, this work can be especially challenging as they are still learning to value students' thinking (over their own) and they must avoid attempts to replace students' thinking with their own ways of thinking and methods of problem solving (Bannister, Kalinec-Craig, Bowen & Crespo, 2018). This means mathematics teachers may need an entry point for assigning competence and one potentially productive entry point for learning to do this practice is to first learn how to notice students' mathematical strengths in a classroom and then to practice naming students' mathematical strengths using a sentence stem (Jilk, 2016; Bannister, Kalinec-Craig, Bowen & Crespo; 2018).

Noticing and Naming Students' Mathematics Strengths

During teaching it is essential that mathematics teachers learn to focus on students' strengths because focusing on strengths helps mathematics teachers position students as competent learners and doers of mathematics (Cohen & Lotan, 1994; Horn, 2012; Jilk, 2016). "Every student brings strengths into the classroom and it is up to us, as teachers, to identify and capitalize on those strengths for everyone's benefit" (White et al., 2018, p. 270). Moreover, repeated affirmation messages can encourage and improve performance and potentially raise group morale (Rowe, 2008). For example, McDuffie and colleagues (2014) focused prospective teachers' attention on students' resources and students' potential rather than deficits by using video analysis. White and colleagues (2018) found generating and categorizing strengths into a taxonomy as beneficial in terms of identifying and highlighting strengths and recognizing that every student can participate in a mathematics classroom. They organized students' strengths into five broad categories:

mathematical knowledge, motivation, doer of mathematics, communication, and problem solving while also acknowledging that there may be other mathematical strengths that require teachers "to know the student on an individual basis" (White et al., 2018, p. 271). However, even when teachers build positive relationships with students, recognize students' strengths, and know all of their students that still may not be enough. As Martin states, "it is very likely that mathematical competencies linked to the cultural contexts and everyday life experiences of African American children are under-assessed and under-valued because their competencies do not fall within dominant views of what counts as mathematical knowledge" (2009, p. 16).

In video club, Jilk (2016) used the sentence frame: "I think it was smart when (name of student) did/said (evidence from the video), and I think this was smart because (how does this strength support students' learning?)" (p. 195) to provide a consistent but flexible way to NNSMS. With the sentence frame resource, Jilk (2016) found that teachers made gradual shifts in how they noticed and named students' mathematical strengths but often struggled to name the strengths in ways that were "generative and student friendly" (p. 194). With regard to prospective mathematics teachers, Kalinec-Craig, Bannister, Bowen, Jaques & Crespo (in preparation) found that while almost every prospective mathematics teacher was able to use Jilk's (2016) strengths-based sentence frame during a digital learning experience, there was variety in terms of the mathematical understandings and ways of participating noticed by prospective mathematics teachers. Moreover, while many students in a mathematics classroom may display multiple strengths, teachers can have "difficult[ies] identifying evidence of any strengths for a few of [their] students" (White et al., 2018, p. 272).

These studies reflect the need for additional research on how practicing and prospective teachers learn to support students' participation and explicitly assign competence to students by NNSMS and when and why prospective mathematics teachers are assigning competence. The next portion of the literature review focuses on how to teach PTs to assign competence, beginning with a broader look at practice-based teacher education.

Practice-Based Teacher Education

Practice-based education privileges what teachers say and do over what teachers know because "practices such as providing feedback to students cannot spread just by describing them or advocating for their use. They have to be seen, observed, experienced, interpreted, inquired into, tried [out], and so on" (Hargreaves & Fullan, 2012, p. 140). For this study, practice-based teacher education (PBTE) refers to coursework and learning experiences for prospective mathematics teachers that are focused on instructional practice and include multiple opportunities to practice instructional practices or aspects of these practices (e.g., Kazemi, Franke, & Lampert, 2009), and these opportunities are situated in K-12 classrooms and utilize representations (i.e., classroom transcripts, case studies, simulations, or videos) of K-12 classrooms (Zeichner, 2012). For meaningful PBTE experiences, PTs need opportunities to learn about and to begin to enact instructional practices. Thus, mathematics teacher educators and scholars must consider how prospective mathematics teachers learn these aspects of the practice and relate these aspects more broadly to their knowledge of teaching and learning. This core instructional practices approach to PBTE is fundamentally different from previous efforts in teacher preparation that focus on mastery of teaching through skill development and practice (see Zeichner, 2012) because it includes a necessary orientation toward using and interpreting student thinking (Forzani, 2014; Neel, 2017). However, if implemented improperly PBTE can lead to a scripting of instruction that undermines teachers' adaptive expertise by "narrowing the role of teachers to that of technicians" (p. 378) as well as a primary solution to improving students' learning outcomes that ignores existing and pervasive inequities in schools and classrooms in the United States (Zeichner, 2012).

Core Instructional Practices

Core instructional practices are pedagogical practices that are fundamental to teaching and critical to helping students learn, in the literature they may be referred to as "core practices" (Mcdonald, Kazemi, & Kavanagh, 2013; Ghousseini, 2015), "generative practices" (Jacobs & Empson, 2016; Franke & Kazemi, 2001), or "high-leverage practices" (Ball & Forzani, 2009; Sleep & Boerst, 2012; TeachingWorks, 2018). These practices are generative, ideally used regularly by all teachers regardless of the subject area, grade level, or context and are central to students' learning of content and supporting students' socioemotional development (TeachingWorks, 2018). Grossman, Hammerness, and McDonald (2009) present six criteria for core instructional practices: 1) Occur frequently in teaching, 2) Prospective teachers can begin to master, 3) Prospective teachers can enact across different contexts using various instructional approaches, 4) Allow prospective teachers to learn about students and teaching, 5) Are research-based and can potentially improve students' learning outcomes, and 6) "[P]reserve the integrity and complexity of teaching" (p. 277). Using core instructional practices aligns with a call from the AMTE that "well-prepared beginning teachers of mathematics use a set of [core instructional] practices that are effective for developing students' meaningful learning of mathematics" (2017, p. 15). To learn core instructional practices, prospective mathematics teachers cannot rely solely on the knowledge, skills, and dispositions necessary for a particular practice — they must also focus on the decisions and actions that are necessary or central to learning about and engaging in that core instructional practice (Ball & Forzani, 2009; Ball & Forzani, 2011). Thus, this study assumes teacher educators need to create authentic learning opportunities for prospective mathematics teachers that go beyond the development of knowledge and provide multiple practice opportunities for prospective teachers to do the interactive and contingent work of teaching (Ball & Forzani, 2009).

While there is a consensus that content and more importantly teaching methods are central to day-to-day teaching, there is a lack of common language and curriculum in teacher education to describe core instructional practices (Ball & Forzani, 2011; McDonald, Kazemi & Kavanagh, 2013). Currently, there is only some agreement about the core instructional practices that prospective teachers should be able to do well before they enter the teaching profession and no assessment that measures their ability to do these practices (Grossman & McDonald, 2008; Forzani, 2014). For mathematics teacher preparation, this means scholars and practitioners must heed calls for a "common language" and a framework for explicating "(a) how teachers learn to practice and (b) the pedagogies teacher educators enact to support teachers in learning to practice" (McDonald, Kazemi, &

Kavanagh, 2013, p. 381). As Forzani (2014) notes, we must move beyond descriptions of what happened in PBTE and move toward capturing the links between core instructional practices and student outcomes to improve teacher education. However, as noted by Grossman, Compton, and colleagues (2009) often these practices (e.g., planning a sequence of lessons) are too broad and PTs must first learn individual components of these practices and have opportunities to practice these components before PTs engage in more complex and contingent teaching experiences.

Pedagogies of Practice

This study utilizes the work of Grossman, Compton, and colleagues (2009) for its pedagogical framework, which describes three pedagogies of practice: representations of practice, decompositions of practice, and approximations of practice. Pedagogies of practice is a framework for conceptualizing how to teach the practices of teaching in mathematics teacher education, whereas core instructional practices are practices for teaching. The concept of decomposing practice was useful for thinking about NNSMS as one component of assigning competence, which is one move teachers use to support students' participation. Grossman, Compton, and colleagues (2009) suggest that it is beneficial for teacher educators to decompose core instructional practices into distinct, teachable components. This approach lets prospective teachers "hone their skills in a single element [...] before they have to manage all the competing demands and conditions of uncertainty in actual practice" (Grossman, Compton, Igra, Ronfeldt, Shahan & Williamson, 2009, p. 2092). PTs "need learning experiences that challenge their assumptions of students' mathematical competence and help them learn to privilege students' mathematical ideas over their own" as they are "in the formative stages of shifting from identifying and thinking as students to doing so as teachers" (Bannister, Kalinec-Craig, Bowen, & Crespo, 2018, p. 15).

When considering how to teach a core instructional practice, teacher educators must note how close the prospective teachers' engagement with the core instructional practice is to the actual work of performing the practice. Grossman, Compton, and colleagues (2009) describe approximations of practice as "opportunities for novices to engage in practices that are more or less proximal to the practices of a profession" (p. 2058). Approximations of practice provide low-risk opportunities for PTs to try specific elements of teaching in controlled conditions and then learn from their engagement in the practice and reflection on the practice (Webel & Conner, 2017) while also providing a space for teacher educators to give feedback and support (van Ingen, 2013). Approximations of practice are strongly connected to the work of teaching because they recreate some of the complexity of teaching and they have the potential to make aspects of a practice learnable (Ghousseini & Herbst, 2016). Approximations of practice also support reflection, and they provide a process for improving specific components of practice (Webel & Conner, 2017). Approximations of practice include rehearsals (Kazemi, Franke & Lampet, 2009; Ghousseini, 2017), student interviews (Moyer & Milewicz, 2002; Nicol, 1998), micro-teaching lessons (van Ingen, 2013; Griffiths, 2016), and teaching simulations (Webel & Conner, 2017; Baldinger, Selling, & Virmani, 2016; Lampert et al., 2013; Shaughnessy, Boerst, & Ball, 2015). For example, PTs may initially practice listening to students' thinking by interviewing one student or interviewing a small group of students before learning to listen to and manage students' thinking in the classroom as a whole (Moyer & Milewicz, 2002). Approximations of practice can also be leveraged to create opportunities for PTs to respond to students' thinking to simulate some of the complexity of responding in-the-moment (Fleming, Grosser-Clarkson, & Bowen, 2015; Webel & Conner, 2017) without the use of a high-stakes setting such as a live classroom.

Representations of practice use artifacts of teaching such as classroom observations, classroom transcripts, videos of teaching, case studies, digital learning experiences, animations, simulations, and lesson plans. "Representations of practice comprise the different ways that practice is represented in professional education and what these various representations make visible to novices" (Grossman, Compton, Igra, Ronfeldt, Shahan & Williamson, 2009, p. 2058). The type of representation determines what aspects of practice are made visible and the extent of that visibility and often with representations of practice the novice teacher has access to an experienced teachers' actions and thinking (Grossman, Compton, Igra, Ronfeldt, Shahan & Williamson, 2009). Chapter 4 describes the approximations and representations of practice that were central to this study.

A Conceptual Framework for Teacher Learning of NNSMS

To best support prospective mathematics teachers' learning, teacher educators need a framework to guide prospective teacher learning as well as a pedagogical framework to explicate how PTs are learning and beginning to use core instructional practices (Ghousseini & Herbst, 2016). Darling-Hammond, Hammerness, Grossman, Rust, and Shulman (2005) emphasize “the interrelationship of these [different] pedagogies to one another” (p. 441) and theorize that teacher education pedagogies may be leveraged together to improve learning opportunities for PTs. An integrated framework is critical as core instructional practices (and how PTs learn them) can serve as an organizational framework for PTs to utilize, build upon, and refine their professional vision, knowledge of content and students, dispositions and beliefs, and resources (Windschitl, Thompson, Braaten & Stroupe, 2012). Foundational to teacher learning and practice development is identifying PTs as situated learners within a variety of contexts, including teacher preparation courses and teaching internships (Borko, 2004). This perspective recognizes what PTs can learn in the context of a university methods course is different than what PTs can learn during field experiences (Grossman, Compton, Igra, Ronfeldt, Shahan & Williamson, 2009). For example, assigning competence requires certain understandings about the content as well as understandings about the context, including who the students are in the classroom. In addition to knowledge of content and students, prospective mathematics teachers may need to develop certain dispositions and beliefs before being able to enact a core instructional practice successfully but at the same time practicing the core instructional practice may also help prospective mathematics teachers develop those dispositions and beliefs: For example, Jilk (2016) found that when practicing mathematics teachers participated in a video club focused on NNSMS they developed more ways of viewing students’ contributions as mathematically smart but these teachers also had extensive training in equity pedagogies.

While a framework for teacher learning is useful for describing what prospective mathematics teachers should know, it does not articulate how prospective mathematics teachers should develop these understandings (Ghousseini & Herbst, 2016). An integrated framework provides a way "to examine the opportunities for teacher learning" afforded by the three pedagogies of practice for a specific core instructional practice (Ghousseini & Herbst, 2016, p. 80). An integrated framework has the potential to capture what prospective mathematics teachers should learn and how they should learn it (Ghousseini & Herbst, 2016). The remainder of this section highlights the interconnectedness between aspects of teacher learning and pedagogies of practice because pedagogies of practice serve as a way to facilitate teachers' learning and this section highlights the need for an integrated framework.

Teachers should learn in teaching and professional contexts that enable them to develop a vision of their practice that draws on their knowledge of content and students and is guided by their dispositions about how to use this knowledge, and a set of practices, tools, and strategies to support their decisions and instruction in the classroom (Hammerness et al., 2005; Ghousseini & Herbst, 2016). Ghousseini & Herbst (2016) use this particular framework to address three challenges in teacher education: the apprenticeship of observation (see Lortie, 1975), the problem of enactment (see Kennedy, 1999), and the complexity of teaching (Hammerness et al., 2005). And, this work evolves from researchers and scholars efforts to develop frameworks for what all new and prospective teachers "need to know, be like, and be able to do" (Zeichner, 2012, p. 377).

For mathematics teachers, Sherin and van Es (2003; 2009) describe professional vision as involving the ability to notice and interpret specific events in the classroom including what teachers select to and attend to and how they apply their knowledge to reason about classroom events. Thus, a vision of practice includes being able to notice and interpret events in the classroom while appropriately applying theories of learning and teaching as well as knowledge of content and students to make decisions (Ghousseini & Herbst, 2016). A vision of practice can also include examples of good teaching that give an idea of quality (Moss, 2011) and it helps new teachers see where they are going with their practice (Feiman-Nemser, 2001). A professional vision of teaching can guide decision making and is informed by a teacher's knowledge about content and students and dispositions or beliefs about teaching and learning, and realized through a set of practices, tools, and strategies that allow new and prospective teachers to apply their knowledge to carry out their vision of teaching (Hammerness et al., 2005; Ghousseini & Herbst, 2016).

Knowledge of students and content and an understanding of how to support students to learn and engage with the material are key to teaching in ways that are responsive to students (Ball & Wilson, 1996). Teachers "need to know the content" *and* "understand the kind of reasoning" and conceptual understandings that are necessary when doing mathematics and they "should be able to interpret student work in light of what students already know" (Ghousseini & Herbst, 2016, pp. 82-83). Knowledge of content and students means "knowing about students" and "knowing about mathematics" and can include anticipating student responses and what students might say and do when given a mathematical task as well as common student mistakes or patterns of thinking (Ball, Thames, & Phelps, 2008, p. 401). Even within the subject of mathematics, "different content involves different mathematical opportunities and challenges in terms of the mathematics itself, the cognitive and social resources children bring to the lesson, children's engagement with the mathematics, and the teachers' level of comfort with the mathematics" (Jacobs & Empson, 2016, p. 186). Moreover, knowledge of content and students is not just crucial for teaching; it is essential for teacher noticing (Sherin, Jacobs, & Philipp, 2011) if teachers are going to teach ambitiously.

Dispositions for using this knowledge and beliefs about teaching are also critical to how PTs learn and develop, and these beliefs and dispositions may be in tension with or complement PTs implementation of core instructional practices. To be able to teach ambitiously and utilize core instructional practices, prospective mathematics teachers must believe "all students are capable of participating [in] and [learning] in mathematics" and that good mathematics instruction leverages students' resources and experiences to "support and enhance mathematics learning" for all students (NCTM, 2014, p. 63). At the classroom level, prospective mathematics teachers must resist thinking about who will do well on a task and instead focus on how to make the task available to all students and counter the pervasive myth that some people are "math people" and that these "math people" are the smartest people (Boaler, 2016). Not only must a prospective mathematics teacher be able to learn from their practice, but they must also be able to do so in a generative way.

Finally, a set of practices, strategies, and tools could support prospective teachers' learning about and initial enactments of essential aspects of practice and core instructional practices (Ghousseini & Herbst, 2016). Tools such as talk moves (Chapin, O'Connor & Anderson, 2013), questioning sequences (Ghousseini, Beasley, & Lord, 2017), and Jilk's (2016) sentence frame for NNSMS can provide prospective and practicing mathematics teachers with specific strategies to enact during instruction. Resources may also describe the practitioner articles PTs are asked to read during preparation programs as well as resources such as lesson plan templates and protocols (e.g., *The Thinking Through A Lesson Protocol*, see Smith, Bill & Hughes, 2008) that provide specific strategies for planning or completing a task of teaching. In addition to having access to these resources and being able to use these resources flexibly, PTs need multiple opportunities to try out these resources and strategies. While it is essential to make learning goals clear to prospective mathematics teachers and create opportunities around these goals, how to teach these goals, and how to measure learning necessitates a pedagogical framework. Chapter 4 gives additional consideration to pedagogies of practice, and teacher learning goals connected to the mathematics education course and data sources that are central to this study and the next chapter describes the methods for this study.

CHAPTER 3: METHODS

Introduction

This sequential qualitative case study investigated prospective teachers' (PTs) use and quality of strengths-based feedback statements before and after explicit support and opportunities to practice NNSMS and examined PTs' moves to support students' participation. The initial analysis used qualitative coding to describe the type of language (strengths-based, mixed language, deficit-based, or uncommitted) and to qualify feedback statements used by six PTs when making feedback statements. Next, a within-case analysis followed two PTs who made meaningful statements on the post-assessment into field placements to determine if there was any evidence of sustained learning (as measured by PTs' reflections on learning, moves in the classroom to support students' participation, and analyses and reflections on teaching). This two-part approach allows for an in-depth description and understanding of two PTs (Alicia and Marissa) to develop narratives for what happens in the classroom after both PTs made meaningful strengths-based feedback statements on the post-assessment for the digital learning experience on NNSMS.

Position of the Researcher

Before describing the methodology of the study, I must acknowledge my dual role in this study as an instructor and a researcher. I was the instructor for the second methods course (Methods II), the site of the study, that I describe below and in detail in the next chapter. Course assignments for Secondary Methods II and data collected during the class (see Chapter 4) make up the majority of this data. Because of my position as the instructor and the researcher, the study participants were not chosen until all course grades were submitted, per IRB agreement. I also modified and reorganized components of Methods II in 2017 to foreground issues of equity and access and used equity and access to frame PTs' learning of core instructional practices (see Chapter 1). In 2016, I joined a LessonSketch Inquiry team using digital learning experiences to support PTs to notice and name students' mathematical strengths. These course changes, and my work with a multi-institutional LessonSketch inquiry group focused on studying how MTEs can help PTs to NNSMS were key motivating factors for this study. In particular, I'm interested in how teachers use feedback statements (teachers' responses to students' mathematical contributions and ways of participating) to support all students to participate.

Research Design

This section provides the research questions, details on the context and participants, and procedures for data collection and analysis, including examples of coding.

Research Questions

The central research question guiding this study is: **What feedback statements do prospective teachers (PTs) make before and after they receive explicit support for using strengths-based language and is there evidence of PTs' sustained learning following this support?**

Subquestions for Part 1 of Study:

RQ1A: What types of feedback statements do prospective teachers (PTs) make before and after they receive explicit support for using strengths-based language in a digital learning experience?

RQ1B: What is the quality of PTs' feedback statements before and after the digital learning experience (as measured by the type of language, mathematical evidence, justification, and teacher reasoning strategy)

Subquestions for Part 2 of Study:

RQ2A: What moves do PTs use to support students' participation after the digital learning experience on NNSMS?

RQ2B: Is there any sustained learning for PTs around the practice of NNSMS (as measured by support of students' participation, reflections, and analyses on teaching, and interview on teacher learning)?

Context

The context of this study was a semester-long secondary mathematics methods course (Methods II) at a large mid-Atlantic public university in the USA, attended by eight teacher candidates (PTs) and taught by one mathematics teacher educator (author). This course is the second of three methods courses for PTs in a graduate-level teacher preparation program that also requires PTs to complete a year-long student teaching internship in a PreK-12 classroom, to participate in an action research inquiry project, and to produce a performance-based teaching portfolio in April of their spring semester. To be enrolled in this course, participants must be in the master's certification program at the university and be completing certification in secondary mathematics, middle school mathematics and science with an emphasis in mathematics, or computer science. The PTs take two courses each semester during the fall and spring. One of these courses both semesters is a secondary mathematics methods course, and the other courses focus on diversity and reading. Methods II took place in the Fall of 2017, and Chapter 4 describes the course in depth.

Participants

All seven of the secondary mathematics PTs enrolled in Methods II chose to participate in the study. Five of seven PTs were in the secondary mathematics program, and two PTs were in the middle school mathematics and science program. Five of the PTs were in a teacher preparation pathway that included some of the coursework for the program during the PTs' undergraduate program (referred to as the BME pathway). These five PTs completed an undergraduate degree from the university in mathematics in the Spring of the previous semester and took the same initial teaching methods course in the sequence of three methods courses during their enrollment in undergraduate education. The two PTs in the middle school mathematics and science program completed their undergraduate degrees elsewhere, and these two PTs completed the same initial teaching methods course during the prior Summer (referred to as the ME pathway). Of these 7 participants, 6 of these PTs agreed to participate in at least one interview following the completion of the Methods II course, and five of the participants completed two interviews. One participant did not meet program requirements at the time of the interviews and therefore excluded from the study. Table 1 lists the participants and includes their program as well as grade level or course for the teaching internship. Melissa chose to participate in the study but opted out of the interview component.

Table 1 *Participants in the Study*

Prospective teacher	Program	Grade level or course for teaching internship
Alicia	ME	8th-grade mathematics (Algebra I)
Ellen	BME	Algebra II
Lindsey	BME	Algebra II
Marissa	BME	Algebra II
Melissa	ME	7th-grade mathematics
Valeria	BME	ESOL Algebra I

Methodology

This study used a two-part approach to analysis and first identified PTs making meaningful strengths-based feedback statements following a digital learning experience on NNSMS then followed two of those PTs into the classroom. A within-case study analysis is appropriate for this study as this study describes how two PTs learned to do this practice rather than to make comparisons across those PTs in the secondary analysis. A case study method is appropriate to gain a deeper understanding at an in-depth level (Yin, 2015) of what PTs learn about supporting students' participation and NNSMS. Qualitative case studies require a thorough and holistic approach and analysis of a bounded context (see Merriam, 2009) such as PTs' experiences in a methods course as in the case of this study. Using multiple sources of evidence to address the research questions provides an opportunity for synthesis of the data to establish converging lines of evidence (Yin, 2015) which will allow for a robust and an in-depth analysis of the two cases.

For Part 1 of the study, all PTs in the secondary math methods course (Methods II) completed a digital learning experience on NNSMS (detailed in Chapter 4) which included making feedback statements and noticing statements about students' work in the pre-assessment and post-assessment activities. Part 2, data from the pre-assessment and post-assessment were analyzed to determine the type of language and quality of the feedback statements and to select cases for part of the study. In terms of case selection, an analysis of the data for Part 1 led to two PTs selected for case study analysis. I selected two PTs (Marissa and Alicia) because of their transitions from uncommitted statements or evaluative strengths-based feedback statements to meaningful strengths-based feedback statements and they spoke highly of their mentor teachers and both regularly used (or adapted) the *Mathematics Vision Project Curriculum* (mathematicsvisionproject.org) for lessons in their class as required by their local district. I excluded Valeria because her classroom and feedback statements to students were in two languages and required additional work to translate and classify. I excluded Melissa because she was unable to participate in the two interviews as part of the data collection. I excluded Lindsay and Ellen after the analysis for Part 1 of this study because the digital learning experience did not support these PTs to make meaningful strengths-based feedback statements. For all research questions, I used Excel for coding, organization of data, to obtain counts, and to compile codes and recode data.

To examine if PTs experienced sustained learning around the practice of noticing and naming students' mathematical strengths when providing feedback, two classroom transcripts were collected and analyzed following the NNSMS digital learning experience and checked with data from interviews, instruction commentaries, journal entries and course reflections to create a holistic picture of PTs' use of feedback statements. This analysis also helped situate and contextualize feedback statements made by PTs by looking broadly at how PTs support students to participate in the classroom. The four components of teacher learning presented in Chapter 2 (i.e., professional vision, knowledge of content and students, dispositions and beliefs about teaching, and a repertoire of resources strategies and practices) synthesized with findings on teachers' moves to support students participation to create the narrative cases presented in Chapters 6 and 7. The initial analysis used classroom transcripts from two self-selected videos taped in November of 2017 and March 2018 to look at feedback statements made by the two selected cases: Alicia and Marissa during teaching but after the LessonSketch digital learning experience. After identifying feedback statements in the transcripts, this analysis utilized the same analytical framework as RQ 1A as it looked at the type of language for each feedback statement and classified the feedback statements by quality. A secondary analysis identified instances when Alicia and Marissa used teaching strategies or practices to support students to participate and confirmed these instances with instruction commentaries for each transcript. After coding for Part 2, I wrote analytical memos for Alicia and Marissa's journal reflections, course reflection, and interview data and then these memos were reorganized to weave together aspects of teacher learning with Alicia and Marissa's moves to support students' participation into three themes for each PT.

Data Sources and Collection

This section describes the data sources and the process for data collection. There are three primary components of data collection: (1) Data collected from the Methods II Course (see Chapter 4), (2) a Performance-Based Teaching Portfolio described below, and (3) the interview of the PTs.

Data Collection

The data collection for Part 1 of this dissertation focused on pre-assessment and post-assessment data from a digital learning experience on NNSMS that took place during a portion of one class (beginning of November) of the Secondary Math Methods II. Additional details on the digital learning experience are in Chapter 4. Participants primarily completed the digital learning experience on NNSMS in class with Marissa returning to explore the digital learning experience on NNSMS over the weekend as evidenced by timestamps included in the raw data. The feedback statements made on the pre-assessment and post-assessment of the digital learning experience were used to address RQ1A and RQ1B. Course assignments including analyses and reflections on teaching, the final teaching portfolio PTs submitted at the end of the preparation program, and one semi-structured interview were collected to address RQ2A and RQ2B to obtain a more holistic picture of the prospective mathematics teachers' learning. For RQ2A two classroom transcripts (15 - 20 minutes in length) and accompanying instruction commentaries were collected to provide a window into PTs' moves to support students' participation and strategy (if any) behind those moves. Table 2 links the data sources with the research questions. The data sources for RQ1A and RQ1B are from the pre-assessment and post-assessment for the digital learning experience on NNSMS described in Chapter 4 and all of the prompts for the digital learning experience are in Appendix B.

Table 2 *Alignment between Research Questions and Data Sources*

Research question	Data sources
RQ1A: What types of feedback statements do prospective teachers (PTs) make before and after they receive explicit support for using strengths-based language in a digital learning experience?	Digital Learning Experience on NNSMS Prompts 5 and 6 on Module 1 and Prompts 3 and 4 on Module 4
RQ1B: What is the quality of PTs' feedback statements before and after the digital learning experience (as measured by the type of language, mathematical evidence, justification, and teacher reasoning strategy)	Digital Learning Experience on NNSMS Prompts 5 and 6 on Module 1 and Prompts 3 and 4 on Module 4
RQ2A: What moves do PTs use to support students' participation after the digital learning experience?	Transcript 1 and 2, Instruction Commentaries 1 and 2
RQ2B: Is there any sustained learning for PTs around the practice of NNSMS (as measured by support of students' participation, reflections and analyses on teaching, and reflections on teacher learning)?	Transcript 1 and 2, Instruction Commentaries 1 and 2, Course Reflection, Interview, Journal Entries

The transcript from the first video recording, journal entries, digital learning experience, instruction commentary 1, and course reflection were course work for Methods II. The last video and written analysis were for the final performance-based assessment. Table 3 describes the timeline for data collection across the academic year and the context for each of the data sources.

Table 3 *Summary of Data Sources*

Dates	Data sources	Context
August – December 2017	Journal entries	Methods II
November 2017	Digital learning experience on NNSMS	Methods II
November 2017	Video transcript 1	Field placement
November 2017	Instruction commentary 1	Methods II
Mid-December 2017	Course reflection	Methods II
February 2018	Video transcript 2	Field placement
April 2018	Instruction commentary 2	Performance-based assessment

All of the data collection from August - December 2017 consisted of data collected directly from Methods II and did not require any additional effort by the participants. Participant interviews took place approximately ten weeks after the conclusion of the course and approximately two weeks after the lesson for transcript two took place.

Data Sources

The data sources used to capture prospective teachers' use of strengths-based language in feedback statements (RQ1A), and quality of feedback statements (RQ1B) are the pre-assessment and post-assessment data from the digital learning experience on NNSMS which included two prompts each as detailed below. The two transcripts (from two lessons) and the two accompanying instruction commentaries are the data sources to address RQ2A. The journal reflections, the course reflection, and the interview were used with the results from RQ2A to address RQ2B and create narrative cases on teacher learning (see Table 3). There are several primary data sources for RQ2B to create a holistic picture there is data that capture PTs' practice (Transcripts 1 and 2), analysis and reflection on practice (Instruction Commentaries), and PTs' learning (Journal Entries, Course Reflection, Interview). The data sources are in chronological order.

Journal reflections. The in-class journal entries provided a space for PTs to reflect on what they have learned from a particular class session and set of practitioner readings and indicate how they would apply it in their field experience. PTs were expected to respond to weekly prompts, to read the specific prompts for each journal reflection, see Appendix A. Almost all of the journal entries were in class and PTs typically wrote for 5 – 10 minutes and were also given time to share parts of their response with classmates. For example, during the third week (a class focused on equity and access) PTs' reflected on: What issues of equity, access, or status have you noticed in your own classroom? During week 6, a class focused on anticipating students' responses, PTs reflected on: Why might you want to anticipate both correct and incorrect approaches to solving a task? The journal entries also included PTs' reflections after conducting weekly assignments including, a student survey and classroom observations on who participates and how. One limitation, with the journal entries, is that the prompts did not specifically address feedback statements as the prompts tended to focus on broader issues of teaching and learning. For example, the journal entry before the class session focused on NNSMS asked PTs to write about assessment, formal and informal assessments, and learning to notice but did not explicitly tell PTs to write about feedback statements.

Digital learning experiences. A digital learning experience that focused on NNSMS was created using the LessonSketch Platform (www.lessonsketch.org). The LessonSketch platform includes comic-based representations of teaching in a useful format for the kinds of transformative experiences that help PTs learn core instructional practices (Amador, Weston, Estapa, Kosko, & Araujo, 2016; Herbst, Chazan, Chen, Chieu, & Weiss, 2011). The NNSMS LessonSketch Experience for secondary mathematics PTs contained four modules including the introduction with pre-assessment, a learning module, a practice module, and a reflection with a post-assessment module (see Chapter 4 for a detailed description of the NNSMS LessonSketch Experience for secondary mathematics PTs). Table 4 presents the text of the two prompts analyzed in Chapter 5, and a list of all prompts by module for the NNSMS LessonSketch Experience is in Chapter 4. Most PTs spent almost two hours working on the four modules, meaning for most PTs, pre-assessment data was captured approximately two hours before post-assessment data, one PT (Marissa) asked for additional time to work on Modules 2 and 3 (learning and practice) outside of the designated time in class.

Table 4 *Prompts from the NNSMS Lesson Sketch Experience*

Pre-assessment (Module 1)	Post-assessment (Module 4)
1. Write a statement about this student's thinking that could be said to the student or shared publicly during whole-class discussion.	1. Now that you have practiced making teacher noticing statements, write a statement about this student's mathematical thinking that could be said to the student or shared publicly during whole-class discussion.
2. Now, return to the group of sixth-grade students discussing the smoothie box task. Write a statement about each student's mathematical thinking that could be said to the student or shared publicly during whole-class discussion.	2. Now, return to the group of sixth-grade students discussing the smoothie box task. Write a statement about each student's mathematical thinking that could be said to the student or shared publicly during whole-class discussion.

Note: The numbering in the table is to indicate alignment between the prompts and is not indicative of the prompt's placement (question number) in the module.

Video recordings and related analyses. Participants submitted two video recordings to demonstrate how they implemented teaching practices and strategies while in their teaching internships. The first video recordings were up to 15 minutes, and the second video recording is approximately 15 - 20 minutes. Each transcript came from one lesson, and each PT submitted two portions of video for each transcript. The first video recording was completed toward the end of Methods II (roughly 11 weeks into the 15-week course) and was performance-based. The PTs were asked to select a 10-15 minute video segment of their teaching and respond to several reflective prompts (See Appendix C). The prompts for this assignment are taken directly from the edTPA performance based-assessment PTs complete the following spring and specifically address broader components of supporting students to participate including creating a positive learning environment, connecting instruction to students' assets and prior learning, and eliciting and building on students' responses (SCALE, 2016). The second video recording was in the spring semester as part of the performance-based assessment portfolio (edTPA). Both the second and third recordings took place after all Methods II Sessions that focused on NNSMS. Thus, Transcript 1 and Transcript 2 were data sources for the types of feedback statements PTs made after participating in the Methods II Sessions focused on NNSMS as well as data sources for the moves PTs used to support students' participation. Finally, it is essential to note that both Transcript 1 and 2 come from lessons that are intended to be exemplars of PTs' teaching experiences and the PTs' were able to select a video from two to three recorded lessons and then select two video clips within the lesson. Thus, the transcripts may not have been representative of PTs' day-to-day teaching and instead some of PTs' best work. The instruction commentaries were incredibly pertinent as they were used to confirm findings in Transcripts 1 and 2 because they captured specific intentions behind PTs' moves to support students' participation seen in the transcripts.

Video transcription. Transcripts were made for each of the video recordings (Video 1 and Video 2) in April 2018 following the completion of each PTs' interview and finished in June 2018. This study used an online transcription service for all data sources, and then I went over each transcription with the recording to check for errors and add gestures to clarify how PTs' supported students' participation at particular moments. In terms of the cases, both of Alicia's videos and Marissa's first video, it was sometimes difficult to see who was contributing because the video camera rarely moved. Even when the video follows Marissa in the second transcript, there were still two times when it was impossible to identify who contributed because the student contributed off-camera or more than one student was speaking. When it was impossible to identify who contributed, the voice was assigned a new name even if the student may have already appeared elsewhere. This decision means in Alicia and Marissa's first transcripts and Alicia's second transcript there may be an overrepresentation of the number of students participating because of this choice, and in Marissa's second transcript there may be an overrepresentation by one or two students. This limitation shows that video transcripts may have limitations when looking along dimensions of assigning competence such as how students are participating, who is participating and how often even though it is useful for analysis along the dimension of teacher moves to support students' participation.

Course reflection. The PTs submitted a course reflection (see Appendix D) at the end of Methods II. The course reflection asked PTs to discuss what they have learned during the class and how it will assist them to improve their teaching practice and to identify strengths and strategies for capitalizing on them, as well as areas for improvement. PTs received a list of course topics and resources for all sessions, including a prompt about assigning competence and NNSMS and the digital learning experience. This data source will be used to capture PT's self-reported learning during Methods II, directly following the PTs' completion of the course. A limitation of using the course reflection is that PTs were not required to reflect on any particular topic and the course reflection included a prompt about assigning competence and noticing and naming students' mathematical strengths but not specifically about feedback statements.

Interview. The interview took place in March, approximately two months after the participants submitted their fall course reflection and one to two weeks after they completed the videotaping for Transcript 2 but before PTs' completion of the teaching portfolio including Instruction Commentary 2. The interview (See Appendix E) opened with questions that asked the PT to describe their teaching philosophy, beliefs, and dispositions about teaching, their knowledge of students and content, and what resources they utilize for teaching (if any). Next, the interview asked a series of open-ended questions that ask PTs to describe what they know about planning, instruction, and assessment, what they do on a regular or daily basis about these components of teaching, and challenges they have faced around these components of teaching (if any). After these general questions, the PTs were asked to define what it meant to notice and name students' mathematical strengths and identify any course resources or experiences that supported their learning of those practices (if any), and give an example as to how they implement this practice in their classroom (if they implement the practice). Table 5 gives the length of each interview and date of interview for each participant in chronological order.

Table 5 *Length and Date of Participant Interviews*

Prospective teacher	Length of interview	Date of interview
Marissa	36 minutes	March 2018 Listed in chronological order.
Lindsey	34 minutes	
Ellen	67 minutes	
Alicia	24 minutes	
Valeria	28 minutes	

Data Analysis and Procedures

Data analysis for this study occurred over 15 months beginning in January of 2018 after participants submitted final course assignments for Methods II and concluded in March of 2019. During Methods II, as the instructor, I read and responded to each PT's lesson plans for the video analyses, journal responses, and course reflections, and watched all of the video recordings before examination of the data. Part 1 of the data analysis identified the type of language in feedback statements and quality of feedback statements. The objective during Part 1 of the analysis was to code feedback statements for the type of language and to establish and refine measures of quality for strengths-based feedback statements by coding feedback statements from the digital learning experience pre-assessment and post-assessment. Part 2 of the data analysis focused on building cases for two of the PTs to summarize the participant's sustained learning in a narrative by examining thPTs' feedback statements and moves to support students' participation and reflections on teacher learning and practice. During Part 2 of the analysis, the priority was to code PTs' feedback statements and moves to support students' participation and then look at PTs' instruction commentaries to confirm findings and create analytical memos. The second objective was to examine the instruction commentaries, journal reflections, course reflection, and interview for facets of teacher learning related to NNSMS.

Analysis of Type of Language in Feedback Statements

Table 6 describes the analytical framework used to determine categories to describe the type of language PTs used in their feedback statements about students' thinking. This taxonomy developed from research on a prior NNSMS LessonSketch Experience for prospective elementary mathematics teachers that used the same prompts and modules but with elementary mathematics content (see Kalinec-Craig, Bannister, Bowen, Crespo, & Jaques, in preparation) and guided heavily by Jilk's (2016) work with practicing teachers to NNSMS in video club. This framework (see Table 6) was used to identify the category of language used by PTs when making feedback statements during the digital learning experience and feedback statements from the video transcripts.

Table 6 *Category of Language Used by PTs in Feedback Statements*

Code	Category	Key ideas
S	Strengths-based	States what students already know, can do and understand in terms of assets and strengths.
D	Deficit-based	States deficits in terms of what students do not know, cannot do and do not yet understand.
M	Mixed	States feedback about students' contributions with strengths-based and deficit-based language.
U	Uncommitted	States what students can do or show but not explicitly in terms of strengths or deficits.

(Kalinec-Craig, Bannister, Bowen, Crespo, & Jaques, in preparation)

Given PTs written responses from the digital learning experience, there was one feedback statement that was not a feedback statement but rather a question. This response was coded as uncommitted and not coded for additional indicators of quality. Feedback statements also contained implied questions. An example of an implied question on the pre-assessment is when Ellen writes "To the student in the yellow shirt I might ask him why he needs to know the areas of all the rectangles and what he would do with that information." However, additional choices were made when coding PTs' feedback statements in the video transcripts for type of language: If PTs used words such as "perfect," "great," "yeah" or "good" the statement was coded as strengths-based language whereas the phrases "okay" and "all right" were coded as uncommitted language and phrases that included "almost," "not," or "close" were coded as mixed-language statements. With "okay" and "all right," PTs may be using these words to position students positively, or have other intentions, so this led to a code of uncommitted. If a statement contained strengths-based language, mixed language, or uncommitted language, it was next coded to determine the quality of the feedback statement.

Analysis of Quality of Strengths-Based Language Feedback Statements

If a statement contained strengths-based language, mixed language, or uncommitted language, it was then coded to determine if it contained mathematical evidence, a justification of why the students' mathematical contribution was smart as well as teacher reasoning strategy (descriptive, evaluative, interpretive). The rationale for including a code for mathematical evidence is that assigning competence and NNSMS must be connected to students' ways of participating and mathematical understandings rather than students' good behavior or attributes such as perfect handwriting. An initial coding for mathematical evidence led to a list of fourteen categories to capture what students know, understand, and are able to do given this content centered on calculating surface area (the content in the digital learning experience): Attending to accuracy, building to a net, using context, labeling dimensions, creating a layout, checking answer, problem solving, attending to precision, using area and surface area, moving the group forward, making multiple views, checking work, and referencing directions or given information. Table 7 gives the condensed list under the broader headings of mathematical understandings and ways of participating when doing mathematics.

Table 7 *Categories of mathematical evidence*

Category	Subcategory
Mathematical understandings	Attending to accuracy or precision
	Using context or building to a net
	Labeling dimensions/creating a layout or multiple views
	Using area and/or surface area
Ways of participating when doing mathematics	Checking answer/work
	Moving the group forward/thinking ahead/predicting next steps
	Asking/posing questions to group/ teacher
	Referencing/using the directions/given information

Additionally, feedback about what students did not know, did not understand and did not do often appeared in mixed language statements and were not included in this analysis as this analysis focused on students' assets. Next, to further differentiate the quality, each feedback statement was coded for a justification. The rationale for looking at the justifications with this analysis is specifically from Jilk (2016), and the use of "because" in the sentence frame responds to a call to avoid empty praise. The justification is for why the students' contribution was essential for moving the group forward and advancing on the task. In feedback statements, the justification was always found following the words "because" or "so." The coding for teacher reasoning strategy is inspired by Sherin & van Es (2009) and the noticing literature: Teachers aim to develop in-depth reasoning about student math thinking to be able to investigate the meaning of students' ideas and methods and generalize or synthesize across student ideas rather than simply restate student ideas and give little or no reasoning about students' mathematics contributions (Sherin & van Es, 2009). Feedback statements with little reasoning were classified as descriptive if the PT repeated or described the students' contribution. If the feedback statement showed a high level of teacher reasoning it was classified as either an evaluative stance because the PT's stance focused on correctness, quickness, or comparing students or an interpretive stance when the PT went on to interpret why the student's contribution was "smart" given the task or the group's progress. If a statement contained interpretive and evaluative language, it was coded as evaluative because an essential transition in making feedback statements is from focusing on "correctness" to interpreting how a students' contribution supports or moves forward the group's learning during a task or solving of a task.

Table 8 gives examples of each language type as seen in data from the digital learning experience in this study as well as initial mathematical evidence codes before compiled into two broader categories of mathematical understandings and ways of participating but after the reduction to the final list of codes that were specific to Research Question 1 to give readers a sense of codes specific to a content area (creating a net and finding a surface area). Table 8 also gives an example with a justification as well as examples of each teacher reasoning strategy.

Table 8 *Coding Feedback Statements for Type of Language and Indicators of Quality*

Example Feedback Statements	Language	Mathematical Evidence	**Justification**	Strategy
It was smart for [the] student to show the different views for their net **because** we can take these two views and all the measurements and build a full net from it.	Strengths-based	Labeling dimensions, creating multiple views and building to a net	'because' indicates the beginning of the justification	Interpretive
The student in the teal understands the importance of labeling the box but does not understand the difference between which dimensions are necessary to label and which are extra information that is not needed.	Mixed	Labeling dimensions	N/A	Evaluative
They were completely lost and had no idea what was going on. They did not really participate because they [were] not sure of the problem.	Deficit-based	[None]	N/A	N/A
The student in the brown shirt said that their drawing has all of the measurements necessary to find the amount of cardboard needed.	Uncommitted	Attending to precision, using context	N/A	Descriptive

These indicators for quality are essential if PTs intend to use feedback statements to disrupt issues of status and participation but feedback statements can also reinforce these issues: If a teacher always recognizes and values certain types of contributions from certain students, status issues may be exacerbated rather than disrupted (See Chapter 8 for an elaboration on this argument). Given these measures of quality, I developed a classification system with three levels: emerging strengths-based feedback statements, developing strengths-based feedback statements, and meaningful strengths-based feedback statements. To read more about the initial work to create this classification system, see Kalinec-Craig and colleagues (in preparation). Table 9 summarizes the decision-making process for classifying feedback statements as emerging, developing, or meaningful strengths-based feedback statements across the four key indicators presented previously in this chapter.

Table 9 *Classifications for Quality of Strengths-Based Feedback Statements*

Quality of strengths-based feedback statement	Key indicators of quality of strengths-based feedback statements			
	Type of language	Mathematical evidence	Justification	Teacher reasoning strategy
Emerging	The statement includes a mix of strengths-based and deficit-based language (mixed language) **or** uncommitted language.	The statement may include mathematical evidence.	The statement may include a justification for the mathematical evidence.	The teacher reasoning strategy is descriptive. evaluative, interpretive or not present.
Developing	The statement includes **only** strengths-based language.	The statement includes mathematical evidence.	The statement may include a justification for the mathematical evidence.	The teacher reasoning strategy is descriptive. evaluative, or interpretive.
Meaningful	The statement includes **only** strengths-based language.	The statement includes mathematical evidence.	The statement includes a justification of the mathematical evidence.	The teacher reasoning strategy is interpretive.

Given Table 9, a feedback statement would need to have strengths-based language, include mathematical evidence, include a justification, and take on an interpretive reasoning strategy to qualify as a meaningful strengths-based feedback statement.

Analysis of Teaching Moves to Support Students' Participation

One approach to expanding the practice of assigning competence is to identify and examine how teachers support students to participate (see Johnson, 2017). Johnson's framework (2017) was an important starting point for thinking about teachers' moves to support students' participation. Initial coding for measures of teacher support of student participation looked for instances of invitation moves for student(s) to state an idea, explain their idea, to add on to another's idea, to agree/disagree with another's idea, or to compare/contrast ideas and follow-up/support moves such as probing, scaffolding, positioning, and revoicing student's ideas, as well as explicit assignments of competence and normative statements around expectations for doing mathematics.

There were two primary decisions made after an initial reading of the transcripts for moves to support students' participation. The first choice was to identify general invitations (general questions asking students to participate) as a way to parse and divide the transcript when coding for moves to support students' participation and it led to 31 general invitations in Alicia's transcripts and 36 general invitations in Marissa's transcripts. However, this unit of analysis was too small, and the unit expanded to episodes that covered multiple general invitations, and this yielded twelve episodes for each PT. These twelve episodes were divided by naturally occurring shifts when the teacher either moved to a different part of the lesson (e.g., from the warm-up to the main task), when the teacher moved from one small-group to another small-group during small-group discussions, or when the teacher moved from one question to another question on a given worksheet.

An initial coding using Johnson's framework (2017) as a guide led to two additional emergent codes added to the framework: Encouragement and Repeat and examples will be highlighted in Chapters 6 and 7. The repeat code was included to highlight the difference between PTs revoicing students' responses versus PTs asking students to revoice their response. Finally, the code of general invitation was left in the analysis as it was useful for capturing if there were broader invitations to participate in each PT's classroom such as "What did you notice about the graph?" before PTs used specific types of questions or asked specific students to participate. Table 10 gives the revised framework for the invitation and follow up moves to support students' participation. In addition to these moves, the framework also coded for normative statements defined as instances in which the teacher makes explicit statements about expectations for normative practices in doing mathematics or participating in class.

Table 10 *Revised Framework for Teaching Moves to Support Students' Participation*

Type of move	Category	Description
Invitation moves	Add on	Invitational move for student(s) to add on to another's idea. Includes inviting students to predict about what another student might do next in their strategy.
	Agree/disagree	Invitational move for student(s) to voice agreement or disagreement with an idea stated by a classmate.
	Compare/contrast	Invitation to compare the details of two or more strategies or representations, noting similarities, differences, or connections.
	Explain	Invitational move for student(s) to explain their idea or to explain what another student did.
	Encouragement	Support moves that encourage students to start to participate or encourage students to continue to

		participate.
Follow-up/support moves	Explicit assignment of competence	Instance in which the teacher explicitly praises, thanks, or otherwise deems a particular student's mathematical contribution or way of participating as productive or desirable.
	Probe	Follow-up move to probe the details of a student's idea or to press for further explanation or justification (Kazemi & Stipek, 2001).
	Position	A student's idea or way of participating is positioned positively by the teacher, a student's strategy or idea is positioned in relation to another strategy or idea (Franke et al., 2015).
	Repeat	Follow up move that asked the student (or another) student to repeat their response
	Revoice	The teacher restates or rephrases a student's idea to support other students to make sense of and engage with the idea, or to highlight or elaborate the mathematics within a student's idea (Chapin et al., 2009).
	Scaffold	Follow-up move to scaffold a student's explanation or sense-making, where the teacher takes over a portion of the mathematical work.

(Adapted from Johnson, 2017)

Analysis of Teacher Learning

The final subquestion looked for evidence of sustained teacher learning by examining PTs' professional vision of teaching, knowledge of content and students, dispositions and beliefs, and resources and strategies directly related to the practices of NNSMS, assigning competence, and supporting students to participate. Specifically, the analysis looked for PTs noticing issues of status and participation as well as student strengths and how PTs used these noticings in a manner that supported all students to participate or to disrupt issues of status and participation in their classroom. Looking at teacher learning is critical as "classroom teachers' practices are the link between teachers' attributes (knowledge and beliefs) and students' learning" (Arbaugh, 2010, p. 50). The analysis also looked for issues of status and participation that were overlooked in class but included in PTs analyses and reflections. Knowledge of content and students meant looking for examples when PTs identified or drew on students' assets and prior learning or relied on content knowledge to identify students' mathematical strengths. Dispositions and beliefs aligned with NNSMS include valuing students' mistakes, valuing students' diverse ways of participating, holding a broad conception of what counts as mathematics, and valuing students' partially correct or partially complete work. Finally, mentions of resources included the sentence frame for NNSMS (see Jilk, 2016) as well as other instructional practices and strategies PTs used to support students to participate and NNSMS including physical resources such as equity sticks or intangibles such as strategies for determining groups and assigning group roles. There were three measures to determine if the PTs' demonstrated any evidence of sustained learning around the practices of NNSMS and supporting students' participation. The first was to look for changes in feedback statements from the pre-assessment to the post-assessment, and this was useful for case selection and to establish short-term learning during the digital learning experience. The second was looking for changes in teaching moves to support students' participation as measured by an increase in the number of moves used to support students' participation and a greater variety of moves to support students' participation from transcript 1 to transcript 2. The third measure used the categories described above to look for changes in how PTs were noticing and responding to issues of status and participation and valuing and using moves to support students' participation across journal entries, the course reflection, instruction commentaries, and the interview. Before the findings chapters, an overview of the course and the digital learning experience is in Chapter 4.

CHAPTER 4: COURSE OVERVIEW FOR METHODS II

This chapter provides the reader with an overview of the Secondary Math Methods II Course (Methods II) including a description of the course and course assignments to help readers understand the types of activities that prospective teachers (PTs) experienced and provide a rationale for course components. After the comprehensive overview of the course, this chapter describes the types of pedagogies that were used to support each element and gives brief examples from the course. Next, this chapter includes a rationale for the digital learning experience on noticing and naming students' mathematical strengths (NNSMS) for prospective secondary mathematics teachers and details on each of its four modules.

Overview of Course

The Methods II course is the second of three methods courses for prospective secondary mathematics teachers. There were 15 class sessions across a 17-week semester, and the class met once per week. Methods II is concurrent with PTs' teaching internships, and the course is intended to be as relevant as possible to PTs' teaching experiences by asking PTs to explore artifacts from their own teaching. The primary course assignments are participation and attendance, weekly journal reflections, seven weekly assignments that involve investigations of practice, two classroom audio analyses, three lesson plan submissions, two lesson reflections with the second reflection including an analysis of student work, one video analysis, an annotated bibliography for the course readings, and a course reflection. Each three-hour class session was typically divided into three components: The first component was an individual journal reflection on and discussion of the readings and other issues of contemporary importance to mathematics teaching and learning. The second component included discussions relevant to the development of core instructional practices for planning, instruction, and assessment. The course explored theses practices through a variety of mathematical tasks, readings, videos, digital learning experiences, discussions, and reflections. In the third component, course participants applied the material learned during the course to three lessons they taught as part of their teaching internship. These lessons were developed throughout the course and will require course participants to use a groupworthy task with small-group or whole-class discussion opportunities. The next session details how course components including the digital learning experience used approximations and representations of practice to create meaningful learning opportunities for PTs.

Pedagogies of Practice and Methods II Components

Building from previous work (Bannister et al., 2018; Kalinec-Craig et al., in preparation) this study posits that NNSMS is a complex practice, and it is essential "for PTs to learn this practice in designed settings as it is unlikely for PTs to learn this practice independently or pick it up from their field experiences" (Bannister et al., 2018, p. 17). To support PTs to do this practice this study utilized an existing resource: Jilk (2016) and her collaborators designed a sentence frame to help teachers state their ideas about math understanding and participation norms as statements of strengths that could support students' learning: "I think it was smart when (name of student) did/said (evidence from the video), and I think this was smart because (how does this strength support students' learning?)" (p. 199). Sentence frames "provide a skeleton for the expression of an entire idea" (Nattinger, 1980, p. 340) in ways that support “learning the language of strengths,” as it is an activity that “takes time and practice” (Jilk, 2016, p. 194). The goal of the sentence frame is to support PTs to link “the observational work of noticing and the discursive work of naming students’ mathematical strengths” (Bannister et al., 2018, p. 17).

Before the digital learning experience on NNSMS for prospective secondary mathematics teachers, there were two pedagogies of practice I used to prepare PTs for making strengths-based feedback statements. The first was I modeled core instructional practices during the Methods II course because PTs must first “have an opportunity to experience ambitious teaching as learners” before teacher educators expect PTs to teach in this way (CBMS, 2012; Silver & Smith, 1996, Grosser-Clarkson, p. 59). There were two common modeling strategies I demonstrated when supporting PTs (in the role as students) to participate: Explicitly assigning competence to PTs’ contributions and positively positioning students’ contributions as they worked on mathematical tasks. Sometimes, when I positively positioned students’ responses, the PTs’ contribution or method was named after the PT (and one participant found this modeling helpful for her own practice, see Chapter 7). PTs also conducted a student survey and reflected on the survey in a journal entry because the more a prospective teacher knows about “students’ mathematical backgrounds and how students make sense of mathematics, the better that teacher is going to be able to build personal relationships with students that support their learning” (Arbaugh, p. 49, 2010). PTs also worked on mathematical tasks with a partner or in a small group to model ways of organizing the classroom and supporting students’ participation that are consistent with Complex Instruction and assigning competence. The next section gives an overview of the digital learning experience on NNSMS for prospective secondary mathematics teachers.

Using Digital Learning Experiences to Represent and Approximate Practice

To introduce PTs to the sentence frame, the study used a digital learning experience (LessonSketch) with comic-based representations for PTs to approximate assigning competence. The LessonSketch platform includes comic-based representations of teaching which are a useful format for the kinds of transformative experiences that help PTs learn core instructional practices (Amador, Weston, Estapa, Kosko, & Araujo, 2016; Herbst, Chazan, Chen, Chieu, & Weiss, 2011). Herbst and colleagues (2011) argue that "comics are useful semiotic resources for creating representations of teaching that capitalize on the advantages of written cases and video" (p. 91), and to approximate aspects of practice (see also Webel & Conner, 2017) which emphasizes the potential digital learning experiences have for supporting PTs' learning of core instructional practices. The cartoon storyboards can be used to reduce complexity to scaffold learning and make particular aspects of practice or classroom features more or less salient (Herbst, Chazan, Chen, Chieu, & Weiss, 2011). This is necessary as PTs may still need to focus on and practice particular aspects of a core instructional practice before attempting to do the core instructional practice well or in a classroom with students.

LessonSketch is promising as PTs can participate in a digital learning experience that highlights students' mathematical thinking through written work and a classroom storyboard with students' verbal responses to provide a space for PTs to

NNSMS (see Bannister, Kalinec-Craig, Bowen, & Crespo, 2018). By examining these cases (and other representations of practice) before actually attempting to NNSMS, PTs have a chance to compare and contrast different examples of teaching and identify what made the lesson successful (or not) and integrate this knowledge with other aspects of their learning. The LessonSketch digital learning experience central to this study was a four-module experience that: elicited the prior experiences and knowledge of the PTs (Module 1); provided instruction in noticing students' mathematical strengths, previewed the lesson storyboard on Designing a Smoothie Box, (see Appendix F for storyboard) and provided opportunities to rehearse the practice (Module 2); introduced the sentence frame as a scaffold for naming students' mathematical strengths and facilitated rehearsals of the practice of NNSMS in the Designing a Smoothie Box lesson (Module 3); and assessed PTs' understanding of practice following the NNSMS experience (Module 4). This digital learning experience is based off of a digital learning experience on NNSMS for prospective elementary teachers (see Bannister, Kalinec-Craig, Bowen, & Crespo, 2018).

In the first module, PTs responded to questions about their prior experiences observing and noticing students' thinking in mathematical classrooms to help elicit their knowledge of the practice. Next, PTs analyzed examples of students' written work from the Designing a Smoothie Box task and recorded any evidence they noticed about students' mathematical thinking and contributions. Lastly, PTs made observation statements about students' work that could be offered as feedback to the student or shared publicly during class discussion. Figure 1 and Figure 2 show the written work and the verbal discussion to provide context for the PTs' responses on the pre-assessment in Module 1 and post-assessment in Module 4.

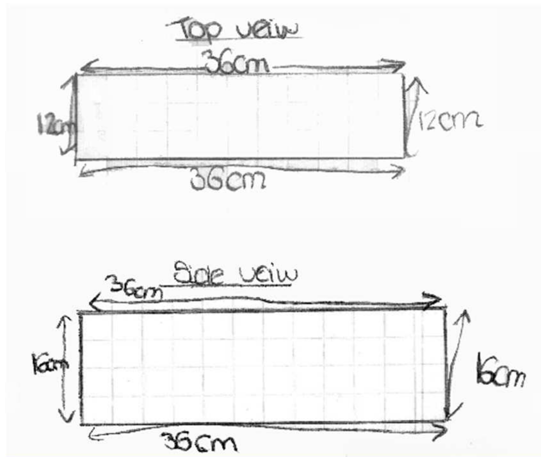


Figure 1. Example of Written Student Work in the Digital Learning Experience[1]

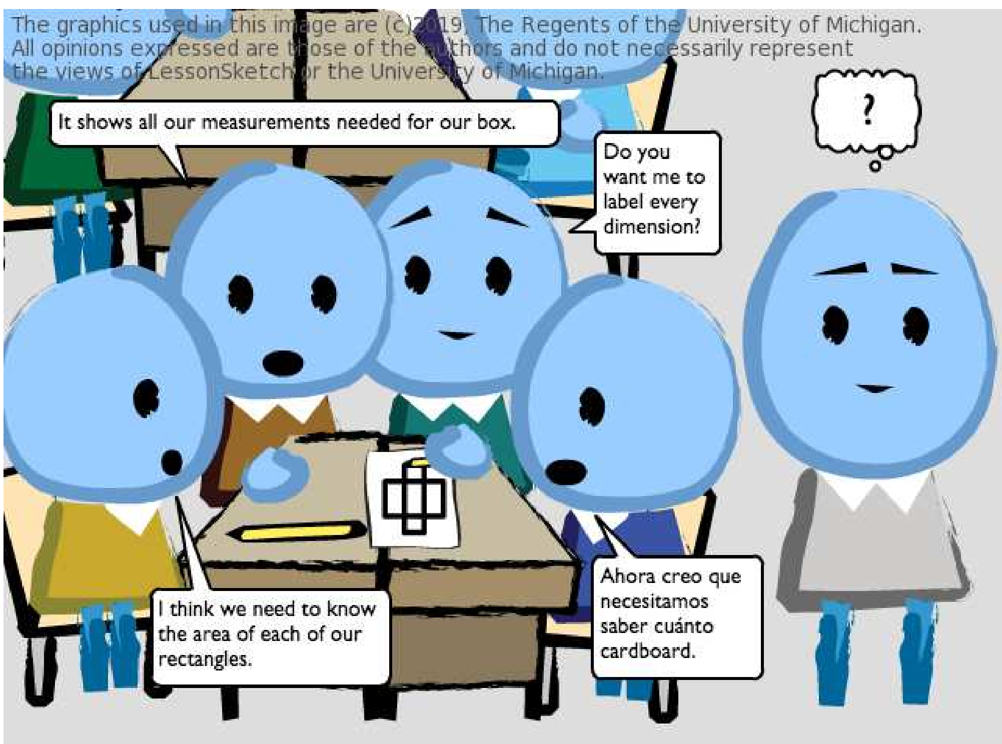


Figure 2. Example of Students' Verbal Responses in the Digital Learning Experience[2]

[1]Fig 1. From: *Sample Response: Jemma*, by Mathematics Assessment Resource Service, 2017, http://www.map.mathshell.org/download/php?fileid=1168

The second module began by focusing PTs' attention on the importance of NNSMS. After reviewing the learning goals for the module and overviewing the module tasks, PTs had to distinguish between noticing deficits and noticing strengths in students' contributions. PTs were directed to read two short articles to learn more about teaching practices integral to naming and noticing students' mathematical strengths, and then to list 10 or more mathematical strengths they found important in students' talk and work. In the third module, PTs reviewed the Designing a Smoothie Box task card (see Appendix F) to identify the mathematical point of the lesson and to identify students' mathematical strengths that might be elicited in the lesson. Next, to practice NNSMS, PTs annotated the 12-slide lesson storyboard (see Appendix F) with the mathematical strengths they observed in the lesson and read an instructional slide that oriented PTs to a noticing sentence frame, provided two examples, and acknowledged the inherent challenge in the practice of NNSMS (see Figure 3). After the third module, PTs reviewed the Designing a Smoothie Box depiction for a second time but were explicitly prompted to use the strengths-based sentence frame when making noticing statements.

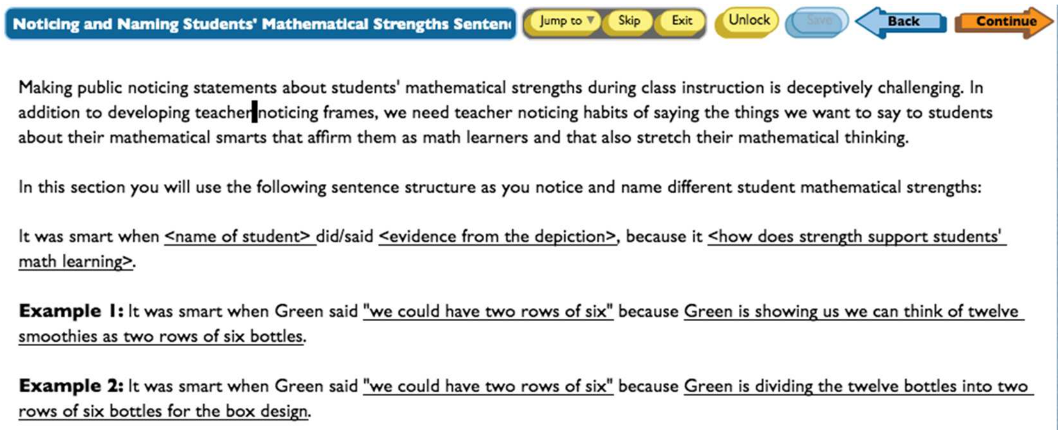


Figure 3. Screen Capture of Instructional Slide used to introduce the Sentence Frame.

In the final and fourth module, PTs returned to selected examples of students' written work (see Figure 1) and a slide from the lesson depiction (see Figure 2) in order to rehearse the practice of NNSMS. The PTs concluded this module and the LessonSketch experience by providing written reflective statements about what they learned, with emphasis on any insights and questions that were raised for them as they completed the experience. Finally, it is important to note that the storyboards intentionally left out aspects of the classroom that were peripheral or potentially distracting for PTs' initial experiences with learning the complex practice, such as students' clothing, in order to sharpen PTs' focus on NNSMS. Given this design choice to foreground specific aspects of mathematics instruction over others, I "acknowledge and value the critique that by using depictions of children with blue skin tones, the classroom did not approximate an opportunity for PTs to notice and draw on children's racial identities as they relate to their mathematical strengths" and ways of participating in the classroom (Bannister et al., p. 23). Chapter 8 revisits the issue of realistic skin tones in the discussion of future implementations of the

NNSMS experience. The overall goal of the LessonSketch experience was to provide an experience that deeply challenged PTs' preconceived notions about who can be smart and what counts as evidence of it in mathematics instruction. Each module in the LessonSketch experience addressed multiple aspects of the complex practice of NNSMS, although this study recognizes that additional layering may create opportunities for PTs' learning that strengthen the experience. The next three chapters highlight the findings of this study.

CHAPTER 5: LANGUAGE TYPE & QUALITY OF FEEDBACK STATEMENTS

This chapter of findings addresses research question one as it presents an analysis of PTs' feedback statements from the pre-assessment (Module 1) and the post-assessment (Module 4) from the NNSMS LessonSketch Experience for secondary mathematics teachers as well as the quality of those feedback statements. First, in response to RQ1A, feedback statements were classified by type of language (strengths-based, mixed language, deficit-based, or uncommitted). Then, to address RQ1B, each feedback statement was classified as emerging, developing, or meaningful by examining the type of language, mathematical evidence, justification, and teacher reasoning strategy. As shown in Chapters 3 and 4, the prompts use students' work from the smoothie box task which asked student groups to design a net for a box of twelve smoothies and determine the amount of cardboard needed for the box. Overall, most PTs (5 of 6) transitioned from mixed language or uncommitted language to strengths-based language, and some PTs (4 of 6) transitioned from primarily emerging strengths-based feedback statements to meaningful strengths-based feedback statements.

Type of Language in Prospective Teachers' Feedback Statements

The goal of this analysis was to identify the type of language for each feedback statement as one of the following: Strengths-based language, deficit-based language, a mixture of deficit and strengths-based language (mixed language), or uncommitted language. Table 11 gives the total counts for each type of language on the pre-assessment and post-assessment. The total number of statements in the analysis is the same from pre-assessment to post-assessment, and almost every PT (except Marissa on the post-analysis) made one statement given a student's written work but did not necessarily make the same amount of statements on the pre-assessment and post-assessment given multiple students' verbal responses and PTs were not required to do so.

Table 11 *Type of Language in Feedback Statements*

Type of language	Pre-assessment	Post-assessment
Strengths-based language	2	24
Deficit-based language	1	0
Mixed language	6	4
Uncommitted language	19	0
Total	28	28

While this sample of data is too small for quantitative analysis, understanding what these changes looked like and who made these changes can provide a detailed picture of how PTs begin to NNSMS and one important shift given these counts is the number of statements that went from uncommitted language to strengths-based language. From the pre-assessment to post-assessment PTs went from two strengths-based statements to 24 strengths-based statements whereas the number of uncommitted statements decreased from 19 on the pre-assessment to zero on the post-assessment. This finding indicates that on the pre-assessment PTs were often uncommitted with their language when stating student's mathematical contributions, and these statements did not explicitly express strengths or deficits. For example, one PT, Marissa writes: "The student in the blue shirt wants to use the drawing to figure out how much cardboard is needed to construct the box" [Pre-assessment]. While

Marissa states what the student wants to do or can do, it is not clear that this student's mathematical contribution is an asset to the work of the group and making progress on the task. As a contrast to this statement, Marissa writes on the post-assessment about the same student: "It was smart when Blue said he wanted to find out how much cardboard was needed because he related the box back to the context of the original problem." From the pre-assessment to the post-assessment, Marissa shifts from an uncommitted statement about what the student in the blue shirt can do to a statement that explicitly states that the student's mathematical contribution is smart. This shift from uncommitted language to strengths-based language may be because the module attuned PTs to specifically making asset or strengths-based statements or because the specific structure of "It was smart when…" can easily be inserted prior to stating what a student knows, understands, or is able to do or because of the combined experience of being introduced to the practice *and* having the sentence frame as a resource for framing students' mathematical contributions.

In addition to looking at overall changes in the counts, it is also important to look at how the counts for the type of language changed from the pre-assessment to the post-assessment for each PT. For example, Table 12 shows that Valeria and Marissa made uncommitted statements on the pre-assessment but only strengths-based statements on the post-assessment. In the pre-assessment Valeria responds

Table 12 *Type of Language in Feedback Statements by Prospective Teacher*

Prospective teachers	Pre-assessment							Post-assessment				
	Written	Verbal						Written	Verbal			
Alicia	U	S	S	U	U			S	S	S	S	S
Ellen	M	D	U	U	U	M	M	S	S	S		
Valeria	U	U						S	S	S	S	S
Lindsey	M	U	M	U				M	M	M	M	
Marissa	U	U	U	U	U			S S	S	S	S	S
Melissa	M	U	U	U	U			S	S	S	S	S

S: Strengths-based M: Mixed D: Deficit U: Uncommitted

Note: Differences in the number of statements across the verbal work is because there were multiple students to give feedback to and PTs were not required to give a statement for each student. The headers written and verbal are used to designate the type of student contribution.

to the student's written work by using uncommitted language to state what the student did then Valeria asks a series of follow up questions about the student's work: "I see you have dimensions given for your top and side view. Can you tell us where exactly did the 36 cm come from? What about the 16 cm? How do the 36 cm in both the top and side view connect/relate? Can you draw a layout/figure where these two pieces will physically connect together?" [Pre-assessment]. On the post-assessment, Valeria responds to the same student's written work with: "It was smart when this student did separate images of the top and side views because it allows us to first identify the multiple 'views' or sides the box has to then find the corresponding dimensions." Valeria moved from uncommitted language to strengths-based language, and instead of questioning the student, she focused only on naming the strengths given the student’s work. Overall, PTs included questions with the feedback statements in 12 instances on the pre-assessment but only three instances on the post-assessment. This could mean that some PTs had difficulties isolating making feedback statements from other teaching practices such as eliciting student thinking by asking questions. Making this separation was especially difficult for Valeria as she asked only one question given several students’ verbal responses when directed to write a feedback statement on the pre-assessment. Given the reduced number of questions on the post-assessment, PTs may find the NNSMS digital learning experience as an opportunity to focus on a single teaching practice and a particular aspect of the decision-making that goes into every moment of teaching.

Marissa’s feedback statements do not include follow up questions, but like Valeria she also states what students know, understand, or are able to do using uncommitted language on the pre-assessment: “The student in yellow shirt thinks that they need to find the area of each rectangle to figure out how much cardboard will be needed” [Pre-assessment]. On the post-assessment Marissa writes that “it was smart when Yellow suggested finding the area of each of the rectangles because this would help us find the amount of cardboard needed for the box.” Like Valeria, Marissa now uses the sentence frame (It was smart when) in her description of the student’s contribution and justifies the strengths of the student’s contribution (because). Marissa’s feedback statement on the post-assessment also states the student’s contribution as a contribution to move the group’s thinking forward by indicating, “because this would help us” [Post-assessment].

While Marissa and Valeria made only uncommitted statements on the pre-assessment, Ellen and Melissa made uncommitted statements and mixed-language statements on the pre-assessment (Ellen also made a deficit statement on the pre-assessment) but only strengths-based statements on the post-assessment. On the pre-assessment given student's written work, Ellen and Melissa focused on the written work conveying that "the student does not understand what is meant by 'net' and how to create a net for the box" [Ellen, Pre-assessment] and "this work is not a net" [Melissa, Pre-assessment] while also highlighting the students' strengths in showing valid dimensions for the box (see Table 13). In terms of analyzing student work, it is important to be able to identify what students understand and do not understand, but PTs must be able to separate the analysis of student's work from the related practice of making strengths-based feedback statements about student's work. Similar to Valeria's inclusion of questions highlighted above, this captures how PTs may have had difficulties isolating a teaching practice, and for making feedback statements, this means including questions to elicit students' thinking as well as a detailed analysis of the student's work.

Table 13 *Shifts from Mixed-Language to Strengths-Based Feedback Statements*

Prospective teacher	Pre-assessment statement	Post-assessment statement
Ellen	This picture tells me that the student does not understand what is meant by "net" and how to create a net for the box. However, this work tells me the student understands the dimensions of the box...	This method is smart because I can see the different dimensions of the bottom of the box and one of the sides and I can see how the height of the bottles and the diameter of the bottle play a role in these dimensions...
Melissa	Although this work is not a net and doesn't show their math, I can assume from the drawing that they have designed a box for two rows of six bottles. From the side view, you can see the height is barely over the height of a bottle and the length is 36 cm which is the 6 bottles with the diameter of 6 cm...	It was smart for [the] student to show the different views for their net because we can take these two views and all the measurements and build a full net from it.

In the pre-assessment, Ellen and Melissa both emphasize that the work is not a net whereas in the post-assessment these PTs highlight the strengths of the work such as creating views and labeling dimensions with Melissa seeing the views as combinable to "build" a net (see Table 13). These particular results highlight how Ellen and Melissa shifted from seeing the side and top views as not a net to the beginnings of a net: PTs valued the student's work (finding and labeling the dimensions for the different views) rather than emphasize how the work is incomplete or the work is incorrect. This shift could be from Ellen and Melissa attempting to notice and name student's strengths rather than merely focusing on what students did wrong or did not include. However, this shift could also be from Ellen and Melissa gaining more insight on how to interpret and respond to student's work for the smoothie box task as they spend more time with the task and view more work samples. This highlights how PTs content knowledge is inextricably tied to how they view and interpret student work, and it is difficult to pinpoint why this change in language occurred.

Finally, looking at the post-assessment results, Melissa and Ellen both use the NNSMS sentence frame first presented in Chapter 3 or language similar to the sentence frame. However, Ellen framed smartness in terms of the method given, "This method is smart because..." whereas Melissa framed smartness in terms of what the student did: "It was smart for the student to…" (see Table 13). While this difference may seem slight, an essential aspect of assigning competence and NNSMS is to state the contribution in terms of the student. In this example, Ellen did not give the student credit for his or her contribution and instead removes the student and focuses on "This method" rather than "This student's method." This becomes even more important in the space of a classroom if a teacher is attempting to disrupt issues of status and participation by giving credit to a student for their method because hearing a teacher say "Jane's method" or "Jamal's method" versus "this method" makes a difference and this will be elaborated on in Chapter 8. In addition to understanding shifts from uncommitted to strengths-based language it is also important to investigate PTs' feedback statements for shifts from mixed language or deficit language to strengths-based language.

Alicia was the only PT to make strengths-based statements before and after the digital learning experience, as shown in Table 12. Alicia made two strengths-based statements on the pre-assessment, however, both of Alicia's statements are evaluative as the feedback statements focused on the student having "the correct idea" and "the right idea" rather than simply focusing on the strengths of the student's mathematical contribution without an evaluation of the correctness of the student's work. Unlike Melissa, Valeria, and Marissa, Alicia does not use the sentence frame on the post-assessment and instead frames the student's contribution in terms of why she "likes" the contribution: "I like how brown emphasized that they have [to] show all their measurements. In the directions, it says they have to do that and it will help them with calculating the amount of cardboard [that] is needed." In Chapter 6, there will be an elaboration on Alicia and her evaluative feedback statements as it examines how Alicia responds to written student work and students' verbal responses during her teaching internship.

Returning to Table 12, the number of mixed language statements decreased slightly from the pre-assessment (6) to the post-assessment (4), and the number of deficit statements decreased from one statement to zero statements. By exploring who continued to use mixed language on the post-assessment and how it was used to frame student's thinking there is an understanding of how the learning experience did not support all of the PTs. Specifically, Lindsey used multiple types of language (uncommitted, and mixed) on the pre-assessment but only mixed language statements on the post-assessment. Specifically, on the pre-assessment Lindsey writes an uncommitted feedback statement about what the student understands: "Brown shirt student seems to understand which parts of the box are necessary to label and which labels are extra and unnecessary." On the post-assessment, Lindsey shifts to comparing the student's thinking to the other students in the group and to focusing on how to improve the student's response: "The student in the brown shirt shows the greatest amount of mathematical thinking since they are able to show why each of the claims made by the other students are not necessary even though they are valid. To better their explanation, they could have explained why." Lindsey focused on the strength of the student's mathematical contribution in comparison to other students' contributions unlike the statements made by other PTs such as Marissa that focused on how the student's contribution moves the group's thinking forward. While generalizing and synthesizing across student ideas is a valuable strategy, it could counteract the work of assigning competence if the synthesizing focuses on evaluation and correctness rather than the diversity of strategies and strengths of each group's or individual's contribution.

Similarly Lindsey provided feedback on the written work that included potential improvements to the students' response and Lindsey suggested a technique perhaps taking over some of the mathematical thinking for the student. Lindsey often focuses on providing corrective feedback rather than feedback that builds from the strengths in student's mathematical contributions. While Lindsey's approach on the post-assessment to analyze and compare students' mathematical contributions is a valuable teaching practice it is in tension with making feedback statements aimed at NNSMS. Moreover, this approach of verbally ranking students is antithetical to the practice of NNSMS because it has the potential to reinforce rather than disrupt notions about whose ideas are smart and who participates in the classroom. Thus, PTs may have difficulty focusing on the strengths in students' mathematical contributions if they aim to correct the student's thinking or replace the student's thinking with their own thinking or if they are focused on how the student's contribution compares to other student's contributions. This is unsurprising as teachers are often "immersed in a culture" that focuses on students' shortcomings in mathematics and teachers "are unknowingly trained to identify learners' mistakes and misunderstandings" (Jilk, 2016, p. 189).

Given the student's written work, Lindsey focuses on how the student's work of showing two views of the box is not capturing the 3-dimensional nature of the box as a net might. Lindsey begins the post-assessment feedback statement by talking about what the student did and then used the word "however" to shift to problematic aspects of the students' work. While it is crucial for PTs to notice incomplete or incorrect student work it is also vital for PTs to be selective about which parts of the student's work they focus on in the feedback statement and the language used to frame the student's mathematical contribution: Noticing strengths and weaknesses in students' work prepares teachers to make feedback statements and formatively assess students but if feedback statements are to be used to address issues of status and participation in the classroom and develop students' mathematical confidence they must be formulated to build on students' strengths. This finding highlights how core instructional practices may intersect in ways that create tension for PTs (see Chapter 8).

In summary, most (5 of 6) of the PTs moved from uncommitted or mixed language feedback statements to strengths-based feedback statements from the pre-assessment to the post-assessment. On the other hand, Lindsey continued to use mixed language across her post-assessment feedback statements by including a detailed analysis of students' work or a comparative analysis of the student's work to other students in the group. While, Lindsey included an analysis of students' work within her feedback statement it was also common on the pre-assessment for PTs to integrate making feedback statements with teaching practices such as eliciting students' thinking by asking questions with the feedback statement. However, on the post-assessment PTs mainly make feedback statements and only a few questions and in-depth analyses of students' work are included in these statements.

Quality of Prospective Teachers' Feedback Statements

The next section of findings looks beyond the type of language to examine each feedback statement for mathematical evidence of what the student knows, understands, or is able to do as well as a justification for why the students' mathematical contribution is smart, and whether or not the strengths-based feedback statement is descriptive, evaluative, or interpretive (teacher reasoning strategy). These three concepts (mathematical evidence, justification of the students' mathematical contribution, and teacher reasoning strategy) are key to determining the quality of PTs' strengths-based feedback statements. In terms of quality, most statements on the pre-assessment were emerging strengths-based feedback statements (20 of 28) whereas the post-assessment contained a substantial number of meaningful feedback statements (20 of 28). This shift occurred because PTs shifted from mixed and uncommitted language to strengths-based language and PTs justified students' contributions. The next three sections summarize the additional measures of quality.

Mathematical Evidence given Students' Contributions

One aspect of quality is whether the statement gives clear and specific mathematical evidence of what a student knows, understands, or is able to do. Table 14 captures two broad categories for organizing students' contributions: Mathematical understandings and students' ways of participating (see Jilk, 2016) and subcategories of mathematical evidence and the counts by category on the pre-assessment and post-assessment (For details on how these categories were developed or condensed see Chapter 3). Overall, the total amount of mathematical evidence named by the PTs was similar from the pre-assessment (35 pieces of mathematical evidence) to the post-assessment (51 pieces of mathematical evidence). The number of pieces of mathematical evidence on the pre-assessment and post-assessment is greater than the number of feedback statements because PTs sometimes included more than one piece of evidence.

The first five subcategories focus on mathematical understandings and practices that are content specific and connected to the smoothie box task such as using context or building to a net whereas the three remaining subcategories focus on ways in which students participate in groups. White and colleagues (2018) note that mathematical understandings are often content dependent whereas ways of participating in mathematics transcend content. For example, Melissa mentions the importance of a students' contribution in terms of moving the group's thinking forward on the pre-assessment and post-assessment and this way of participating is possible regardless of the content or task whether they move the work forward by suggesting an idea, asking a question, or referencing the directions. It is noteworthy that most of the mathematical evidence on the pre-assessment (34 of 35 pieces) and post-assessment (44 of 51 pieces) connected to the category of mathematical understandings rather than the ways students participate. At the same time, there is one piece of mathematical evidence focused on participation norms on the pre-assessment and seven examples on the post-assessment which may show PTs beginning to notice and/or value these ways of participating when doing mathematics. Capturing a broad range of what students' mathematical contributions can look like whether the contribution is content knowledge, mathematical practices, or desirable ways of participating is key to broadening our conceptions of what counts as doing mathematics (Jilk, 2016). Across the pre-assessment and post-assessment, the four most common categories of mathematical evidence were the initial work of labeling dimensions or creating views, using or referencing the real-world context and working to build a net, attending to precision and/or accuracy with the drawing of the net, and using area and/or surface area to determine how much cardboard is needed for the box (see Table 14).

Table 14 *Mathematical Evidence by Category and Assessment*

Category	Subcategory	Pre-assessment	Post-assessment
Mathematical understandings	Attending to accuracy or precision	8	8
	Using context or building to a net	7	10
	Labeling dimensions/creating a layout or multiple views	13	17
	Using area and/or surface area	4	6
	Checking answer/work	2	3
Ways of participating when doing mathematics	Moving the group forward/thinking ahead/predicting next steps	1	3
	Asking/posing questions to group/ teacher	0	1
	Referencing/using the directions/given information	0	3
Total pieces of mathematical evidence		35	51

Of the 22 strengths-based feedback statements on the post-assessment with mathematical evidence, 16 of those statements included at least two pieces of mathematical evidence of what students know, understand, or are able to do. For example, during the post-assessment Marissa wrote: “It was smart when [the student in the] Yellow suggested finding the area of each of the rectangles because this would help us find the total amount of cardboard needed for the box” which contains a description of the student attending to the context of the problem and making connections between area and surface area. In another example Valeria writes: “It was smart when student in blue shirt said, ‘Now I think we need to know how much cardboard,’ because it demonstrates the connection they have made between finding the surface area to the amount of cardboard needed for the entire box based on the measurements [the] students in green and brown shirts were attending to." With this feedback statement, Valeria notes the student is making connections between area and surface area while also attending to the context of the problem. This example also captures how Valeria (and Melissa) typically frame their feedback statements in terms of the student's contribution to the group's work or in terms of how they connect to other student's contributions whereas the rest of the PTs (Alicia, Ellen, Marissa, and Lindsey) do not make feedback statements in terms of the group's progress. In another example, Melissa writes: "It was smart when green shirt asked if the group wanted him to label each dimension because it shows he is part of the team to make sure they get everything done." Students are more committed to the learning of others when teachers send (and reinforce) "a constant message that students need[ed] to work together" and make sure everyone understands because learning mathematics is a collective endeavor (Boaler, 2008, p. 181).

In addition to the 22 strengths-based statements with mathematical evidence, there were also two statements that were strengths-based that did not include any mathematical evidence on the post-assessment. Both of Ellen's feedback statements did not include mathematical evidence as she wrote: "That's a great idea, how might you figure that out?" and "That's a smart idea, how did you come up with that?" In these statements, Ellen vaguely mentions the student has a "great" or "smart" idea but does not provide specific mathematical evidence of the students' contribution. Often this type of strengths-based language is referred to as "empty praise" (see Dweck, 2006) as it is praise without a connection to why the student is receiving praise. In addition to avoiding empty praise, teachers should not "lower their standards" or expectations for students and teachers should not attempt to make feedback statements about “anything a student says or does that is remotely mathematical” (Jilk, 2016, p. 191).

Table 15 indicates for each feedback statement whether the statement contained mathematical evidence (Y) or not (N) except for the deficit statement which was coded as N/A.

Table 15 *Mathematical Evidence in Feedback Statements by Prospective Teacher*

Prospective teacher	Pre-assessment							Post-assessment				
	Written	Verbal						Written	Verbal			
Alicia	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y
Ellen	Y	N/A	Y	Y	Y	Y	N	Y	N	N		
Valeria	Y	N						Y	Y	Y	Y	Y
Lindsey	Y	Y	N	Y				Y	Y	N	Y	
Marissa	Y	Y	Y	Y	Y			Y Y	Y	Y	Y	Y
Melissa	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y

To summarize, Alicia, Marissa, and Melissa included mathematical evidence in each feedback statement on the pre-assessment and post-assessment. Ellen did not include mathematical evidence consistently on the pre-assessment or post-assessment while Valeria did not include mathematical evidence on the pre-assessment given student’s verbal contributions but included mathematical evidence on the post-assessment. Finally, Lindsey generally gave mathematical evidence on the pre-assessment and post-assessment with her response to one student on the verbal work being the exception on both assessments. In addition to looking for mathematical evidence, this analysis also looked for a justification as to why the student’s contribution was “smart” given the mathematical evidence, and this analysis also addresses PTs’ reasoning given the mathematical evidence in each feedback statement. The next section of this analysis examines the strengths-based statements, mixed-language statements, and uncommitted statements for justifications.

Justifications in Feedback Statements

Each of the feedback statements were also analyzed to see if they contained a justification for why the student's mathematical contribution was "smart." Table 16 is organized by participant and lists "Y" if there was a justification and "N" if there was not a justification for each feedback statement and "N/A" is listed for the uncoded deficit statement.

Table 16 *Justifications in Feedback Statements by Prospective Teacher*

Prospective teacher	Pre-assessment							Post-assessment				
	Written	Verbal						Written	Verbal			
Alicia	N	N	N	N	N			Y	Y	Y	Y	Y
Ellen	N	N/A	N	N	N	N	N	Y	N	N		
Valeria	N	N						Y	Y	Y	Y	Y
Lindsey	N	N	N	N				N	N	N	N	
Marissa	N	N	N	N	N			Y Y	Y	Y	Y	Y
Melissa	N	N	N	N	N			Y	Y	Y	Y	Y

Across the pre-assessment, none of the feedback statements included justifications for why the students' contribution was "smart" including the two strengths-based feedback statements made by Alicia on the pre-assessment. This is of note because most of the feedback statements on the pre-assessment contained mathematical evidence, but even the strengths-based statements did not include justifications. On the post-assessment 22 of the 28 statements contained a justification for why the given student's mathematical contribution was "smart." For example, on the pre-assessment Alicia wrote: "Student in the brown had the correct idea of showing all the measurements on the box, but my question to them would be how did they come up with those measurements." Alicia wrote about the students' idea of showing all the measurements on the box but does not justify why this is contribution is important. On the other hand, Alicia writes on the post-assessment: "I like how brown emphasized that they have [to] show all their measurements. In the directions, it says they have to do that and it will help them with calculating the amount of cardboard is needed." With this statement, Alicia connected showing all the measurements to following directions and she noted it would help the students with solving the task. In another example, Melissa gave feedback to the student in the brown shirt on the pre-assessment: "Your diagram shows measurements. Can you point out and explain how your net holds and ships 12 smoothie bottles?" and on the post-assessment: "It was smart when brown shirt said that they had all the dimensions needed because this shows that he checked their work before deciding to move on to the next step." Melissa transitioned from simply stating that the student has a diagram that shows measurements to commenting on the importance of checking for all the measurements in your diagram before moving on to the next step. In the post-assessment, Melissa valued the work of showing measurements in a diagram as part of the learning process for solving the smoothie bottle task, whereas on the pre-assessment she did not justify the importance of this contribution.

On the post-assessment, the statements that did not include justifications were the two strengths-based statements made by Ellen that did not include mathematical evidence and the mixed language statements made by Lindsey. On the post-assessment, PTs used the word "because" to indicate the justification whereas Ellen's two statements that had no mathematical evidence and therefore nothing to justify and the feedback statement did not contain the word "because." One reason for so many justifications on the post-assessment could be because the sentence frame provided a structure to PTs that makes it easy to include a justification. Another possibility is that the modules and this experience brought to PTs' attention to the importance of stating why student's mathematical contributions are smart when giving feedback. After establishing which statements contained mathematical evidence and a justification, the statements were examined to determine the level of teacher reasoning around students' mathematical contributions.

Teacher Reasoning Strategies in Feedback Statements

The teacher reasoning strategy in each feedback statement was examined to provide a more nuanced view of PTs' reasoning, given the mathematical evidence named by PTs. Table 17 gives the findings for teacher reasoning strategy (descriptive, evaluative, or interpretive) by PT for each feedback statement except the deficit statement, which was coded as "N/A." On the pre-assessment, 13 feedback statements were descriptive, seven statements were evaluative, two statements were interpretive, and five statements did not have a reasoning strategy. For the post-assessment, there was one statement identified as descriptive, three statements identified as evaluative, 22 statements identified as interpretive and two statements were coded as having no teacher reasoning strategy (see Table 17). The overall counts show a shift from statements that took a descriptive stance on students' contributions to statements that took an interpretive stance on students' contributions. For example, Marissa repeats the student's thinking on the pre-assessment: "The student in the brown shirt said that their drawing has all of the measurements necessary to find the amount of cardboard needed." On the post-assessment, Marissa connected the student's contribution to the group work and noted that finding all the measurements was useful for calculating area of the base of the box: "It was smart when Brown said that the box has all the necessary measurements because this group calculated the length and width of the base of their box using the measurements of the bottles." This shift is crucial as it showed Marissa's reasoning strategy progressing from a restatement of the students' contribution to an interpretation of how the students' contribution can further the group's work.

Table 17 *Teacher Reasoning Strategy on Feedback Statements by Prospective Teacher*

Prospective teacher	Pre-assessment							Post-assessment				
	Written			Verbal				Written		Verbal		
Alicia	I	E	E	D	D			I	I	I	I	I
Ellen	E	N/A	N	N	N	E	E	D	N	N		
Valeria	D	N						I	I	I	I	I
Lindsey	E	D	E	I				E	E	E	I	
Marissa	D	D	D	D	D			I I	I	I	I	I
Melissa	E	N	D	D	D			I	I	I	I	I

D: Descriptive E: Evaluative I: Interpretive N: None N/A: Not Applicable

Another important trend given the criteria of stance is the shift from feedback statements coded as “no stance” or “stance unknown” to feedback statements coded as interpretive. On the pre-assessment, there were six statements coded as “no stance” or “stance unknown,” and this occurred because PTs focused on asking a question with embedded feedback rather than simply making a feedback statement. For example, Valeria writes “Why do you think we should label every dimension of the box?” which implies the students are labeling all the dimensions and this contribution is important, but it is not a feedback statement. Thus, this criteria helped capture responses by PTs that are worded as questions or implied questions (see Chapter 3), coded as uncommitted for the type of language, and do not explicitly make a feedback statement. On the pre-assessment, Valeria, Ellen, and Melissa posed questions or implied they would pose a question to students six times during the pre-assessment without making any explicit feedback statements. This finding may highlight PTs' resistance to making explicit feedback statements because they are trying to initially create space for students' to share their thinking by posing questions to the students. The lack of questions on the post-assessment showed that PTs might have been able to isolate making feedback statements from the practice of eliciting students' thinking by the time PTs reached the post-assessment of the digital learning experience. This also shows support for why PTs need representations of practice to reduce complexity and to isolate the work of a specific practice.

For feedback statements, it is important for teachers to be able to have in-depth reasoning about students' thinking. For example, many of the PTs commented that the students' incorrect drawing of a net smartly labeled the dimensions of the box but only some of the PTs connected these labels to creating a valid layout given the radius and height of the bottle and the number of bottles. Moreover, PTs failed to notice and/or failed to name all of the students' strengths connected to labeling dimensions or possibly taking place before the student labeled the dimensions: Rounding up to leave a small amount of space between the bottles, creating a valid layout (e.g. 6x2, 3x4, 12x1) for the 12 smoothie bottles, scaling up from the radius and height of the smoothie bottles to find the dimensions of the box, and connecting each view of the box to its dimensions. It is possible that PTs were focused on the work that they saw given the students' drawings not what the work meant for how the students were solving the smoothie box task or possible prior steps. Now that the reader understands the criteria of the type of language, mathematical evidence, justification, and teacher reasoning strategy, the final section looks at each statement across these four criteria to determine the quality of the statement.

Emerging, Developing, and Meaningful Strengths-based Feedback Statements

To classify strengths-based statements by quality three categories were developed to capture differences in quality even when the feedback statement contains only strengths-based language or has the potential to contain only strengths-based language because it contains mixed language or uncommitted language. As presented in Chapter 3, these classifications are: emerging strengths-based feedback statements, developing strengths-based feedback statements, and meaningful strengths-based feedback statements. Table 18 shows four of the PTs (Alicia, Valeria, Marissa, and Melissa) were able to shift from not making feedback statements (six instances) and making developing (two instances) and emerging (20 instances) strengths-based feedback statements to making meaningful strengths-based feedback statements (20 instances, Valeria also made one developing strengths-based feedback statement). On the other hand, Ellen's statements were not classified as meaningful because they lacked mathematical evidence and a justification or in one instance because the feedback statement was descriptive. All of Lindsey's statements were emerging strengths-based feedback statements because of mixed language.

Table 18 *Quality of Feedback Statements by Prospective Teacher*

Prospective teacher	Pre-assessment							Post-assessment				
	Written	Verbal						Written	Verbal			
Alicia	E	D	D	E	E			M	M	M	M	M
Ellen	E	N/A	N/A	N/A	N/A	E	E	D	E	E		
Valeria	E	N/A						D	M	M	M	M
Lindsey	E	E	E	E				E	E	E	E	
Marissa	E	E	E	E	E			M M	M	M	M	M
Melissa	E	N/A	E	E	E			M	M	M	M	M

N/A: Not Classified E: Emerging D: Developing M: Meaningful

Moreover, Table 18 shows most of the time the four PTs (Alicia, Valeria, Lindsey, and Melissa) that made meaningful strengths-based feedback statements on the post-assessment "jumped" from making emerging feedback statements to meaningful statements. An interpretation of this finding is that the module supported PTs to simultaneously add a justification to feedback statements as they shifted to a more interpretive stance and used explicitly strengths-based language. Additionally, Table 18 shows that on the post-assessment there were no "N/A"s meaning all of the PTs made feedback statements, and none of those feedback statements used deficit-based language or uncommitted language with only a question. This connects back to earlier findings that showed PTs might have struggled to separate this practice from the practice of eliciting students' thinking because PTs often included questions with the feedback statements but did not continue to do so on the post-assessment. The next section summarizes the findings presented throughout this chapter and explains how these findings supported the case selection for the second research question in this study.

Conclusion

To summarize, the primary finding for Research Question 1A was that most (5 of 6) PTs transitioned from uncommitted statements to strengths-based statements from the pre-assessment to the post-assessment. In addition to making changes to the type of language, four of these PTs also included justifications of students' contributions and interpreted students' work rather than describing or evaluating students' contributions. This led to the primary finding for Research Question 1B: Some (4 of 6) PTs shifted from emerging strengths-based feedback statements on the pre-assessment to meaningful strengths-based feedback statements on the post-assessment. While Ellen shifted to strengths-based feedback statements, her statements did not qualify as meaningful strengths-based feedback statements because the statements lacked mathematical evidence, justifications, and/or failed to interpret the student's work. Lindsey continued to use a mix of strengths-based and deficit-based language on the post-assessment, and she often took an evaluative stance on student's work by focusing on what was right and what was wrong. It is noteworthy that four of six PTs used the sentence frame or a similar format to make feedback statements on the post-assessment. This suggests the sentence frame can be used as a resource to provide scaffolds for PTs to move from emerging strengths-based feedback statements to meaningful strengths-based feedback statements. Feedback statements sometimes included questions (primarily on the pre-assessment) meaning

PTs may have had difficulties isolating the practice of making feedback statements from the practice of eliciting students' thinking.

Finally, given the amount of mathematical thinking to attend to given student's written work, it may be useful to direct PTs to attend to one aspect of the work or to write one statement for each piece of feedback. Given the findings for RQ1, it is essential to understand how this learning experience influenced PTs' learning and teaching practices (if at all) and when and how PTs gave feedback to students' verbal responses and ways of participating in the classroom. The next section of findings presents results and analysis of PTs' feedback statements and moves to support students' participation, given two classroom episodes from two PTs. The results for RQ1 were used to select which PTs' feedback statements to examine: The next two chapters focus on Alicia and Marissa because of their transition from uncommitted statements or evaluative strengths-based feedback statements to meaningful strengths-based feedback statements.

CHAPTER 6: ALICIA'S STORY: REVOICING TO VALUE *AND* EVALUATE

Chapter 6 presents Alicia's case, including her use of feedback statements in the classroom, her support of students' participation, and how these connected to Alicia's learning. Alicia regularly invited students to participate, and she used a variety of strategies as she revoiced students' responses, positively positioned students' responses, scaffolded students' answers by taking over part of the students' thinking, encouraged students, and twice Alicia explicitly assigned competence to a student. Alicia also followed up on students' responses by asking students to explain their thinking, add on to given responses, or Alicia probed students responses, but these moves were less frequent across both transcripts. However, Alicia's focus on correctness and constant evaluation of students' responses as well as Alicia's messages to students about who can participate and who holds a high status in Alicia's classroom possibly undermined Alicia's various strategies to support participation. While Alicia placed a high value on correctness, there was also evidence in Alicia's transcripts, reflections, and interview that Alicia strongly valued supporting all students to participate and Alicia saw making mistakes as a valuable opportunity for students to learn. However, when Alicia positively positioned students with incomplete or "incorrect" work tensions arose as she may have affirmed students' contributions before or instead of understanding students' contributions. While Alicia often positively positioned students' contributions, Alicia's actions may have created or aggrandized issues of status and participation as she sometimes positioned students using "besides" to exclude a specific student from participating.

While there were no significant shifts in Alicia's moves to support students' participation, there are more strategies in Alicia's second transcript, including examples of assigning competence. In terms of strengths-based language, Alicia used positive but evaluative language in the pre-assessment of the digital learning experience on NNSMS (see Chapter 5) and that positive but evaluative language continues in her two classroom episodes.

Alicia as a Prospective Teacher

Alicia Allen is a Black female prospective middle school mathematics teacher, and she graduated from a public mid-Atlantic university with degrees in sociology and anthropology. Alicia worked as a paraeducator for one year before entering the master's certification program at this university. In terms of her teaching philosophy as a PT, Alicia believed building relationships with students, providing collaborative learning opportunities, and creating a positive learning environment are essential. Moreover, Alicia believed "[students] can kinda build off of their, each other's responses and you know really help each other out" (Interview I, Line 12). When asked about her dispositions in the classroom, Alicia said, "the number one thing, is showing that you care. Not, you don't necessarily have to nurture the students, but just showing your support and care for their learning environment, I guess or education" (Interview I, Line 32). Starting with her very first journal entry in August, Alicia valued mistakes: "One norm or routine that I hope to establish in my classroom is that mistakes are valuable. Have my students understand that it is okay to make mistakes because you can be able to learn from them" (Journal Entries, p. 1). Throughout Alicia's reflections, this theme continues, and at the end of the semester, she wrote that she saw mistakes as learning opportunities and a chance for students to become better mathematicians (Alicia, Course Reflection, p. 2-3).

In terms of her classroom environment, Alicia wanted her students to see each other as resources by being respectful of each other's correct and incorrect answers. Alicia wanted to "create an environment where my students are comfortable asking questions and acknowledge that they could be helping another student by asking their questions" (Journal Entries, p. 1). Finally, Alicia described her classroom as mostly small-group work or discussion before the whole-class discussion, and she organizes her classroom this way to support all students to participate. This format is especially important for students who do not typically participate because it allows more students to participate, helps students gain confidence in their response, and encourages collaboration (Journal Entries, p. 4-5). When asked, Alicia, talked about the challenge of noticing and naming students' mathematical strengths and she realistically noted that teachers could not help every student at once and know precisely each student's progress at a given moment, so she makes sure "I'm praising them on doing like well. And even if the student is not doing well, I'm still praising them on what they've done so far" (Interview I, Line 133). When asked to name students' strengths Alicia's answers included able to show and explain their work, able to solve problems quickly, and able to complete questions without a calculator (Interview I, 105-106).

Given Alicia's journal entries, reflections, and interview transcripts, Alicia only mentioned the practice of NNSMS when asked explicitly about the practice, and she did not write about this practice in her reflections. Thus, while Alicia's philosophy of teaching, strategies to support students' participation, and dispositions aligned with NNSMS, NNSMS did not appear to be integral to her repertoire of teaching practices. And Alicia's description of students' strengths was focused on students' accuracy and efficiency. Alicia saw analysis and reflection of her teaching and obtaining feedback are essential for her improvement. Alicia also sought out professional development opportunities, and Alicia plans to continue to develop her practice once she enters the profession (Course Reflection, p. 3). Finally, Alicia found practice-based learning experiences that involved role-playing as a student and as a teacher, analysis, and reflection of her teaching, and opportunities to analyze student work as key to her development and growth as a teacher (Course Reflection, p. 3; Interview 144-148).

It is noteworthy that before the digital learning experience on NNSMS and the classroom episodes, Alicia had one opportunity to investigate issues of status and participation in an experienced teacher's classroom for a journal entry. In this journal entry Alicia wrote broadly: "The status issue I noticed is that the minority students in the class [were] not eager to volunteer to answer the questions, but when the students [were] called on by the teacher they answer the question with no problem, which was very interesting to me" (Journal Entries, p. 5). Here Alicia noticed who participated and how and what happened when the teacher called on specific students, but she did not suggest how the teacher might support these students to participate or elaborate on why these status issues may exist in this particular classroom. This journal entry was included to capture Alicia's prior learning opportunities to investigate who participates and how in a classroom and the results of her investigation. Finally, during the digital learning experience on NNSMS, Alicia noted a broad range of students' mathematical strengths in module two, and after the experience, she said that she learned "the difference between" noticing students' mathematical strengths and noticing students' deficits (see Appendix G). These findings show that before the digital learning experience, Alicia valued students' diverse ways of participating, and she was able to recognize issues of status and participation during classroom observations.

Alicia's School and Classroom Contexts

Alicia taught at a public middle school in a large suburban school district, Parkside Middle School, which served approximately 688 students in grades 6-8 (nces.ed.gov, 2017-2018). About 48% of the student body were White, 21% of the students were Black, 13% of the students were Hispanic, 12% of students were Asian, and 5% of students identified as two or more races. In the fall Alicia's teaching internship was in an 8th-Grade Algebra I classroom, and in spring (end of March) Alicia moved from this teaching internship to an in-service teaching role in a 6th-Grade Math classroom at Parkside. Both of Alicia's transcripts were from her teaching internship in the 8th-Grade Algebra I classroom, and this Algebra I class met for 51 minutes each day. Alicia was in a district with an initiative that requires all 8th-Grade students to take Algebra I or above regardless of prior course enrollment. Finally, Alicia used the provided district curriculum, but she was able to make modifications and adjustments to the lessons.

Background on Alicia's Transcripted Lessons

For the lesson featured in Transcript 1, Alicia's goal was for her students to interpret and highlight features of a contextualized function. Alica's two key learning objectives were: The students will solidify their understanding of the domain and distinguish between the domain of a function, and the domain of a situation and students will use function notation to interpret the meaning of a situation. Transcript 1 is from the second lesson (of three) that Alicia submitted as part of her requirement for Methods II and the larger unit for this lesson was about functions and function characteristics. The second lesson began with students making observations (as many as possible) given a graph of the amount of water in two different pools at a waterpark over time. After students individually listed observations, Alicia brought the class back together for a whole-class discussion before students worked in small groups on the remainder of the worksheet (See Appendix H, for a full list of prompts). While Alicia began with an open question with many possible responses, overall, the lesson is best described as "procedures with connections" (see Stein, Smith, Henningsen, & Silver, 2000, p. 16).

For the lesson in Transcript 2, Alicia's learning objective was: Students will be able to complete the square and formulate relationships that will be used to identify perfect square trinomials and Alicia introduced Algebra Tiles to support her students' explorations. This lesson was the second of three lessons Alicia submitted, and this lesson was part of a unit on quadratic functions. Similar to her lesson in Transcript 1, Alicia used whole-class and small-group discussion to create opportunities for students to participate in procedures with connections. To begin, Alicia led a whole-class discussion on using Algebra Tiles to represent negative quantities before students used the tiles to model the given equations and complete the square. For each prompt, Alicia gave students a few minutes to work in small groups, and then she brought the class together to discuss. Alicia's second transcripted lesson can be described as "procedures with connections" (see Stein, Smith, Henningsen, & Silver, 2000, p. 16).

Alicia's Feedback Statements in the Classroom

An initial analysis of Alicia's two transcripts identified 50 feedback statements (n = 50) across the two transcripts, and these feedback statements were coded using the framework presented in Chapter 3 and applied in Chapter 5. Given these feedback statements, Alicia used strengths-based language in 29 of 50 instances, mixed-language in 2 of 50 instances and uncommitted language in 19 of 50 instances (see Table 19).

Table 19 *Alicia's Indicators of Quality for Feedback in the Classroom by Transcript*

Indicators	Codes	Transcript 1		Transcript 2		Total	
		n	%	n	%	n	%
Type of language	Strengths-based	14	67%	15	52%	29	58%
	Mixed language	0	0%	2	7%	2	4%
	Deficit-based	0	0%	0	0%	0	0%
	Uncommitted	7	33%	12	41%	19	38%

Mathematical evidence	Yes; mathematical understandings	19	90%	20	69%	39	78%
	Yes; ways of participating	1	5%	2	7%	3	6%
	No	1	5%	7	24%	8	16%
Teacher reasoning strategy	Descriptive	10	45%	8	29%	18	36%
	Evaluative	10	45%	13	46%	23	46%
	Interpretive	1	5%	0	0%	1	2%
	No strategy	1	5%	7	25%	8	16%
Justification	Yes	0	0%	0	0%	0	0%
	No	21	100%	29	100%	50	100%

In 42 of 50 feedback statements, Alicia included mathematical evidence of what students knew, understood, or could do, but Alicia did not include any justifications for this evidence. Three of the 42 examples of mathematical evidence focused on the smart ways in which students participated, whereas the remaining 39 instances focused on students' mathematical understandings. In terms of her reasoning strategy, Alicia often evaluated students' contribution (23 instances) and sometimes described students' contributions (18 instances), and Alicia only interpreted students' work in one instance. Looking across transcripts, Alicia moved away from revoicing or rephrasing the students' response to evaluating the students' response, which is a definite shift in terms of her strategy. Alicia may have regressed in some ways as well as she fails to reason about students' responses and provide mathematical evidence on seven occasions in Transcript 2.

Finally, given classroom transcripts, it is also possible to check if Alicia used students' names when making feedback statements and Alicia used students' names in 12 of 50 instances. However, Alicia aimed to use more students' names when giving feedback about their contributions: "Another thing I would change… is to use the student's name when referring to them when they give a correct answer. I said, 'good job' to Meg but did not say her name. When you say the students' name[s] I believe that it helps with their confidence and students will become more engaged when they know that they got the answer correct" (Alicia, Instruction Commentary 1, p. 4). Alicia's emphasis on correctness can be seen throughout her feedback statements and reflections and is problematic as it may prevent her from supporting students with partially correct or partially complete thinking even though she wants to do so as indicated by her reflections. The analysis led all of Alicia's feedback statements to being classified as emerging or developing examples of strengths-based feedback statements (see Table 20).

Table 20 *Quality of Alicia's Feedback Statements by Transcript*

Quality of Strengths-Based Feedback Statement	Transcript 1		Transcript 2		Total	
	n	%	n	%	n	%
Emerging	9	43%	16	55%	25	50%
Developing	12	57%	13	45%	25	50%
Meaningful	0	0%	0	0%	0	0%

Given these summary findings solely there seems to be little evidence that the digital learning experience led to sustained learning as measured by the quality of Alicia's feedback statements as Alicia continued to use uncommitted language and she does not provide any justifications when positively positioning students' contributions or assigning competence to students. However, this analysis does not capture the situational or relational nature of Alicia's statements as it looks at the feedback statements without context. The next section of findings summarizes Alicia's strategies to support students to participate in her classroom as well as a series of classroom episodes to highlight trends in Alicia's responses to students.

Alicia's Support of Students' Participation in the Classroom

Overall, Alicia created opportunities for her students to participate by inviting students to answer questions (31 instances) and she usually replied to students' verbal responses by revoicing (27 instances) and often after revoicing, Alicia scaffolded students' responses by taking over a portion of the mathematical work or adding her explanation (18 instances), and in 14 instances Alicia positioned students' contributions (see Figure 4).

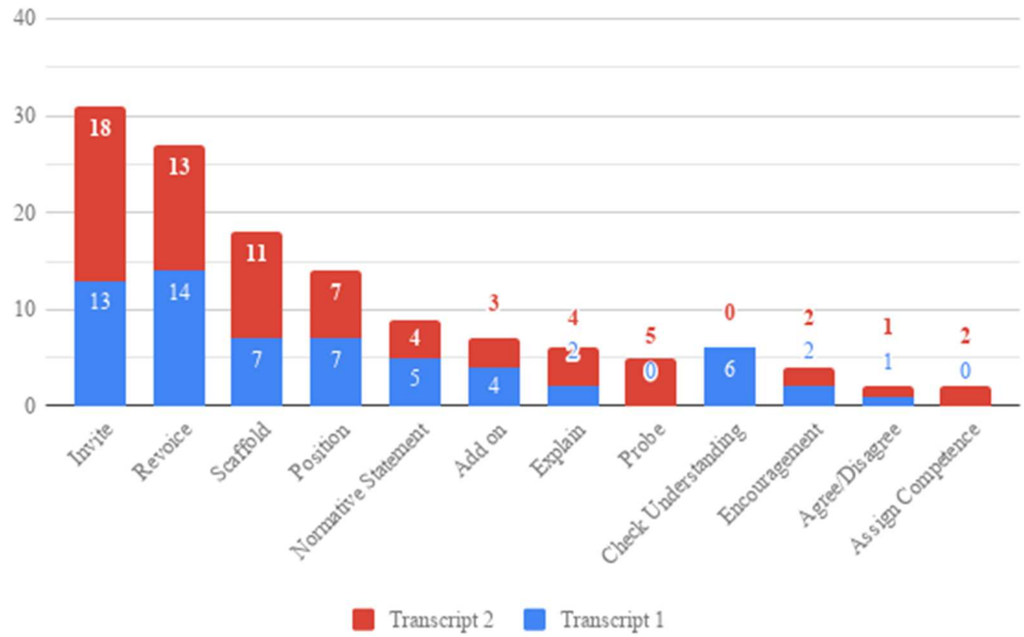


Figure 4. Alicia's Moves to Support Student Participation

After asking an initial question to invite students to participate, Alicia often asked additional students to add on to the initial student's mathematical contribution (seven instances), or Alicia asked students to explain their own or other students' thinking (six instances). In nine instances Alicia made a normative statement such as "raise your hand" (Line 52) or "I need some new hands" (Line 85) or "with your groups" (Lines 27, 43, 51) to set norms and expectations for students' participation. Finally, Alicia made statements to encourage students in four instances, and she explicitly assigns competence to a student in two instances. For most support moves there were no noticeable differences between Transcript 1 and Transcript 2 as shown in Figure 4, however there are a few key differences worth highlighting: Both of Alicia's examples of assigning competence occurred in Transcript 2, Alicia went from asking students to explain their thinking on two occasions to four occasions, Alicia went from probing students' thinking 0 times to 5 times, and Alicia went from 6 checks for understanding to 0 checks for understanding and potential explanations for these changes are explored in the remainder of this chapter. The next section of findings presents six classroom episodes from Alicia's transcripts that best characterize how Alicia supported students to participate and missed opportunities for Alicia to support students to participate.

Revoicing to Value and Evaluate Students' Responses

The most salient theme across all of Alicia's episodes and Alicia's feedback statements (as far back as the pre-assessment in the digital learning experience on NNSMS for secondary mathematics PTs) was Alicia's use of strengths-based language to evaluate students' responses. In the classroom, Alicia often revoiced and evaluated students' responses before moving on to another student's contribution. The first episode from Alicia's classroom contains six feedback statements and captures how Alicia used revoicing, adding on, and positioning to support students' participation (In all classroom transcripts, green highlights indicate feedback statements and yellow highlights indicate supports of student participation.):

4 Ms. Allen All right, so what do you guys notice about the graph? *invite*

5 Cameron: They intersect.

6 Ms. Allen: They intersect, okay. *revoice*

7 Sam: Both lines are decreasing.

8 Ms. Allen: Okay, they're both decreasing, perfect. Tatum? *revoice*

9 Tatum: They don't, um, go for a, um [inaudible] *add on*

10 Ms. Allen: Okay, so they don't go forward for an infinite amount of time. I mean, they have a stopping or ending point. Jamie? *revoice/ scaffold*

11 Jamie: Um, they're functions? *add on*

12 Ms. Allen: They're functions, okay. Jenna? *revoice*

13 Jenna: It doesn't start from the origin. *add on*

14 Ms. Allen: It doesn't what?

15 Jenna: It doesn't start from the origin.

16 Ms. Allen: It doesn't start from the origin, right. Bridget? *revoice*

17 Bridget: Ally's pool has more water, but it drains faster. *add on*

18 Ms. Allen: Okay, so she said, "Ally's pool has more water, but it drains faster." Okay, so those are all really good observations, and they're all correct. All right. *revoice position*

(Episode from Video 1, 0:38 – 1:34)

Note: Line 7 is labeled as revoice/scaffold and counted as both in the analysis because it is unclear which move Alicia used given the inaudible portion of the transcript.

This episode illustrates Alicia's typical strategy of revoicing as Alicia followed a pattern of inviting students to contribute, revoicing the contribution, and then asking another student to add to the list of observations: For example, Alicia said "They're functions, okay. Jenna?" in the transcript above. Alicia invited six students to participate by asking an open-ended question: "What do you notice about the graph?" and after calling on each student, Alicia always revoiced the student's contribution. Sometimes Alicia positioned the students' contributions in a positive manner such as when she says "Okay, they're both decreasing, perfect." and "It doesn't start from the origin, right." or Alicia responds with "okay" rather than a definitive sign of praise such as "right" or "perfect." At the end of the episode, Alicia positioned all of the students' mathematical contributions in a positive but evaluative way as she notes: "Okay, so those are all really good observations, and they're all correct. All right." Alicia's use of an open-ended question may have created space for more students to participate and/or space to widen the range of contributions as shown by the number of students participating and the variety of mathematical evidence (Alicia's students noticed the intersection of the lines, the direction of the lines, and aspects of the domain and range of the lines, and one of Alicia's students interpreted the system of equations given the real-world context, and another student identified the lines as functions). However, Alicia's attempt to create space for many students to contribute successively may have made it difficult for Alicia to take time to assign competence to students or positively position students' responses.

In Alicia's commentary on this lesson, Alicia wrote about why she often revoices students' responses as seen in the episode above as well as specifically about how she intended to support student participation through revoicing: "Throughout the lesson I initiated wait time for the students, by asking a question and then giving a short period of time to think... This gives everyone an equal opportunity to think about the problem first and individually come up with an answer. I also walked around and rephrased student's thoughts so that everyone can hear their other classmate's thoughts and mathematical reasoning" (Alicia, Instruction Commentary 1, p. 2). This quote shows that Alicia revoiced students' responses so classmates can hear each others' ideas, but she does not seem to use revoicing to highlight mathematical understandings in students' ideas. Thus, while Alicia's question may have created space for many students to participate, Alicia's responses did not capitalize on the diversity and strengths in students' responses because she revoiced and evaluated students' responses then immediately invited another student to add on to the list of observations. Alicia also commented on how to improve her practice: "I could have asked the students, what does it mean for functions to intersect" which indicates that Alicia valued asking students to explain their thinking even though Alicia did not do so regularly throughout her lesson. While Alicia did not typically ask her students to explain their thinking or the thinking of other students as shown by the previous episode, Alicia valued the practice of asking students to explain their thinking and she noted that later in her lesson she "had one student at a particular group who had the correct answer and did [an] excellent job at explaining her answer to me, so I said, 'Explain that to your group'. It is a good idea to have other students explain to one another because students do learn from their peers" (Instruction Commentary 1, p. 2).

Supporting Students to Participate with Encouragement

As a contrast to Alicia's emphasis on correctness, the next two classroom episodes show how Alicia supported students' participation by encouraging students with low confidence and students unsure of their answer as well as how Alicia positively positioned students with partially correct responses. These two episodes highlight how encouragement to invite a student to participate or to validate a student for taking a risk, and participating can be helpful. However, when teachers use encouragement as a follow-up move to validate a students' response, it must be saved until a teacher fully understands a student's contribution. Thus, these episodes are included to capture tensions that appear when teachers support students' responses with partially complete, partially correct, or incorrect work. In the first episode, Alicia reflects "I had [Carl] answer, and he did not give quite the answer I was looking for, but I did not tell him he was incorrect. I simply stated that '[Carl] is onto something.' Building off what [Carl] said I called on another student and [Lorna] gave a more appropriate answer." (Instruction Commentary 2, p. 1):

6 Ms. Allen: And, guys I see that one side is blue and another side is red. You guys think there is a reason for that? What would the different colors represent? Carl? *invite*

7 Carl: Just a guess, but maybe one is [pause] side is like if you needed a hole in the side [inaudible]...[inaudible] area of...[inaudible]

8 Ms. Allen: Okay.

9 Carl: [inaudible]

10 Ms. Allen: So Carl, is onto something. So, he's saying if one side represents taking away something. So, what do you guys think that is? *position revoice add on*

11 Lorna: [inaudible].

12 Ms. Allen: Perfect. Okay? Can you repeat that one more time for me, Lorna? *position*

13 Lorna: Like one side is negative, and one side is positive.

14 Ms. Allen: Okay, and what side do you think would be negative? *probe*

15 Lorna: The red side.

16 Ms. Allen: The red side. *revoice*

(Episode from Video 2, 4:06 – 5:04)

Even though parts of Carl's contributions were inaudible, he has ideas about negativity and "if you needed a hole" and while Alicia was unable to draw on these strengths in Carl's response specifically, she found a way to rephrase and revoice as well as affirm Carl's contribution before asking Lorna to add on to Carl's contribution. While it is unclear from Alicia's instruction commentary and the inaudible portions of the transcript if Alicia truly unpacked and understood Carl's thinking, Alicia at least gave Carl space to explain his thinking. Alicia also asked students to build from Carl's thinking, "So, what do you guys think that is?" rather than to replace Carl's thinking with their ideas (Line 10).

As noted earlier, there are two feedback statements when Alicia used mixed-language statements and similar to Carl's contribution these student's answers were partially correct, incorrect, or incomplete. In one case, Alicia told Kristen "Almost" before calling on Carl to respond (Transcript 2, Line 30) and while Alicia does not immediately follow up with Kristen, she said on Line 32: " Okay? So you, Kristen, you were onto...you answered more of my questions. I just wanted you to tell me what each side would be before you squared, okay?" (Transcript 2). Alicia's response to Kristen was a possible strategy of encouragement or an attempt to validate Kristen's contribution on Line 29. While Alicia stated that Kristen "answered more of my questions," Kristen's contribution (and Alicia's response) also indicated that Kristen was not making connections between the side length and area, and their corresponding expressions *or* Kristen thought she was answering a different question *or* Kristen made an error when calculating the area as the product of the side lengths. Alicia validated Kristen's response instead of unpacking Kristen's response, and this illustrates a possible tension teachers face when responding to partially complete, partially correct, or incorrect work. These episodes show Alicia had strategies for supporting students to participate when students' answers are incorrect, partially correct, or partially complete but Alicia's use of mixed language and her efforts to validate *all* students' contributions may have undercut Alicia understanding her students' contributions.

In the next episode, Alicia's initial encouragement in the transcript below may have helped support Molly despite Molly's low-confidence in her answer and hesitancy to participate and Alicia reflected: "I was able to motivate her not to second guess herself and that it would be okay if she got it incorrect" (Instruction Commentary 1, p. 2):

33	Ms. Allen: Okay, so for our domain [pause] What is our domain of the function, the entire function? Molly?	*invite*
34	Molly: Okay, I don't know if this is right.	
35	Ms. Allen: Give it a shot.	*encouragement*
36	Molly: Um, 0 is less than or equal to x so that's our domain.	
37	Ms. Allen: Perfect, that's correct. Okay, so our domain is 0 which is less than or equal to x, which is less than or equal to 24. Does everyone see how Molly got that?	*position* *revoice* *scaffold*
38	Jordan: Yes.	

39	Ms. Allen: Thumbs up if we understand how Molly got that answer. Perfect, okay.	*check for understanding*

(Episode from Video 1, 5:50 – 6:27)

Here Alicia's transcript and commentary highlight the importance of creating a low-risk learning environment where mistakes are valued and encouraged, and teachers support students to participate. This episode also captures how Alicia used checks for understanding to positively position a specific student as in this case: "Thumbs up if we understand how Molly got that answer" (Line 39) whereas in other instances Alicia asked, "Did everyone see how Cody's group got that scale?" (Line 21). Depending on Alicia's classroom environment and her established norms and expectations, Alicia's students may be comfortable giving a "thumbs up" but this strategy could also create or magnify issues of status if the *same students* have their "thumbs up" at each check for understanding and this a reminder of the situational and relational nature of teaching, a concern detailed in Chapter 8. Additional examples of these checks for understanding included: "Raise your hand if you do not understand." (Transcript 2, Line 52), "Does everyone see that? Okay? That makes sense? Raise your hand high if you understand it. Perfect." (Transcript 2, Line 62). "Raise your hand if you did not get 22" (Transcript 1, Line 56), and "We got that?" (Transcript 2, Line 45). Finally, in terms of scaffolds, Alicia took over part of the mathematical work as she inserted the upper bound into the domain statement (Line 37).

Supporting Students' Various Ways of Participating

The fourth episode from Alicia's classroom transcripts gives examples of feedback statements that connect to how students are participating as well as how Alicia made implicit statements about who is expected to participate in her classroom and how. For example, in the episode below, Alicia's student Jamie asked: "Can I draw a line?" and Alicia invited him "up here" to show his idea:

57	Ms. Allen: And then our last one says, "When is a(x) greater than d(x)?" Okay? This kind of goes back to what you guys did in your homework. We're looking for when a(x) is greater than our d(x). So, at what point on our graph is a(x) greater than d(x). So, Jamie please come and show us up here when the graph is greater than...	*invite*
58	Jamie: Can I draw a line?	
59	Ms. Allen: Yeah, you can draw a line. Perfect. Okay? So, a(x) is greater than d(x) at this point of our function, okay?	*encouragement*
60	Ms. Allen: So, if we're looking at it on our domain, when is a(x) greater? Besides Laura and Cara, when is a(x) greater, on our domain, for our function? All right, I have to pick someone. Heather. What do you think? For D. When [is] a(x) is greater than d(x)?	*invite* *position* *normative statement*

(Episode from Video 1, 12:25 – 14:00)

Alicia supported Jamie by encouraging her to participate in a way in which he was comfortable, which shows Alicia's acceptance of broader ways of participating not limited to merely verbalizing mathematical understandings. While Alicia sometimes used broad normative statements such as "raise your hand," there were multiple instances when Alicia's comments to students implied that there are norms and expectations about who can participate and how often. Later in this episode, Alicia posed a question and asked students to respond "Besides Laura and Cara" and when no one does she suggested "I have to pick someone" which may imply there were current issues surrounding status and participation in Alicia's classroom, *but* Alicia expected everyone to participate. However, whether intentional or not, Alicia's attempt to encourage more students to participate may have actually reinforced existing status hierarchies in her classroom because by positively positioning Laura and Cara in relation to her other students there is an implication that the remaining students must participate differently/less or have a lower status in Alicia's classroom. Alicia provided two explanations that give insight into why she may have employed this strategy: "It was evident that not all students were willing to participate" and "it is possible that the more vocal students overshadowed many of the other students" (Instruction Commentary 1, p. 6). While Alicia's explanations are plausible, her explanations did not include any indication of how her role as the teacher and her actions and practices created or magnified status issues in her classroom and in Chapter 8 this will be elaborated on as a potential weakness or missing component of the LessonSketch digital learning experience on NNSMS for secondary mathematics.

The final two classroom episodes are from Transcript 2, and these episodes provide one example (of two) of an occurrence when Alicia explicitly assigned competence to a student but within the same episode may have reinforced existing status hierarchies in her classroom as well as one missed opportunity to assign competence. Similar to the previous episode, Alicia asked for participation but excluded one student from participating as she said, “What would my length be?” and followed with “Someone besides Carl.” While excluding Carl from participating opens up space for Laura and Teddy to participate, Alicia’s way of positioning Carl once again sent a message to students that Alicia had differential expectations for her students in terms of participation. However, by excluding Carl, Alicia later had an opportunity to invite Teddy to the board to draw her response, and she assigns competence to Teddy when giving her feedback: “So, Teddy did a great job in showing what her algebra tiles would be if she was adding three to both sides.” This example is one of two instances across both transcripts when Alicia explicitly assigns competence to a specific student:

33	Ms. Allen: So, yes. X+3 would be for my width. What would my length be? So, I'm adding three inches to each side so what would my length be? Someone besides Carl. Laura?	*revoice invite position*
34	Laura: Adding three.	*position*
35	Ms. Allen: Right, adding three. Okay? So, that's how it would look algebraically with the X+3 times X+3. So, how would you show that with your algebra tiles? [Pause] Perfect. Can you draw that on the board? Oh, yes Teddy.	*revoice scaffold invite invite*
36	Ms. Allen: Okay, Teddy.	*scaffold*
37	Ms. Allen: Okay, get all those squares right here [pause] good. Good. Good. All right, perfect. So, Teddy did a great job in showing what her algebra tiles would be if she was adding three to both sides, okay? So again, this is telling me I have X plus three more and then I have X plus three more.	*assigning competence*

(Episode from Video 2, 7:07 – 8:43)

The last episode is a contrast to the two occurrences of assigning competence to illustrate how Alicia missed an opportunity to assign competence when making a feedback statement about Katie's contribution. In the transcript below, Alicia invited students to give the written expression, and after Katie's initial response, Alicia positively positioned Katie's answer and asked her to explain her thinking:

80	Ms. Allen: So, how am I writing this as an expression? Katie.	*invite*
81	Katie: Um, x squared + 8x + 16.	

82 Ms. Allen: Perfect, okay? And, how did you get that Katie? *position*

83 Katie: Oh. Um, well. I just like did the squared x squared and then the like these one are each x...so I just counted how many there were for 8x. And, then there were 16 little box[es]. *explain*

84 Ms. Allen: Perfect. Okay? So, she described her diagram in order to get her expression. Okay? *position* *scaffold*

(Episode from Video 2, 17:04 – 17:47)

Following Katie's explanation, Alicia again positively positioned Katie's response as she summarized the importance of Katie's response. If Alicia instead said "Katie" described her diagram rather than "she" it would have been coded as assigning competence because the feedback must explicitly name the student. With this episode, Alicia used the word "perfect" and words such as "perfect," "right," and "correct" can sound evaluative regardless of Alicia's intent whereas when Alicia says what is "good," a "great job," when a student is "on to something," or when Alicia "likes" a student's response (recall, Alicia used this phrasing on the post-assessment in Chapter 5) she shows she has alternatives to her typical evaluative stance. Thus, Alicia may have missed opportunities to assign competence in her classroom because she did not use students' names when making feedback statements and when her feedback statements used strengths-based language, they typically included evaluative language. Finally, Alicia's instruction commentaries and these episodes showed that Alicia assigned competence to students to support those students to participate and to help other students hear their ideas, but Alicia does not use assigning competence and favorable positioning of students to mitigate known issues of status and participation explicitly. When Alicia did attempt to change who participated in her classroom, she may have sometimes done so in a way that reinforced issues of status, although Alicia did succeed on one occasion to get other students to participate.

Conclusion

The six episodes in this chapter provide the reader with a sense of the types of feedback statements Alicia made as well as Alicia's overall practices to support students' participation in her classroom. Looking at Alicia's feedback statements without context tells only part of Alicia's story as her evaluative stance, lack of justifications and occasional use of uncommitted language overshadowed Alicia's use of strengths-based language in her feedback statements and it does not capture the range of strategies Alicia used to support students' participation including encouragement. With the broader analysis, it was possible to capture and highlight two clear examples of assigning competence and show that Alicia most often revoices students responses and positively positions students' but does so through her evaluation of their responses but there is no evidence she uses these practices to disrupt issues of status and participation specifically. Alicia also employed encouragement strategies to support students to participate when students were unsure of their answers (Molly) or when students gave incomplete or partially correct answers (Carl), and this is in alignment with Alicia's belief that mistakes are valuable and opportunities to learn. However, sometimes, Alicia replaced normative statements with positional statements about who could participate and when they could participate, which may lead to or magnify existing status and participation issues in Alicia's classroom.

Looking back at Alicia's results in sum, Alicia needed opportunities to use students' names as she did not do so regularly in her classroom transcripts, *and* this was a desired area of improvement for Alicia which points to a weakness of the digital learning experience on NNSMS as it lacked these opportunities (this will be elaborated on in Chapter 8). Alicia was able to use a variety of moves to invite students to participate and to follow up on students' participation, but when she made feedback statements Alicia used language that focused on correctness, and there is no indication she adopted the strengths-based language ("It was smart when…") suggested in the digital learning experience. The two examples of Alicia explicitly assigning competence in Transcript 2 and the three examples of Alicia supporting students' ways of participating demonstrated Alicia beginning to support students to participate. However, there is no indication that seeing and practicing these strategies in the digital learning experience on NNSMS for secondary mathematics led to Alicia doing so in her classroom, especially since Alicia made no mention of the digital learning experience and the practice was not central to her teaching as demonstrated by the interview, course reflection, and journal entries. Moreover, Alicia was only in the formative stages of assigning competence as she used the practice to support students to participate but did not connect it more broadly to disrupting issues of status and participation in her classroom.

CHAPTER 7: MARISSA'S STORY: LEARNING TO ASSIGN COMPETENCE

This chapter presents the case of Marissa and her progression in her use of feedback statements and moves to support students' participation. Marissa is a unique case as she indicated an early interest in assigning competence and naming students' strengths as evidenced by her journal entries. Her interest was piqued again with the digital learning experience as assigning competence became central to Marissa's philosophy of teaching and how she supported students to participate in her classroom as seen in her course reflection and interview. Marissa's case was unique because her colleagues mentioned assigning competence after the digital learning experience or when prompted in interviews, but only Marissa writes explicitly about assigning competence in early journal reflections and extensively in her course reflection. Marissa showed growth along several dimensions as her first transcript included examples of her failing to validate students' responses and Marissa used normative statements to set expectations around what students should and should not be doing which may be indicative of potential issues with classroom management or setting norms for participation. In Transcript 2, Marissa continued to follow up on students' responses by asking students to explain their thinking and Marissa's practice exhibited more instances of probing and adding on as well as new moves such as comparing and connecting students' ideas which is a specific practice Marissa expressed wanting to learn how to enact in a journal entry from the fall semester.

While Marissa valued and aimed to assign competence and notice and name students' mathematical strengths (NNSMS) and Marissa talked about these practices as a specific way to mitigate issues of status and participation, Marissa was unable to enact the practice of assigning competence in her first transcript. Given Transcript 2, Marissa only explicitly assigned competence once but there are three other occurrences where Marissa implied a students' mathematical contribution was desirable which shows giving credit to students via their contributions may be a first step for Marissa before she is explicit about assigning competence. However, outside of these occurrences Marissa rarely used students' names in either transcript and when Marissa positioned students' contributions that were "not" what Marissa desired she did not use students' names at all. Even though Marissa is in the formative stages of learning to NNSMS, assign competence, and support students to participate, the digital learning experience led to sustained learning as measured by Marissa's progression in support moves of students' participation, her removal of normative statements that send mixed messages to students and deficit language that invalidated students' thinking, and her well-developed beliefs that assigning competence can be used to address noticed issues of status and participation in her classroom.

Marissa as a Prospective Teacher

Marissa Young is a White female prospective high school mathematics teacher, and she participated in the 5-year integrated master's certification program first earning an undergraduate degree in mathematics with an emphasis in mathematics education and then a master's of education in mathematics. In her interview, Marissa responded to the first question about her teaching philosophy and what is vital in teaching with: "making the students feel confident about their math abilities is really really important because I know that if they don't feel confident and they're probably not going to try anything" (Interview, Line 2). In September, Marissa wrote in her journal: "Something I hope to establish is a routine of recognizing each student for their work," and she elaborated "[k]eeping track of which students have been recognized for their work is a great way to make sure that no student falls through the cracks" and she felt "honored" when her high school teachers set aside her work for recognition (Journal Entries, p. 1). More generally, Marissa valued mistakes in her classroom and connected developing students' confidence to the idea of setting/developing sociomathematical norms to support students' participation: "Teachers can set the norm at the beginning of the school year that mistakes are valuable and necessary for student growth. When students know that mistakes are okay to make in the classroom, they are more likely to participate and share their work with the rest of the class" (Course Reflection, p. 1).

Excerpts from Marissa's journal including her observation on status and participation show Marissa thought about how to support students to participate, issues of status and participation in her classroom, and her role in disrupting issues of status and participation. In early journal entries Marissa also wrote about how she intended to use a survey she gave to students at the beginning of the year (a required weekly assignment in Methods II): "Most of the students in these classes have a slightly negative view of math and aren't super confident in their abilities either [...] Now that I know the students don't enjoy math, I need to pay more attention to making the lessons fun and interactive. I also need to build the students' confidence and validate their work so that they are more willing to try difficult math in the future" (Journal Entries, p. 2). While Marissa's first solution was focused on her lesson materials and making the lessons more "fun" and "interactive" she also wrote about building students' confidence and validating students' work as a means to support students "to try difficult math in the future" which is evidence that Marissa connected her support of students to developing her students' confidence, and she linked this to students engaging with challenging mathematics. For her observation on status and participation, Marissa asked her mentor teacher to observe issues of status and participation while Marissa led a whole-class activity and Marissa noted in her reflection that "the talkative students" were given more authority because "they were the ones that participated the most in group discussions and asked the most questions during instruction" and some of the students "never participated in the discussion" including students that are learning English and "do not speak English well" (Journal Entries, p. 7). While Marissa did not offer suggestions for supporting this particular group to participate, in the same observation reflection Marissa included one example of how she involved a specific small-group "uncomfortable sharing with the class as a whole": "I noticed that the quiet table in the back of the room used a new approach to the problem that other students had not yet come up with. When going over the problem, I shared the solution that had come from this back group and gave them credit for thinking of this approach. Even though the back table was uncomfortable sharing with the class as a whole, the class still recognized their mathematical thinking as valuable" (Journal Entries, p. 8). This chapter will later demonstrate how Marissa continued to monitor students' work to support students to participate in her class as the year progressed.

In her course reflection, Marissa described naming students' strengths and assigning competence as "another important skill," and she cited the LessonSketch digital learning experience as "the most helpful activity" for learning these practices as "this activity helped me identify student strengths, even when they were not that obvious at first" and "this formatted way of commenting on students' thinking was helpful to both me and my students" (Course Reflection, p. 2). As noted in Chapter 3, Marissa even asked to spend additional time outside of class exploring the LessonSketch digital learning experience and the timestamps show she spent approximately two hours the following Saturday in the various modules and adding responses to the practice module (Module 3) after submitting her responses to the pre-assessment and post-assessment during Monday's class.

Marissa goes on to describe a specific incident in her classroom (which she also shared unprompted in her interview) that caused her initial "confusion" before she was able to "pinpoint their thinking" and name her student's mathematical strength (Interview, Line 9):

> In the classroom, finding student strengths can help the students feel that they are understood and not wrong for approaching a problem [in] a certain way. This strategy was incredibly effective in my classroom. There was an instance of the students learning how to rewrite exponential expressions with a common base. I asked the class how we could rewrite 36 and six so that they shared a common base. A student answered, 'Wouldn't you just divide?'. Even though this answer wasn't what I was looking for, I wanted to hear his thinking behind his answer. After asking him what he was dividing, he

> responded, 'You could just divide 36 by 6 and get 6'. So I responded, 'What Brandon said was smart because 36 can be rewritten as six times 6, which is the same thing as six squared.' Not only was I able to see where this student was coming from, but I also helped the other students make the connection between division and rewriting exponential expressions with a common base. This comment was also helpful to the student who took a risk and participated in the class discussion because he knew that he made a valuable contribution to the discussion. (Marissa Young, Course Reflection, pp. 2-3)

This excerpt illustrates Marissa's nuanced views as to why NNSMS is vital for supporting students to participate and for supporting students to make connections with each other's ideas. More importantly, Marissa wanted "to hear his thinking behind his answer," which indicated a desire for Marissa to understand her students' thinking before she moved to respond to students' contributions. Marissa also talked in her interview about monitoring students' work during warm-ups and small-group tasks as a way to notice and leverage students' strengths and she recognized a challenge to NNSMS was "I would say I feel like, um, sometimes it's a lot of the same students that I'm noticing" (Line 176) and elaborated "it's the ones who participate in the most like in the discussions, and so that's why I think it's important to like monitor and look at each student's work" (Line 178). After recounting this story in her interview, Marissa said "it just helps, like, if students are doing something, like, if they try a problem and their like, 'Oh my gosh, like, I don't understand. I'm so frustrated.' And I'll just like look at their paper and try to find one thing that they did right and then say like, 'No, no, no but like, you did this. This was a good start.' And so like that kind of encourages them to keep going. So the lesson sketch assignment helped me pinpoint that" (Interview, Line 11). Marissa again characterized NNSMS as a practice for supporting students to participate when students' work is partially complete or partially correct indicating an understanding that NNSMS goes beyond naming mathematical strengths: Teachers must make decisions about when to name students' mathematical strengths and whose mathematical strengths to name.

In addition to the digital learning experience, Marissa brought up one more moment during the Methods II when asked about course assignments and course resources that supported her learning to NNSMS: "At the beginning of the year where like each of us, not each of us, but like a handful of us would like come and present like our idea up on the board, and then you would like, you wrote like, 'Oh, this is Marissa's idea. This is Carina's idea.' And like just the fact that like the- our name was attached to our work like gave it more value" (Interview, Line 164). Here Marissa recounted a specific class during the Methods II when I directly modeled aspects of supporting students to participate in class by physically writing "Marissa's method" above her idea on the board and referring to it as "Marissa's method" throughout the whole-class discussion in the methods course.

Marissa's School and Classroom Contexts

Marissa taught at Riverside High School, a public high school in the same large suburban school district as Alicia. For the 2017-2018 school year, Riverside High School was a federally-designated Title I school and served almost 3000 students in grades 9-12 (nces.ed.gov, 2017-2018). Approximately 33% of the students were Hispanic, 25% of the students were Black, 22% of the student body were White, 15% of students were Asian, and 4% of students identified as two or more races. In Fall 2017 and Spring 2018 Marissa's teaching internship was in an Algebra II classroom, and Marissa's school was part of a technology initiative during this school year which meant each student at Marissa's school received a Chromebook. In the Fall and for Transcript 1, Marissa's students met for 90 minutes each day as Marissa taught a double-block section of Algebra II and in the spring (Transcript 2) Marissa's students met for 90 minutes every other day meaning they spend half as much time on the same Algebra II content. Both of these classes are considered "on grade level" in terms of tracking, and there is a designated "honors" Algebra II course offered at Riverside in addition to these options.

Background on Marissa's Transcripted Lessons

In Marissa's first transcripted lesson the primary objective was that "students will be able to solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation" (Instruction Commentary 1, p. 1). Marissa identified this lesson as "procedures with connections" (see Stein, Smith, Henningsen, & Silver, 2000, p. 16) because "students learned about different methods used to solve quadratic equations, and identified the advantages and disadvantages of each" (Instruction Commentary 1, p. 1) including factoring, completing the square, inverse operations, and the quadratic formula and "students answered questions about which method was better" (Instruction Commentary 1, p. 1). Marissa began the first transcripted lesson by asking students about the significance of finding a solution to an equation before reviewing the warm-up on solving quadratic equations. Following this review and initial question, Marissa asked students to read and examine (fictitious) students' work for solving quadratics and identify the methods used in each prompt. Marissa submitted this lesson as part of her requirement for Methods II and the larger unit for this lesson was about techniques for solving equations. While Marissa's students sat in small groups during the lesson, Marissa asked students to think about each prompt individually before students discussed the questions, and she repeated this process throughout Transcript 1.

Marissa's second transcripted lesson was the second lesson in a series of three lessons for her performance-based teaching portfolio and this lesson introduced trigonometric ratios and explored applications for trigonometric ratios including finding the position of a seat on a Ferris Wheel. Marissa's primary objective for the second transcripted lesson was: Students will be able to use the sine ratio to determine the height of a point following a circular path at a given point on a circle. She began the lesson by asking students to name objects with circular motion, and she showed a video of a Ferris Wheel. Marissa then asked students to label the Ferris Wheel using the given information before calculating the height of specific seats on the Ferris Wheel. In the warm-up students could use two different strategies to find the height of the seat at the top of the Ferris Wheel. As students proceeded to find additional seat heights, they utilized different trigonometric ratios, and various strategies, and many students recognized the usefulness of the symmetry of the Ferris Wheel for finding seats at the same height. Thus, the warm-up in this lesson was best characterized as "procedures with connections" while the primary task includes procedures with connections as well as students "doing mathematics" (see Stein, Smith, Henningsen, & Silver, 2000, p. 16). For a full list of prompts for both of Marissa's transcripted lessons, see Appendix H.

Marissa's Feedback Statements in the Classroom

An initial analysis of Marissa's two transcripts identified 57 feedback statements (n = 57), and these feedback statements were coded using the frameworks for the type of language and quality of the feedback statement (presented in Chapter 3 and applied in Chapter 5), and the findings are presented below in Table 21.

Table 21 *Marissa's Indicators of Quality for Feedback in the Classroom by Transcript*

Indicators	Codes	Transcript 1		Transcript 2		Total	
		n	%	n	%	n	%
Type of Language	Strengths-based	10	42%	11	33%	21	37%
	Mixed Language	2	8%	1	3%	3	5%
	Deficit-based	3	13%	0	0%	3	5%
	Uncommitted	9	38%	21	64%	30	53%
Mathematical Evidence	Yes; Mathematical Understandings	15	63%	27	82%	42	74%
	Yes; Ways of Participating	1	4%	2	6%	3	5%
	No	5	21%	4	12%	9	16%
	N/A	3	13%	0	0%	3	5%

Teacher Reasoning Strategy	Descriptive	14	58%	24	73%	38	67%
	Evaluative	5	21%	3	9%	8	14%
	Interpretive	0	0%	3	9%	3	5%
	No Strategy	2	8%	3	9%	5	9%
	N/A	3	13%	0	0%	3	5%
Justifications	Yes	0	0%	0	0%	0	0%
	No	21	88%	33	100%	54	95%
	N/A	3	13%	0	0%	3	5%

Given these feedback statements, Marissa used strengths-based language in 21 of 57 instances, mixed-language in three of 57 instances, deficit language in three of 57 instances, and uncommitted language in 30 of 57 instances. In 45 of 57 feedback statements, Marissa included mathematical evidence. Three of the examples of mathematical evidence focused on the smart ways in which students participated, whereas the remaining 42 instances focused on students' mathematical understandings and none of the statements contained justifications. In terms of her reasoning strategy, Marissa usually described the students' contributions (38 instances), Marissa sometimes evaluated students' contributions (8 instances), and Marissa interpreted students' work on three occasions. Looking across transcripts, Marissa removed deficit language and used more uncommitted language and less strengths-based language, and she was more likely to include mathematical evidence in the second transcript. This led to all of Marissa's strengths-based feedback statements being coded as emerging or developing (see Table 22).

Table 22 *Quality of Marissa's Feedback Statements by Transcript*

Quality of Strengths-Based Feedback Statement	Transcript 1		Transcript 2		Total	
	n	%	n	%	n	%
Emerging	9	28%	9	41%	18	33%
Developing	23	72%	13	59%	36	67%
Meaningful	0	0%	0	0%	0	0%

Note: Statements with deficit language only are excluded resulting in n=54

Finally, looking at Marissa's use of student's names, it was rare for Marissa to use students' names when making feedback statements to students and she did so only seven times across the 57 statements indicating this was an area of needed growth for Marissa. The next section of findings presents Marissa's moves to support student participation.

Marissa's Support of Student Participation in the Classroom

Overall, Marissa invited her students to participate by providing scaffolds to support students' participation (36 instances) and by asking initial questions (36 instances), and she usually replied to students' verbal responses by revoicing (33 instances), and in 22 instances Marissa positioned students' contributions (see Figure 5). Marissa also asked students to explain their thinking (22 instances) or add on to their thinking (seven instances), and on ten occasions, Marissa probed students' responses. An important finding from Marissa's transcripts is that Marissa used seven normative statements in her first transcript to make statements about what students should and should not be doing and this may be evidence of some broader classroom management issues detailed later in this chapter.

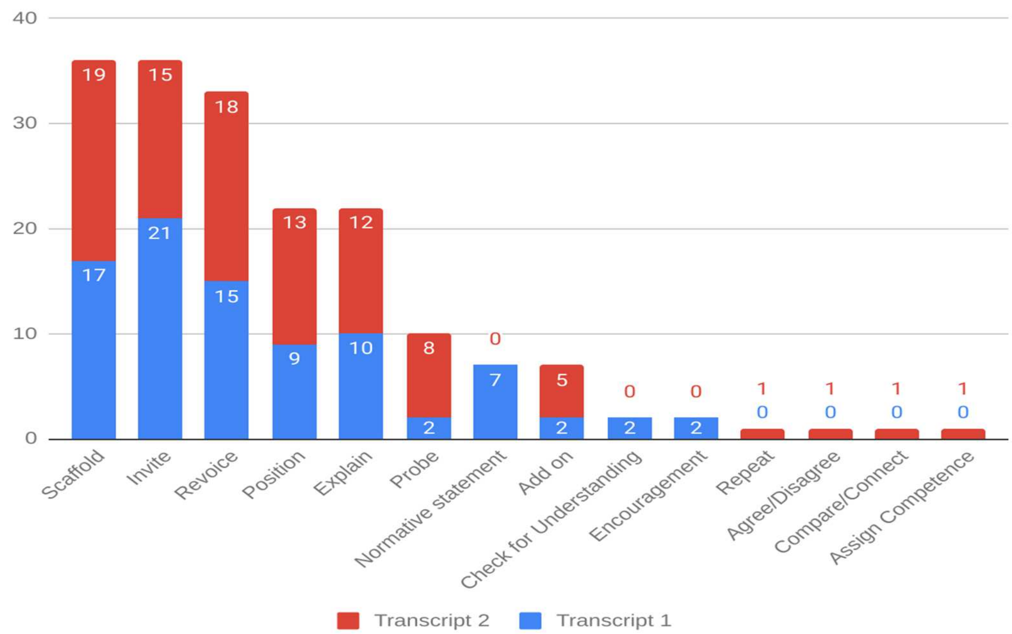


Figure 5. Marissa's Moves to Support Student Participation

Marissa's six episodes center on three themes: Marissa's responses when students' contributions are "not" what she expects; Marissa's additional moves to support students' participation; and Marissa's connections between supporting students' participation and disrupting issues of participation and status in her classroom. For Marissa, it was important for these themes to highlight salient moves and moments in Marissa's classroom as well as illustrate her progression in terms of how often Marissa used moves to support students' participation, which support moves, and when Marissa saw her teaching moves as potentially disrupting issues of status and participation or contributing to these issues.

When Students' Contributions are "not" what Marissa Expects

The first two episodes are included to characterize a series of episodes in Marissa's first transcript that make salient how Marissa's feedback statements acknowledged but failed to validate students' responses because they were "not" the response Marissa was looking for as well as Marissa's normative statements about what students should *and* should not be doing. The episode began with Marissa presenting a fictitious students' work and asking students to identify the method he used to solve the quadratic equation:

57	Ms. Young: You guys, I can't hear what your classmates are saying. We need to be respectful and listen. Okay. What did Benji do to solve for x? I heard it from someone. What did Benji do to solve here? [crosstalk]. All right, I don't know why everyone's talking in their group. What did Benji do? Benji did, no--	*normative statement* *invite* *encouragement* *normative statement*
58	Jack: Inverse.	
59	Ms. Young: It's not inverse. Alison?	*invite*
60	Alison: Standard form.	
61	Ms. Young: All right, so standard form is not a method we use to solve, that's just a form that we can write our equation in. What method did, did Benji use here? [crosstalk] Alia?	*scaffold* *invite*
62	Alia: Greatest common factor?	
63	Ms. Young: So it's not the greatest common factor.	
64	Gary: Lowest common. lowest common...	
65	Ms. Young: Let's go back to our warmup... (Episode from Video 1, 8:00 – 9:26)	

Marissa invited students to participate by asking: "What did Benji do?" and some of her students are comfortable participating as multiple students volunteered answers (Line 58, Line 60, Line 62, Line 64). However, Marissa suggested, "Let's go back to our warm-up" (Line 65) after eliciting several responses that indicated students were not sure of Benji's methods because students named different methods for solving quadratic equations and one student suggested a written form for quadratic equations. Marissa did not explicitly tell the students they are "wrong" or "incorrect," but she noted that their contributions were "not" what she was looking for: "It's not inverse" (Line 59) and "It's not the greatest common factor" (Line 63). This captures Marissa's uncertainty of how to respond to students to support students' participation when students did not participate how Marissa expected and/or did not give the answers that Marissa was looking for: Marissa did not ask any students to elaborate on their contributions, so there is no way to know or identify if there were valid ideas or strategies behind students' responses that were "not" the right method. Furthermore, looking at Benji's Solution (Figure 6) it is possible that Alison said "standard form" (Line 60) because Benji's quadratic equation is in standard form.

Benji's Solution

$$3x^2 - x - 6 = 0$$

$$9x^2 - 3x - 18 = 0$$

$$36x^2 - 12x - 72 = 0$$

$$36x^2 - 12x + 1 = 1 + 72$$

$$(6x - 1)^2 = 73$$

$$x = \frac{\sqrt{73} + 1}{6} \text{ or } \frac{-\sqrt{73} + 1}{6}$$

Figure 6. Benji's Solution to the Quadratic Equation (Recreated from Marissa's Worksheet)

Marissa explained (Line 61) why Alison's response was "not" what she was looking for instead of asking Alison more about her contribution. Looking at Benji's solution and Alia's contribution of greatest common factor (Line 62) it's possible she was looking at the fourth line of Benji's work and noticing that 6x is the greatest common factor of $36x^2 - 12x$ *or* she may be thinking that's how Benji factored to move from line four to line five of his work and she is expressing confusion about the factoring or the type of factoring. This example again highlights how Marissa may have missed opportunities to learn more about students' thinking or potential strengths' in students' responses when students' answers were "not" the answer. Finally, when Gary offered up an additional contribution (Line 64), Marissa does not acknowledge Gary's contribution and instead suggests "Let's go back to our warm-up" (Line 65).

In her commentary, Marissa wrote that she thought a graphic organizer would have helped students organize the methods, forms of equations, and advantages and disadvantages of each but Marissa did not make any suggestions on how to improve her teaching or support of students (Instruction Commentary 1, p. 4). This uncertainty was a broader concern for Marissa as she wrote in her course reflection when she monitors students' work: "I am sometimes surprised to see that students use a certain method of solving equations" (p. 4). Thus, Marissa wanted to spend more time "thinking about possible strategies students could use to solve a problem" (p. 4, Course Reflection). In a similar example from the same class, Marissa asked students how to use a graph to solve the quadratic equation $(x-3)^2 = 49$ (Line 14), and Marissa's student Ali suggested graphing the quadratic expression and the line $y =$

49 (Line 17, Line 19). Marissa had a slide on her Promethean Board with the quadratic equation $y = (x - 3)^2$ graphed, and she added the line $y = 49$ and then again asked students how to use the graph to find solutions:

21 Ms. Young: Take a look at the graph, and look at...Look at the lines that we've drawn. How could we use that to find the solution to this equation? *scaffold* *invite*

22 Stuart: So, I mean x equals y in liters.

23 Rachel: Y is equal to-

24 Stuart: Where the y, I mean x-intercept, that may be your value.

25 Ms. Young: How- *explain*

26 Stuart: X and y-intercept.

27 Ms. Young: So, we're not looking at the x and y-intercepts. You- You're close, though. (Pause) Where have we found solutions before...when we draw, when you draw a line y equals a number on the graph. Where have we been able to find our solutions? *encouragement*

28 Ali: Where they intersect, where they touch each other.

(Episode fromVideo 1, 2:39 – 3:20)

After Stuart brought up the intercepts (Line 24) as a place to find the solution(s) to the equation $(x - 3)^2 = 49$, Marissa asked "How" (Line 25) and Stuart responded the "x and y-intercept" (Line 26) and Marissa answered that it is "not" what she was looking for before adding encouragement: "You- You're close, though" (Line 27). Stuart's contribution showed it is reasonable for a student looking at the graph of the two functions $y = (x - 3)^2$and $y = 49$ to offer the x-intercepts of a particular function as solutions *or* a solution to the system such as a point. While Marissa's initial question called for students to "find the solution to $[(x - 3)^2 = 49]$" (Line 21) there is no evidence that Marissa recognized that Stuart's contribution was an important reminder that words such as "solution" could reference the zero of a function, a statement that makes an equation true, or a set that satisfies a system of equations. Marissa wrote that she felt her response "validate[d]" the students' contributions because "[t]his comment gives credit to the students who have taken a risk and shared their ideas with the class [and] places value on the responses that they have shared…" (Instruction Commentary 1, p. 2). This reflection confirmed Marissa's reasoning strategy around Stuart's response was limited to an evaluation of his response and her use of "You're close, though" (Line 27) was to "validate" Stuart for "taking a risk" and to demonstrate that she valued Stuart making a response *not* that she valued the content of Stuart's response or that she recognized why he might contribute the intercepts of a function when asked about solutions and given a graph. Additionally, Marissa's use of encouragement ("you're close") is relative in nature which creates ambiguity about how "close" a students' contribution is and to what and while some encouragement may be useful for inviting students to participate, it should not be used unless it is used to specifically name why a students' contribution is "close" (see Chapter 8). Finally, as a contrast to the first episode, Marissa asked "how" (Line 25) in an attempt to gather more insight before evaluating her students' contributions whereas in the first episode Marissa did not ask the students to elaborate on their answers.

Returning to the first episode, Marissa also made statements about the expected norms for participating in her classroom and quipped: "You guys, I can't hear what your classmates are saying. We need to be respectful and listen." And as the crosstalk continued, Marissa added, "All right, I don't know why everyone's talking in their group" (Line 57). These two examples as well as statements such as:

“Guys, side conversations have got to end, all right.” and “We’re talking about the work you just did.” (Line 67) illustrate how Marissa struggled with classroom management and setting/reinforcing clear expectations for students on when and how to participate. On the other hand, Marissa avoided singling out individual students and negatively positioning students with one exception when she said: “David, put your phone away” (Line 65). In addition to these problematic statements about when and how students participate, Marissa also made problematic statements about what students should know: “Someone, help me, fill out the quadratic formula. You should’ve learned it in Algebra one. Someone help me write it down. So, what is the quadratic formula?” This exclamation might have sent a message to students that they did not belong in Marissa’s classroom if they did not know the quadratic formula (Line 47).

While Marissa’s first transcript showed she positioned her students’ responses as “not” what she is looking for, and she made normative statements about what students should not be doing, there are also strengths in Marissa’s first transcript that deserve mention to capture a holistic picture of what Marissa does and does not do to support students’ participation. There are several instances in Marissa’s first transcript where she positively positioned a students’ contribution even though she did not explicitly assign competence such as “that’s what George is saying, an equation sets two quantities equal to each other.” (Line 13) and “Saleem said, that the square root of 49 equals seven.” and “Ali’s telling me I need to do what?” (Line 16). These are the only three occurrences when Marissa positively positioned a student’s contribution *and* used the student’s name and Marissa notes that with these occurrences she had a two-fold intention to praise students for participating "but also showed the rest of the class that students who share their ideas [would] gain recognition" (Instruction Commentary 1, p. 1). However, Marissa did not connect positively positioning students to specific issues of status and participation in her classroom in this reflection. This lack of connection shows that immediately after the digital learning experience, Marissa valued giving students' credit and supporting students to participate, but she did not reflect on how to use naming students' strengths and assigning competence to disrupt issues of status and participation explicitly. The next two episodes are used to portray how Marissa probed students' thinking before positioning students' contributions.

More Moves and New Moves to Support Students to Participate

When students in Marissa's classroom did "not" give the desired response, Marissa often evaluated students' contributions, and Marissa did not notice or name the strengths in students' contributions. On the other hand, when Marissa probed students' responses before evaluating students' responses, Marissa created opportunities for students to add on to or explain their responses. This episode from Transcript 2 is included to characterize Marissa's use of moves to support students to participate as she often probed students' thinking and then ended by positively positioning a students' contribution even though she did not explicitly assign competence. Before this episode, Marissa called upon students to recall what they learned in the last unit about trigonometry, and she played a video of a Ferris Wheel and asked students what they noticed about the Ferris Wheel and the Ferris Wheel's motion (Lines 1-28). After making these connections to prior learning and the circular motion of a Ferris Wheel, Marissa presented her students with a warm-up and asked her students to identify what they knew about the Ferris Wheel:

29	Ms. Young: So, let's look at your warmup. All right. We're talking about Ferris Wheels in your warmup. Okay. So what do we know about the Ferris Wheel in this problem?	Invite
30	Multiple Students: You know it's [crosstalk] 25 Feet. [crosstalk] I just said that.	
31	Ms. Young: All right, radius is 25 feet. [writes "Radius: 25" on board]	
32	Brian: And the ground to the bottom is 5 feet.	
33	Taylor: And the diameter is probably 50 feet.	
34	Ms. Young: What does it, what does it tell you in the problem?	*invite*
35	Brian: Up from the ground is 30.	
36	Ms. Young: From the ground up to the very top is 30?	*probe*
37	Brian and Another Student: To the middle.	
38	Ms. Young: To the middle. So the center point is 30 feet off the ground… All right, so, someone remind me again, what does the radius mean?	*revoice*
39	Multiple students: Half.	
40	Ms. Young: Half of what?	*probe*
41	Brian: Half the diameter.	
42	Derrick: The diameter	
43	Ms. Young: Okay, what's the diameter?	*probe*
44	Mason: The full length.	
45	Ms. Young: The full length of what?	*probe*
46	Mason: The circle.	
47	Wes: It's a line from one side to the other side through the center. (Gestures with hands)	
48	Ms. Young: Okay so, Wes is saying [gestures at Wes with both arms outstretched] that it's a line that's going from one side of the circle to the other side of the circle. That's the diameter. So the radius is half of the diameter. All right. Another way you could think of the radius is the line that goes from the center point of the circle to one	*position* *scaffold* *invite*

of the points on the outside of the circle. So here's our radius. And how long is it again?

49 Multiple students: 25

50 Ms. Young: 25 feet. *revoice*

(Episode from Video 2, 3:18 – 4:58)

Marissa began by asking a question that invited students to participate by sharing what information was given in context (about the Ferris Wheel) and how those lengths connected to the radius and diameter of the circle. Brian responded with "up from the ground is 30 feet" (Line 35), but in his response, it is not clear if he means the center point or the top of the Ferris Wheel. Rather than scaffold and complete Brian's response or point out how it is "not" specific enough, Marissa questioned if he meant "from the ground up to the top is 30 feet?" and that probed Brian (and a second student) to specify Brian's contribution (Line 37). Marissa probed students' responses three more times until she received a contribution from Wes, who stated the diameter is "a line from one side to the other side through the center" (Line 47). Although this analysis did not examine the dimensions of how (often) students participate and who participates, during the whole-class discussion (Lines 1 - 88) this is the only comment made by Wes, and there is no more information known about how Wes participates because his small-group discussions are not in the video transcript. This lack of clarity points to a need for data collection and analysis that looks at how PTs learn to support specific students to participate in tandem with PTs' moves to support students' participation in small-group and whole-class settings.

The next episode is included to show a specific shift for Marissa as she was able to compare and connect students' ideas in her second transcript after being unsure of how to enact that practice in the fall semester. In September, when asked to write about a routine or norm she hopes to establish, Marissa wrote: "I'm not sure how well this would work in my current classes, but I love the idea of listening to different student approaches and giving those students credit for them. For example, if a class [discussed] different ways to approach a problem, I would want the students to name each idea after the person who created that approach" (Journal Entries, p. 4). From this entry, it is clear that Marissa had a desire before the digital learning experience to give students' credit for their contributions while also comparing students' contributions but she was not sure how to enact this practice in her classroom. While ambiguous, when Marissa wrote that she was "not sure how this would work in her current classes," this may imply Marissa was not sure how it would work for her students. Almost five months later, the episode below is an example (the only example in either transcript) of when Marissa compared and connected students' responses (here she does both). Before this episode, Marissa asked the students to answer some initial questions about the Ferris Wheel using the given information in the problem, and the episode began with Marissa at the board writing up information from a previous question, and she asked students "how did you calculate his height?" (Line 73) referring to a person seated at the bottom of the Ferris Wheel:

73 Ms. Young: All right. Let me write this thing. So at the top we added 30 feet plus 25 feet and we got 55 feet. Alright. What about when he's at the bottom, Mason I know you had something to say *scaffold* *position*

about when he was at the bottom. How did you calculate his height? *invite*

74 Mason: [inaudible] 55 minus 50 is 5

75 Ms. Young: Okay, so Mason is saying that 55 feet minus 50 will give you the height at the bottom. Which was what? *position, revoice add on*

76 Mason: 5 feet.

77 Ms. Young: Did anyone use a different method to calculate his height when he was at the bottom of the wheel? Brian? *compare*

78 Brian: Um, 30-25.

79 Ms. Young: So where did you start on the wheel? *explain*

80 Brian: The middle is 30 and it says the radius is 25 so.

81 Ms. Young: Okay so Brian started at the center point and then subtracted 25 from 30 to get 5 feet. So either method would've worked here. You would've gotten the same answer. Alright. So at the bottom he's at 5 feet. *position connect revoice*

(Episode from Video 2, 7:40 – 9:09)

While it is not clear how Marissa knew Mason and Brian used different methods, when Marissa revoiced Mason's response she intended to elicit more student responses and her follow-up question "required students to build on the previous student's response" and promoted procedural fluency "because it showed them that they could have used more than one method to calculate the height at the bottom of the wheel" (Instruction Commentary 2, p. 4). This finding shows that it is possible for PTs to compare and contrast students' methods and positively position contributions from multiple students without ranking students' work.

Beginning to Reflect on and Address Issues of Status and Participation

The final two episodes depict how Marissa began to address issues of status and participation in one table group of three students as well as Marissa's reflections on a missed opportunity to address participation in another table group of three students. The first of the two episodes is from the beginning of the second video in Marissa's transcript, and students are now working at tables in groups of two or three. While each student has a handout, all three students are leaning over a blank Ferris Wheel handout inside a clear sleeve and Brian is holding a dry erase marker. One of the three students has filled in the height of the wheel:

89 Brian: You can take this, And then given that, you know that is 25. [Marker squeaks, everyone laughs] We know this is 25. [Gestures to radius of Ferris Wheel with dry erase marker]

90 Lamar: This is the same height? [Lamar points to two seats at the same height]

91 Brian: Well, well shouldn't it be? Well we know this is 25. He was thinking we would minus 50 from that and then that's 30 = 7 plus the five so that's wrong.

92 Ms. Young: Well, if you subtract 50 from this, do you know for sure that the distance between CD and CH is 50 feet? *scaffold*

93 Brian: I feel like there's a better way to do 3.

94 Chris: No... [Laughter]

95 Ms. Young: Why not? *probe*

96 Chris: Well, I assumed it was because you had to go through the center to get to the other one. Okay but if you...

97 Lamar: This is not the center [points] it's like to the side. [Gestures with pencil]

98 Chris: What do you mean it's not the center, man?

99 Lamar: From here to here? [Traces the vertical distance between the two points with his pencil] That doesn't go through the center.

100 Chris: Ok, but from here to here...
[Chris sits back in his chair and puts both hands to his cheeks in exclamation as Ms. Young begins to speak]

101 Ms. Young: That doesn't go. Yeah, Lamar brings up a good point. That doesn't go to the center. *assign competence*

102 Brian and Chris: OHHHHHH. [Chris interjects with "Dang it!"]

103 Ms. Young: So, I'm gonna give you guys a clue. Why don't you try drawing your right triangles in again? That you used to find these seats up here? And see if you can find a way to relate it to the bottom of the wheel. You guys are onto something. You're really close. Alright, but I would draw those right triangle back in to help you figure out some of the symmetry that is going on there. *scaffold*

(Episode from Video 2, 9:53 – 11:33)

In her commentary, Marissa wrote that her comment to Lamar on Line 101 "validated Lamar's response and also drew him into the conversation" (Instruction Commentary 2, p. 6). While it is not clear from the transcript (and without interviewing Lamar) that Marissa's response is what drew Lamar into the conversation, Marissa explicitly assigned competence to Lamar. Moreover, the transcript shows that the beginning of the conversation focused on Brian telling Marissa how he calculated a height (Lines 89-91) and then the conversation shifted to Chris's confusion as he assumed "you had to go through the center" (Line 96). While Chris seemed to connect with Lamar's idea right before Marissa began to speak given his reaction, Marissa made it explicit that Lamar's contribution was valuable. There was a moment of realization for both Brian and Chris around their approach to the problem (Line 102), and Marissa thought Brian and Chris realized at this time that they needed to draw a different line to find the vertical height (Instruction Commentary 2, p. 2).

After Marissa walked away, the video showed Brian, Chris, and Lamar continuing to work as Marissa moved on to another group of students and she briefly discusses with those students how to find trigonometric ratios using a calculator before moving on to the group of three students working in the next episode. In this episode, each student was asked to find the height for a specific seat around the Ferris Wheel, and Marissa started with a general check-in before speaking to two students (Anna and Jane) in the group:

126 Ms. Young: Yeah. Yeah try it. [Moves to a new table with three students] How's it going guys? Okay good. Were you guys able to find C, D, And E? *invite*

127 Jane: We're working on E

128 Ms. Young: What did you guys notice about C and D? What did you guys notice about the heights of C and D? *probe*

129 Jane: The same.

130 Ms. Young: Ahhh so they're the same. There is some symmetry there. SO what do you think the height of E is going to be? *revoice*

131 Jane: The same as the height of D.

132 Ms. Young: Mmmmm right, that's an interesting observation. *position*

133 Jane: Where do you write it for-

134 Ms. Young: Why don't you uh- who found the height of E for this group? *connect*

135 Anna: I did.

136 Ms. Young: And what did you get? *invite*

137 Anna: The same thing as B.

138 Ms. Young: Okay, so you drew the triangle in and you like found the sine of your angle and you like got what you, what was it 44 point... Okay. So why do you think that's important? That we know that you can find the height of what this is on one side and then you will know the height of the other side. Why is that helpful? *scaffold*

139 Anna: I would say because like, from the point to like between 1 and 2, it's gonna be the same height all throughout so if you just have to circle, it's gonna be the same..

140 Ms. Young: It's less work too. *scaffold*

(Episode from Video 2, 13:38 – 14:57)

On Line 134, Marissa opened the conversation up to the group but in a way that resulted in Marissa continuing the conversation with only Anna. In her Instruction Commentary 2, Marissa admitted, "I mainly just talk to Anna. Out of the three girls in this group, she participates the most in class and takes the lead during group activities" and while Marissa "had a good discussion with [Jane]," Marissa "did not do a good job of including the other two girls in the conversation" (Instruction Commentary 2, p. 5). As seen by the transcript, the third student does not participate, and Marissa does not make an explicit attempt to include that student in the conversation.

After making this recognition that she played a role in including the student (or not), Marissa noted that she could have started the conversation by asking students what each student found for the height to include all three group members and Marissa suggested revised questions such as "What do you notice about both sides of the circle?" and "What property do circles have that will make the seats directly across from each other have the same height?" to support her students to see the symmetry (Instruction Commentary 2, p. 6). Marissa then wrote: "Including everyone in the conversation also sends the message that everyone's work is useful and necessary for the group to learn. It would also give each student a chance to do the mathematical thinking for the group" (Instruction Commentary 2, pp. 5-6). With this excerpt, it was clear that Marissa recognized how who she included (or did not include) in the discussion sent messages to students' about the utility and necessity of everyone's work. Secondly, Marissa recognized that "asking questions like this provides multiple entry points, which increases group participation as a whole, allowing these students to demonstrate their mathematical competence" and she connects her practice of questioning to her practice of assigning competence. Similar to Marissa, Chris Alger analyzed her teaching and wrote about a situation when she realized a group's efforts to include Dennis (a low-status student) were purported, and she acknowledged her role as a teacher in (not) supporting all students to participate:

> I realized I had addressed the other members of the group as if Dennis were truly invisible. Instead of assigning competence, I did the opposite. I disembodied, objectified, and ultimately disempowered Dennis. No wonder the expectations of his peers were lower than I would have liked. In my own way I had unwittingly silenced him. (Shulman, Lotan, and Whitcomb, 1998, pp. 63-64).

Alger's analysis and Marissa's reflection show how teachers must support all students to participate during small-group discussions by sending messages about the significance of students' contributions especially low-status students and by playing an active role in who participates and when.

Finally, to present a holistic view of Transcript 2, it is also important to note two tensions in Marissa's classrooms that do not appear in the six episodes and Marissa did not reflect on these moments in her Instruction Commentary 2. First, when Marissa introduced students to the lesson, she asked: "[All right], so who here has ever been on a Ferris Wheel?.... Raise your hand. *murmurs* Has anyone not been on a Ferris Wheel before?" before showing students a video of a Ferris Wheel (Transcript 2, Line 8). While Marissa was attempting to interest students by promoting the context, Marissa's phrasing of her question may have unnecessarily created a binary of who-has-been-on-a-Ferris-Wheel and who-has-not-been-on-a-Ferris-Wheel. While it does not seem intentional, Marissa may have sent a message to students that they had something different/less to contribute if they had not been on a Ferris Wheel. Although it is essential to use real-world contexts, it is critical to think about how to draw on students real-world experiences in a way that is inclusive and does not create status groupings or imply messages about who has something worthy to contribute based on prior experiences alone.

Another tension becomes noticeable in Marissa's episodes when all of Marissa's episodes are organized chronologically into the whole-class portion of the class (Lines 1 - 88) and the small-group discussion portion of the class (Lines 89 - 140). The transcript includes a total of 13 students of Marissa's 16 students (seven female students, nine male students) and it is unknown if any students were absent that day. Looking at the whole-class portion (Lines 1 - 88) of Transcript 2, only one female student (Jane) participated once during the discussion (Line 23) that lasted nine minutes and 52 seconds. While this transcript comes from two video segments in one lesson, and it would be unfair to draw broad generalizations, but for this one case, male students dominated the whole-class discussion in Marissa's classroom. Marissa does not address this in her instruction commentary, so this could be another issue of participation that Marissa did not notice or Marissa did notice but was unable to address it. This example captures how Marissa began to notice and address some issues of status and participation, but at the same time, she may have overlooked other issues or been unable to address these issues while teaching highlighting the complexity of practice.

Conclusion

The six episodes in this chapter provide the reader with a sense of the types of feedback statements Marissa made as well as Marissa's practices to support students' participation in her classroom. Looking at Marissa's feedback statements without context tells only part of Marissa's story as her use of uncommitted language, and lack of justifications do not capture how Marissa used feedback statements to positively position her students and Marissa's moves to follow up on students' contributions. With the broader analysis, it was possible to capture and highlight clear examples of assigning competence, and there is some evidence Marissa used (or thinks she should have used) practices that support students' participation to disrupt issues of status specifically. Marissa also employed a plethora of strategies to support students to participate, and in her second transcript, Marissa successfully set up opportunities for students to compare and connect work, explain their thinking, and to add on to other students' contributions. In Transcript 1, Marissa made normative statements about what students should and should not be doing and may have had issues of classroom management, and Marissa struggled to respond to students when students' contributions were "not" what Marissa expected.

Looking back at Marissa's results in sum, Marissa transitioned from wondering how to support student's participation in her classroom to displaying a diverse repertoire of practices to support students' participation. Moreover, Marissa showed a nuanced understanding of assigning competence by the spring semester, and Marissa used assigning competence to address issues of status and participation in her classroom. Marissa often used uncommitted language, and in Transcripts 1 and 2 Marissa did not use the sentence frame ("It was smart when…") suggested in the digital learning experience but Marissa reflected on using the sentence frame successfully in her classroom (once) on another occasion. However, Marissa explicitly assigned competence only once and there are only three examples of Marissa supporting students' ways of participating. These findings demonstrate that while Marissa may have a well-developed understanding of the practice of assigning competence, it is clear she is not always able to translate those beliefs and understandings to practice. Finally, there is a strong indication that the digital learning experience was fundamental to Marissa's learning and teaching, as demonstrated by the interview, course reflection, and journal entries.

CHAPTER 8: DISCUSSION

Summary of Study

Noticing and naming students' mathematical strengths (NNSMS) is one component of assigning competence, which is a core instructional practice to support students' participation to disrupt issues of status and inequities in mathematics classrooms. Given the complexities and contingencies of teaching, prospective teachers (PTs) need opportunities to learn aspects of core instructional practices using representations and approximations of practice such as digital learning experiences. This study posits that NNSMS is one way to reclaim smartness for students' contributions and a way to broaden what teachers count as mathematics to better value students' diverse ways of participating in mathematics classrooms. The study examined how PTs make feedback statements before and after a digital learning experience on NNSMS and PTs' broader moves to support students to participate.

Analyses of feedback statements from before and after the digital learning experience reveal a transition from problematic feedback statements that focus on deficits or use uncommitted language and are vague about students' mathematical contributions to meaningful strengths-based feedback statements. The presented analysis modified (see Kalinec-Craig et al., in preparation) and further developed a framework to determine the quality of strengths-based feedback statements and this analytical work led to concrete examples of emerging, developing, and meaningful strengths-based feedback statements. However, after analyzing classroom and interview data collected after the experience, this study found that the PTs' learning did not necessarily carry over into classroom practice. Alicia is beginning to use assigning competence to give students credit for their contributions and value students' diverse ways of participating, but she is not using the practice to address specific issues of status and participation in her classroom. Marissa is starting to use assigning competence and noticing students' strengths to disrupt issues of status and participation, but she also leaves other participation issues unnoticed or unaddressed. With the secondary analysis, there were some noticeable shifts in Alicia's and Marissa's moves used to support students to participate, but only Marissa saw the practice as central to the work of teaching. Marissa and Alicia were also able to identify missed opportunities such as not using students' names or not speaking with every student in a small group. While this is promising, unless PTs are noticing and disrupting issues of status and participation as we saw examples of in Marissa's classroom, the PTs may continue to perpetuate status hierarchies in their classrooms.

Conclusions

The next section presents four conclusions that are a result of this study. The first conclusion is that the sentence frame and the analytical framework are potential tools for mathematics teacher educator to scaffold PTs' learning around the practice of NNSMS and make distinctions given different types of feedback statements in designed settings such as digital learning experiences. The second conclusion is that while it was promising, there were some examples of PTs noticing and naming the mathematical strengths in students' ways of participating, overall the PTs primarily focused on more traditional ways of being smart in mathematics. The third conclusion is that this study created space to study how assigning competence leverages, is in tension with, or connected to other core instructional practices as well as insights into if and how PTs are making those connections and experiencing those tensions. The fourth conclusion is that even when two PTs were able to make meaningful feedback statements in the digital learning experience, there are still noticeable differences in how PTs transfer that knowledge to the classroom.

Meaningful Strengths-Based Feedback Statements

This study provides concrete examples of meaningful strengths-based feedback statements as well as additional insights into problematic feedback statements. These examples are useful for understanding the practice of assigning competence in CI as it calls for feedback that is public, attends to intellectual contributions, and specific as well as related to the group's work. (Cohen & Lotan, 1997; 2014). By performing an analytical categorization of feedback statements, this study helps better define what looks like empty praise (strengths-based language without mathematical evidence) and empty encouragement (positive positioning lacking specificity) as well as praise or encouragement about non-mathematical aspects (such as students' behavior) and differentiate these statements from assigning competence. Thus, the framework for determining quality provides helpful categories around language, mathematical evidence, and teacher reasoning strategy for PTs and mathematics teacher educators alike.

Building off the work of Kalinec-Craig and colleagues (in preparation) this study was also able to name, describe and give examples of uncommitted language (language that is not explicit about students' strengths). Moreover, most of the PTs (4 of 6) made meaningful strengths-based feedback statements on the post-assessment which adds to a growing body of literature that shows "preparation centered on strengths-based practices might help teachers to resist" focusing on students' deficits and draw attention to what students already know about, understand, and can do in, mathematics (Boaler & Staples, 2008; Cohen & Lotan, 2014; Crespo & Featherstone, 2012; Horn, 2007; Jilk, 2016; Bannister et al., 2018, p. 14). However, as Marissa started to mitigate issues of status and participation in the classroom actively, she reflected on how she was sometimes noticing the same strengths for the same students. Similarly, White and colleagues (2018) found that it can be difficult for practicing teachers to notice evidence of strengths for some students and easy to identify many strengths for other students.

Jilk's Sentence Frame as a Resource

Jilk's (2016) sentence frame for practicing teachers is useful for PTs as well with four of the PTs continuing to use the sentence frame on the post-assessment (without being prompted), and Marissa reflected on using (and the usefulness of) the sentence frame in practice. On the post-assessment there were some unjustified statements, and all feedback statements in the classroom transcripts lacked justifications, and many of those feedback statements contained uncommitted language. The sentence frame is a resource for PTs to frame students' contributions in terms of strengths (It was smart when…) and to justify those contributions (because) which were the two types of support PTs needed based on the findings. This is initial evidence that the sentence frame is a useful resource for both PTs and practicing teachers to NNSMS. Jilk uses the sentence frame to reframe students' participation norms as mathematical strengths because it is not solely about students' content knowledge but also the methods, skills, and actions that students might contribute during group work (2016). Jilk's sentence frame can be adapted as needed, and PTs called on it as a resource to make feedback statements on the post-assessment, showing it is easy to learn and use the sentence frame. While Jilk's sentence frame may appear to be a routine or a routinization of practice, there is no evidence from this study that the practice was reductive. The sentence frame is a learnable and adaptable resource for practicing and prospective teachers to NNSMS. While the sentence frame's intended use is to practice NNSMS in video club or digital learning experiences - it has the potential to be used in classrooms with students as well.

Intersections of Core Instructional Practices

In practice, when PTs make strengths-based feedback statements these statements are made in a complex and contingent space and often connected to other core instructional practices, in tension with other practices, or used to leverage other practices. For example, in the digital learning experience, many of the PTs included questions alongside feedback statements to students or only asked questions (i.e., Valeria) when asked to make a feedback statement. Moreover, PTs had difficulty on the pre-assessment isolating the practice of NNSMS from ranking students' work, evaluating students' work for correctness, and eliciting students' thinking (asking questions) which lends support for why PTs need explicit opportunities to practice NNSMS in designed settings such as the digital learning experience. For example, when given multiple students' responses, Lindsey ranked students' responses in her feedback statements. Being able to assess students and make a quick determination of who understands a new topic, who is starting to understand a new concept, and who may need additional support is an essential instructional practice for all teachers.

Moreover, evaluating the correctness and naming students' mathematical strengths share an intersection as both practices aim to interpret and make use of students' contributions. However, there must also be a recognition that these practices are in tension. Lampert captured this classroom tension nicely: "She debates with herself about what to do, and instead of screening out responsibilities that contradict one another, she acknowledges them, embraces the conflict, and finds a way to manage" (Lampert, 1985, p. 190). When PTs notice a student's contribution, they must deliberate and decide if they need to gather more information about the student's response by eliciting additional information about the student's thinking, if they should respond to the student by assigning competence, or if they should ask another student to respond to the students' contribution. In addition to choosing which core instructional practices to use, PTs must also be fully committed to equity and access and principles of CI. As Cohen and Lotan state: "If you use ability groups and if these lessons use only a narrow range of skills, you can quickly reconstruct a status order. If you stress competitive marking and grading as the major form of feedback for students, you will also aggravate status problems" (2014, p. 160).

For Marissa, she is leveraging the practices of monitoring students' work and eliciting students' thinking through questioning as part of her strategy for assigning competence and supporting students' participation. Both Marissa and Alicia used small-group work and whole-class discussion as well as monitoring of students' work to create space for more students to participate. A case study of practicing mathematics teachers found that the teachers used whole-class discussion and small group work as spaces to assign competence to students about students' mathematical thinking, abilities to provide explanations, ownership of the mathematics, and students' sense of their capability to do mathematics (Battey et al., 2016). Thus, while some practices may be useful for leveraging assigning competence, other practices and decisions may be in tension with NNSMS and assigning competence.

Practicing Assigning Competence to Assigning Competence in Practice

PTs need opportunities to focus on students' strengths and see the value in students' work before moving to evaluate or rank the students' work, and this was especially true for Alicia as she did not separate the evaluation of students' work from identifying the strengths in students' work. On the pre-assessment, Alicia showed she could use evaluative strengths-based language to make feedback statements before the digital learning experience, but she continued to make these same feedback statements after the digital learning experience and only mentions this practice in the interview when prompted. One explanation for Alicia's trajectory is that many PTs initially see strengths-based strategies as ancillary rather than essential practices of teaching (Crespo & Featherstone, 2012). Even when PTs focus on students' strengths, the feedback statements can still be problematic if the statements come across as empty praise or empty encouragement or feedback statements are vague about students' mathematical contributions or use uncommitted or ambiguous language. Moreover, certain words and phrases such as "okay" and "all right" can make it challenging to identify when PTs are making a feedback statement versus when PTs are using these words to ask a question, indicate a transition, or reply to a question. Another example is Alicia and Marissa's use of the word "close" or when Alicia and Marissa are not specific about the strengths in a students' contribution.

While interview data show PTs valuing this practice it does not translate to PTs regularly assigning competence in the classroom (looking at one small snapshot) which is consistent with literature that shows PTs may not be able to replicate the practice due to the complexities and contingencies of the classroom. For example, Marissa may have struggled to support students to participate and notice and name students' mathematical strengths because she still working on her classroom management. Moreover, PTs may view the work of assigning competence in isolation, or it may be a practice that becomes central to PTs' philosophy of teaching and practices for addressing issues of status and participation in the classroom. For Marissa, by attempting to NNSMS, she found she was broadening her own mathematical connections, and she was able to see why a student might connect the operation of division to solving expressions and equations with exponential variables. While there were few examples of Alicia and Marissa explicitly assigning competence in the classroom, there was an increase in how often Alicia and Marissa positively positioned students and recognized students' diverse ways of participating. Jilk (2016) found that with practicing teachers, small shifts in video club led to teachers talking and thinking differently about their students and they carried this language of strengths back into their classrooms.

Speaking Back to My Story

In the introduction to this study, I also shared my story including my personal and professional experiences that led to this dissertation, but it is equally important to look back on my experience throughout the study as well. Before this work, I often positioned low-status students' contributions as smart and worked to support all students to participate in my classroom. However, when I was working on this study, I sometimes found myself making problematic feedback statements to students. I have more than ten years of experience in the classroom, and I am acutely aware of the importance of what teachers say to students when giving feedback (I wrote a dissertation on it!) yet I found myself saying some of the things I wrote about in this dissertation that are problematic. For example, I recently asked students to share their responses in class, and after hearing from the same PTs, again and again, I found myself saying "Besides Elsa" and after speaking those words, I followed with: "Let's take a moment to zoom out and talk about why what I just said is problematic." Another example is that I sometimes give students praise that does not include a justification or any elaboration on why the students' contribution is essential. I may say "good question" when a student asks a central question related to the task at hand or "good idea" when the student has a contribution to move the work forward. When I reflect back on these moments, I often felt constrained by time but still wanted to acknowledge the students' way of participating, so this created tension, and I was left to make a decision. I share these examples because I wanted to highlight how difficult supporting students to participate and assigning competence can be even when teachers are actively thinking about it and studying it and to highlight these tensions from my own teaching experiences.

Speaking Back to the Pedagogies of Practice

First, Grossman, Compton, and colleagues' "pedagogies of practice" (2009) was a useful framework to determine what to study and to make decisions on how to decompose the practice of assigning competence into one component: NNSMS. Pedagogies of practice was also a useful conceptual framework for developing the digital learning experience and cartoon storyboard to approximate the practice of NNSMS as PTs needed an opportunity to practice NNSMS in a low-risk space before trying the practice in their classrooms. However, the framework does not provide clear guidance on how to recompose the practice to capture the complexities of the practice that were parred down during the digital learning experience. Moreover, the analyses and reflections on teaching do not fit neatly into the pedagogies of practice framework: In her dissertation study, Grosser-Clarkson (2016) suggests investigations of practice and reflections on practice also be included in Grossman, Compton, and colleagues' framework and this study supports that finding. The field of mathematics education also needs a better understanding of how to decompose and then sequence specific components of core instructional practices, so that prospective teachers develop adaptive expertise (Janssen, Grossman, & Westbroek, 2015). Moreover, mathematics teacher education scholars also need to better understand tensions that may arise when aspects of practices are in conflict to prepare prospective teachers to manage those contradictions.

Implications

This section discusses the implications of this study for PTs, for mathematics teacher educators, and for the digital learning experience on NNSMS for prospective secondary mathematics teachers.

Implications for the Digital Learning Experience on NNSMS

The digital learning experience on NNSMS needs students' names as this is central to the practices of NNSMS and assigning competence, and the lack of names led to a missed opportunity for PTs to learn the practice while using students' names. When teachers are positively positioning students' ideas, they should give credit to the students for their contributions in the classroom rather than simply saying "this method." Now that there is a framework to identify emerging, developing, and meaningful strengths-based feedback statements, it is possible to include examples in the digital learning experiences that create space for PTs to compare and contrast these levels of quality in strengths-based feedback statements. One option for fulfilling this implication is to include scenarios that can help highlight these nuances as well as particular issues of status and participation. Marissa even requested scenarios or multiple-choice responses in her feedback on the digital learning experience on NNSMS. The digital learning experience needs to make use of new software (skin tones) updates to start to address specific oppressive norms that perpetuate issues of status in classrooms, schools, and society and to reflect the racial diversity in U.S. classrooms (see Kalinec-Craig, Bannister, Bowen, Jacques, & Crespo, in preparation). As it stands, the digital learning experience seems aligned with principles of equity and access during each module but it falls short with the cartoon storyboard as it fails to highlight diverse groups of students outside of linguistic differences and did not include student names.

Implications For Mathematics Teacher Education

PTs need opportunities for practice-based experiences that highlight the importance of using students' names when giving credit for their mathematical contributions. PTs need opportunities to learn to give credit to students and positively position students' contributions using students' names as both Alicia and Marissa did not regularly use names in class. These might be useful entry points into NNSMS. PTs need specific directions to work on this practice in isolation from teaching practices such as evaluating, ranking, or comparing students' work and questioning to focus only on students' mathematical strengths. Moreover, sustained learning is unlikely if PTs do not see this practice as central to their philosophy of teaching and useful for supporting students' participation and addressing issues of status which implies PTs may need more time to learn about and practice NNSMS or additional representations of practice before moving to NNSMS in the classroom and before valuing the practice at a level that leads to regular implementation. PTs also need opportunities to examine how to leverage specific strategies such as using wait time, asking open-ended questions, and have students working at the board as ways to encourage students to participate. Moreover, PTs might benefit from opportunities to examine students' written and verbal work for contributions and phrase them in a non-evaluative manner and focus on interpreting students' work in terms of the group's progress rather than evaluating students' work. Finally, while PTs may show similar results during the PBTE, this did not translate into similar results in practice as seen by the cases of Alicia and Marissa.

Limitations

This section looks back on the methodology of the study to discuss some of the challenges to implementation, including limitations of the study. In terms of the methodological limitations, there were a small number of participants. For the video transcripts, lesson plans, analyses, and reflections, it is noteworthy that these were participant-submitted and not selected for analysis by the researcher meaning these are most likely exemplars and not entirely representative of the day-to-day work prospective mathematics teachers do. Moreover, having only two video transcripts made it challenging to tell a longer story or a broader story about teacher learning in the two case studies. One additional limitation in terms of data collection is that the IRB did not include permission to record each Methods II course session, so all data collected during the class sessions are individual written responses such as the journal reflections and participants' responses to the digital learning experiences and do not capture the activity of the group. Capturing the activity of the group of PTs is essential to get a complete picture especially given Marissa's reference in the interview to the instructor's use of direct modeling to gain a complete picture of teacher learning. Finally, as I noted earlier, I play a dual role as researcher and instructor, and it is important to acknowledge my unique position in terms of this study. Since this data collection is primarily embedded within a university methods course inherently connected to the PTs' teaching internship, it may be difficult to parse out the influence of the coursework versus the daily internship experiences as well as additional contextual influences such as the PTs' mentor teacher. It was also difficult to untangle and understand complex and contingent aspects of teaching: For example, knowing PTs' intent and impact when making feedback statements were challenging to trace, and there is no way to know how students felt in the PTs' classrooms without additional data collection around students.

Generalizability

There is a lack of generalizability as this is two cases studies of two PTs from two particular classes on two particular days (of many). On the other hand, the framework for identifying the type of language and framework for the quality of feedback statements are applicable in all mathematics classrooms or with small changes – any classroom. This captures how the analytical tools of this study can be generalized to all classroom settings. Moreover, examples of analysis make it possible for mathematics education scholars to adopt or adapt the framework with ease. Another useful feature of this study is that the digital learning experience is a stand-alone course component so mathematics teacher educators can take this component and integrate it with existing course activities. Thus, while the results of the case study cannot be generalized to larger populations, Part 1 of the study can easily be replicated with additional groups of prospective mathematics teachers.

Future Directions

Several lines of future research emerge as fruitful possibilities to pursue. The first is to connect changes in how PTs and practicing teachers NNSMS to changes in status and participation with an end goal of connecting to student success: How does this work connect to student outcomes? How do MTEs begin to teach PTs to take a more nuanced approach to assign competence that specifically disrupts issues of status and participation? What representations of practice and formats beyond video clubs, video transcripts, and digital learning experiences are useful for PTs beginning to assign competence? Finally, the second line of research is necessary to explore how student learning occurs and students' contributions when teachers support students to participate. This line of research must also address any unintended consequences of making public feedback statements to students by capturing how students are thinking *and* feeling. Moreover, this study does not explore how the idea of assigning competence might be distributed to students because this study focused on only the teacher as an agent to NNSMS and assign competence.

Final Conclusions

In this dissertation study, the aim was to begin to describe and tell the story of PTs beginning to learn to NNSMS and support students' participation and trace PTs experiences into the classroom. Findings show that even when two PTs have similar results during PBTE (the digital learning experience), this does not mean that PTs will have similar experiences in the classroom when teaching. Finally, it is essential to acknowledge the difficulties in assigning competence and using moves that support students' participation to interrupt issues of status and address classroom inequities. However, if PTs can start to position all students' contributions positively (especially students marginalized by school mathematics) and begin to notice and respond to issues of status and participation - there are more opportunities for students to learn mathematics and in turn, see how they are valuable contributors in the classroom.

Appendix A: Journal Prompts in Secondary Math Methods II

While all of the journal prompts were included in the initial analysis, the prompts in yellow highlight prompts for journal entry reflections included in the final case narratives.

<table>
<tr><th>Date</th><th>Journal Prompts</th></tr>
<tr><td>8/28</td><td>Beginning of Class:
Think back to your own time as a student and think about one positive experience with a teacher that you hope to recreate in your own classroom and one negative experience with a teacher you hope to avoid as a new teacher.
What are three things you learned about mathematics teaching or mathematics?
What are two questions you still have about mathematics teaching or mathematics?
End of Class:<ol start="4">
What is one thing you plan to apply in your own mathematics classroom?
What is one norm or routine you hope to establish in your classroom?
What is one norm or routine you or your mentor have already established or plan to establish?</td></tr>
<tr><td>9/4</td><td>Weekly Assignment 1: Give a short survey (at least five questions) in the class where you (will) teach the most. The survey can be written or online. This survey can focus on students' beliefs, attitudes, dispositions, prior experiences, strengths, interests, or other information. The purpose of this assignment is for you to (1) deliberately create an opportunity for you to get to know more about your students and (2) reflect on what you learned from the survey, what questions yielded the most useful information, and how what you learned will inform your teaching.

Outside of Class:
What questions did you ask on your student survey?
What did you hope to learn by asking these questions?
What did you actually learn by asking these questions?
How will you use these findings to inform your teaching?
What are some principles of equitable mathematics teaching?</td></tr>
<tr><td>9/11</td><td>What issues of equity, access, or status have you noticed in your own</td></tr>
</table>

	classroom? 2. What interventions, teaching practices, teaching strategies, materials, or theories around equity and access do you plan to use in your own classroom?
9/18	1. What norms or routines do you want to establish in your classroom to support learning and doing mathematics? 2. What are some actions you currently perform in your classroom, how do these actions affect what your students learn? 3. What issues may prohibit a (new) teacher from implementing the pool tiling task?
9/25	1. How do you currently lesson plan? Describe your process. 2. How does the process that you described compare with what is suggested in the TTLP? 3. What do you see as the value of the TTLP, if any, of the breadth of questions that the TTLP asks you to consider?
10/2	1. What do you see as the advantages of solving the task in which students will engage? Is this something you routinely do? Why or why not? 2. Why might you want to anticipate both correct and incorrect approaches to solving a task? 3. What additional questions do you have about anticipating student responses and monitoring student work?
10/9	**Weekly Assignment 3:** The purpose of this assignment is to unpack issues of status and agency in the classroom by examining who participates and how during the course of a lesson and to examine the issue of authority by tracking what the teacher allows the students to do. For this assignment you have two options: **Option 1:** You complete an observation of another teacher focused on who participates and how and reflection. **Option 2:** Your mentor teacher, supervisor, or methods course instructor completes an observation of your classroom focused on who participates and how and reflection. **After the Observation:** Following the observation you will complete a reflection in your journal addressing the following questions: 1. Use your seating chart notes to describe what you noticed about which students participate in each class and which do not. 2. Use your tally chart to describe the level of authority the teacher allocated to students in their classrooms. 3. a. What status issues did you observe in these classes?

	b. In what ways did the teacher reinforce or mediate status issues?
10/16	1. What do you know about anticipating student responses and student thinking? 2. What do you still want to learn about anticipating student responses and student thinking? 3. Looking back on your audio analysis, what improvements or changes do you want to make to your questioning practices? What questions do you have about questioning?
10/23	1. What opportunities have you or your mentor created for students to discuss in your classroom? What opportunities have you or your mentor created for students to lead discussions in your classroom? 2. How may your beliefs impede or enhance your ability to orchestrate discussions in your classroom? 3. What additional questions do you have about orchestrating classroom discussions and promoting classroom discourse?
10/30	1. Given the table, what levels of discourse do you currently support in your classroom? 2. How do you plan to increase the level of discourse? 3. What formal and informal assessments do you and/or your mentor use in your classroom? How do you use assessments to inform your teaching? 4. What questions do you have about assessment or learning to notice?
11/13	1. How is your semester going so far in terms of your coursework and student teaching? 2. In what ways do you want to grow as a teacher over the remainder of your internship and coursework?
11/20	1. How do you support students with IEPs, students with 504 Plans, and students designated as ESOL or ELL in your classroom? 2. How do you support student learning for diverse groups of students in your classroom? 3. (Optional) Do you have any additional questions about assessment or International Mathematics Education?
11/27	1. What have you learned about professional collaboration this semester through your work with me (your instructor), your classmates, your mentor, your supervisor, and other teachers in your building? 2. How have you used people such as me (your instructor), your classmates, your mentor, your supervisor, and other teachers in your

	building as resources?
12/4	1. How has your semester been in terms of your coursework and student teaching? In what ways do you want to grow as a teacher over the remainder of your internship and coursework?

Appendix B: LessonSketch Digital Learning Experience Prompts by Module

Prompts highlighted in yellow are data sources for RQ1A.

Module 1: Pre-assessment

1. Have you had opportunities to learn about observing in the mathematics classroom prior to this module?
2. Briefly describe one (or more) example(s) of a classroom observation assignment or class activity you may have done in your teacher preparation courses that may have connections with this module. Write "N/A" if you have no experience with classroom observations.
3. What do you notice about the students' mathematical thinking in each of the students' written contributions?
4. A group of sixth-grade students designed a net for a cardboard box to hold and ship twelve smoothie bottles. What do you notice about the students' mathematical thinking in each of the students' verbal contributions?
5. Write a statement about this student's thinking that could be said to the student or shared publicly during whole-class discussion.
6. Now, return to the group of sixth-grade students discussing the smoothie box task. Write a statement about each student's mathematical thinking that could be said to the student or shared publicly during whole-class discussion.

Module 2: Learning about mathematical strengths

1. List 10 or more mathematical strengths you think are important and that you would want to notice in your students' mathematical talk and work.

Module 3: Practicing noticing and naming students' mathematical strengths

1. Identify the mathematical learning goals for the [Smoothie Box Task] lesson.
2. Identify students' strengths that might be elicited from this task.
3. **View** and **annotate** the "Designing a Smoothie Box" LessonSketch Storyboard with the mathematical strengths that you notice in what the students are saying and doing in this classroom. Specify the slide number and the student shirt color that go along with the mathematical strength you have noted.
4. Now review the "Designing a Smoothie Box" LessonSketch Storyboard and use the Noticing and Naming Students' Mathematical Strengths Sentence Frame structure in order to help you practice ways of making your teacher noticing public to students during a math lesson. Use the following sentence structure as you notice different student math strengths:

It was smart when <name of student> did/said <evidence from the depiction>, because it <how does strength support students' math learning>.

Example 1: It was smart when Green said "we could have two rows of six" because Green is showing us we can think of twelve smoothies as two rows of six bottles.

Example 2: It was smart when Green said "we could have two rows of six" because Green is dividing the twelve bottles into two rows of six bottles for the box design.

Module 4: Post-assessment

1. Let's revisit the sixth-grade students' nets: What do you notice about the students' mathematical thinking in each of the students' written contributions?
2. Let's also revisit the sixth-grade students' discussion: What do you notice about the students' mathematical thinking in each of the students' verbal contributions?
3. Now that you have practiced making teacher noticing statements, write a statement about this student's mathematical thinking that could be said to the student or shared publicly during whole-class discussion.
4. Now, return to the group of sixth-grade students discussing the smoothie box task. Write a statement about each student's mathematical thinking that could be said to the student or shared publicly during whole-class discussion.
5. Reflect on what you learned from this module and provide feedback to help improve it. Use the learning goals for this module (reprinted below). You may share some of the insights and questions that were raised for you by completing this set of activities. Provide examples when possible to illustrate what you are taking away from this module. You may share what you found to be unclear or confusing or challenging and any ideas you may have for improving this Module.

Appendix C: Video Analysis and Instruction Commentary

For this assignment you need to video record an entire lesson. (Note: when you video record for the edTPA you will need to have students sign consent forms.) From this video you will need to identify 1-2 video clips (unedited and continuous) totaling no more than 15 minutes that demonstrates "how you interact with students in a positive learning environment to develop conceptual understanding, procedural fluency, and mathematical reasoning and/or problem solving skills" (edTPA secondary handbook, 2017, p. 16). You will need to submit a written response to the following prompts in no more than 5 single-spaced pages (including prompts). Some of the prompts and rubrics below are taken from the edTPA handbook. Use timestamps to refer to specific scenes.

Provide Background for your lesson (1 pts. for responded to each prompt)

a. Identify the learning objective of this lesson.
b. Identify the common core standards and practices that are addressed in this lesson.
c. Identify the cognitive demand level (i.e., memorization, procedures without connections, procedures with connections, or doing mathematics) of the task or activity.

Promoting a Positive Learning Environment (Rubric 6)

a. "How did you demonstrate mutual respect for, rapport with, and responsiveness to students with varied needs and backgrounds, and challenge students to engage in learning?" (edTPA, p. 21).

Engaging Students in Learning (Rubric 7)

a. Explain how your instruction engaged students in developing
    i. Conceptual understanding
    ii. Procedural fluency
    iii. Mathematical reasoning and/or problem solving skills
b. Describe how your instruction linked students' prior academic learning and personal, cultural, and community assets with new learning.

Deepening Student Learning during Instruction (Rubric 8)

a. Explain how you elicited and built on student responses to promote thinking and develop conceptual understanding, procedural fluency, and mathematical reasoning and/or problem solving skills.

Representation (Rubric 9)

a. How does the candidate use representations to develop students' understandings of mathematical concepts and procedures?

Analyzing Teaching (Rubric 10)

a. What changes would you make to your instruction—for the whole class and/or students who need great support or challenge—to better support students learning of the central focus (e.g., missed opportunities)?
b. Why do you think these changes would improve student learning? Support your explanation with evidence of student learning and principles from theory/ and or research.

The edTPA rubrics found in your edTPA Handbook will be used to grade your analysis. The following scale will be used to translate the edTPA rubric level to points for this assignment:

Level 5 = 3 points Level 4 = 2.5 points Level 3 = 2 points
Level 2 = 1.5 point Level 1 = 1 points

Video Analysis Rubric

Category	**Objectives**	**Points**
Provide Background for your lesson (1 pts. for responded to each prompt)	a. Identify the learning objective of this lesson. b. Identify the common core standards and practices that are addressed in this lesson. c. Identify the cognitive demand level (i.e., memorization, procedures without connections, procedures with connections, or doing mathematics) of the task or activity.	3
Promoting a Positive Learning Environment (Rubric 6)	a. How did you demonstrate mutual respect for, rapport with, and responsiveness to students with varied needs and backgrounds, and challenge students to engage in learning? b. Use timestamps to refer to specific scenes.	3
Engaging Students in Learning (Rubric 7)	a. Explain how your instruction engaged students in developing i. Conceptual understanding ii. Procedural fluency iii. Mathematical reasoning and/or problem solving skills b. Describe how your instruction linked students' prior academic learning and personal, cultural, and community assets with new learning. c. Use timestamps to refer to specific scenes.	3
Deepening Student Learning during Instruction (Rubric 8)	a. Explain how you elicited and built on student responses to promote thinking and develop conceptual understanding, procedural fluency, and mathematical reasoning and/or problem solving skills. b. Use timestamps to refer to specific scenes.	3
Representation (Rubric 9)	a. How does the candidate use representations to develop students' understandings of mathematical concepts and procedures? b. Use timestamps to refer to specific scenes.	3
Analyzing Teaching (Rubric 10)	a. What changes would you make to your instruction—for the whole class and/or students who need great support or challenge—to better support students learning of the central focus (e.g., missed opportunities)? b. Why do you think these changes would improve	3

	student learning? Support your explanation with evidence of student learning and principles from theory/ and or research.	

Refer to your edTPA handbook for further meaning of scores.

Appendix D: Course Reflection in Secondary Math Methods Two

This assignment is a personal reflection, so there are no right or wrong answers. Teaching is complex and requires lifelong learning. This course has provided a mere glimpse into many aspects of teaching secondary mathematics. Below is a list of the topics we explored:

- Identifying the big ideas of Algebra
- Building relationships with students
- Equity and access
- Establishing classroom norms
- Identifying the cognitive demand level of a task (printed and/or enacted)
    - Memorization, procedures without connections, procedures with connections, doing mathematics
- Lesson planning
    - Creating explicit & assessable goals/objectives
    - Identifying Common Core Content Standards & Practices
- The 5 Practices for Orchestrating Productive Mathematics Discussions
    - Anticipating, monitoring, selecting, sequencing & connecting
- Teacher questioning practices
- Assessment/Formative assessment
- Naming student strengths and assigning competence
- International perspective/TIMSS results
- Learning disabilities
- Teachers knowledge & beliefs
- Mathematical Mindsets
- Mathematical tasks
    - Hexagon task, Pool/garden tile task (Case of Darcy Dunn), Staircase task w/ video (Inside Mathematics), Sometimes, always, never task w/ video (MARS)

In a 3-5 page double spaced paper, discuss what you have learned during the class and how it will assist you in improving your teaching practice. Please identify your strengths and your strategies for capitalizing on them, as well as areas where you feel you need to focus your attention. Being a reflective practitioner is an important aspect of continually improving your craft. I hope this assignment provides you an opportunity to reflect back on the course and grow as an educator.

Appendix E: Interview Protocol

Questions labeled with numbers will be asked of all participants whereas questions labeled with letters will be used to follow up questions on participant responses as necessary.

Questions:

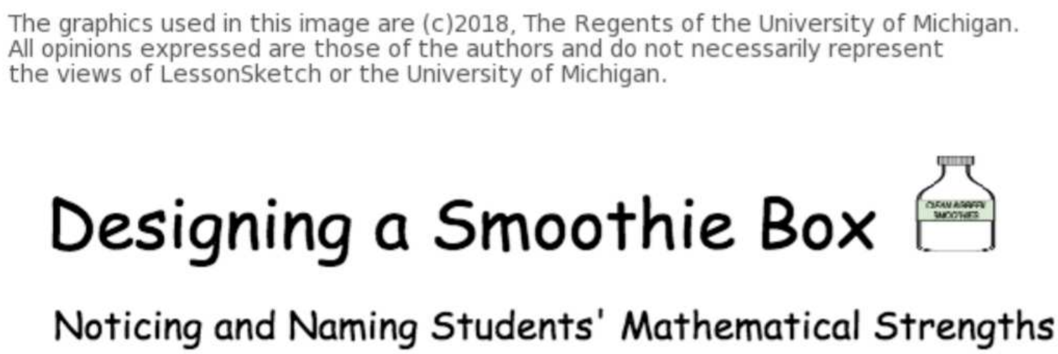
1. How would you describe (or characterize) your professional vision of teaching or your philosophy of teaching?
    a. What is important to you as a teacher?
2. What do you think you need to know about your students to be successful in the classroom?
3. What do you think you need to know about your content to be successful in the classroom?
4. What types of dispositions or beliefs about teaching do you believe you need to possess to be successful in the classroom?
5. What specific resources from the methods class do you believe were fundamental to the development of your professional vision, knowledge of students, and your dispositions about teaching, if any?
6. What are some practices you believe are necessary or important to planning, if any?
    a. What course resources and/or course assignments, if any, best supported your learning in terms of assessment?
    b. If you had to pick [those resources course assignments] (list resources or course assignments the interviewee mentions) the most important of those resources or assignments, which would you pick?
7. What are some practices you believe are necessary or important to instruction, if any?
    a. What course resources and/or course assignments, if any, best supported your learning in terms of assessment?
    b. If you had to pick [those resources course assignments] (list resources or course assignments the interviewee mentions) the most important of those resources or assignments, which would you pick?
8. What are some practices you believe are necessary or important to assessment, if any?
    a. What course resources and/or course assignments, if any, best supported your learning in terms of assessment?
    b. If you had to pick [those resources course assignments] (list resources or course assignments the interviewee mentions) the most important of those resources or assignments, which would you pick?
9. One teaching practice often associated with assessment is noticing and naming students' mathematical strengths, how would you define this practice or explain it to someone who is not a teacher?

    a. What course resources or assignments, if any, helped you learn to ability to notice and name students' mathematical strengths?
    b. Why do you think [these course resources or assignments] helped you learn to notice and name students' mathematical strengths?
    c. What additional teaching practices, if any, do you see as related to or part of noticing and naming students' mathematical strengths?
    d. What challenges, if any, have you faced with regard to assessment and noticing and naming students' mathematical strengths?
10. Currently, what do you to notice and name students' mathematical strengths on a day-to-day or regular basis in your classroom?
    a. What types of student strengths do you notice and name in your classroom?
11. Is there anything else that you was instrumental to your learning and growth as a teacher from the methods course in the fall that we have not touched on?
12. What are some experiences or courses outside of the methods course that you feel have been instrumental to your learning and growth as a teacher?
    a. Have any of these experiences impacted how you notice and name students' mathematical strengths?

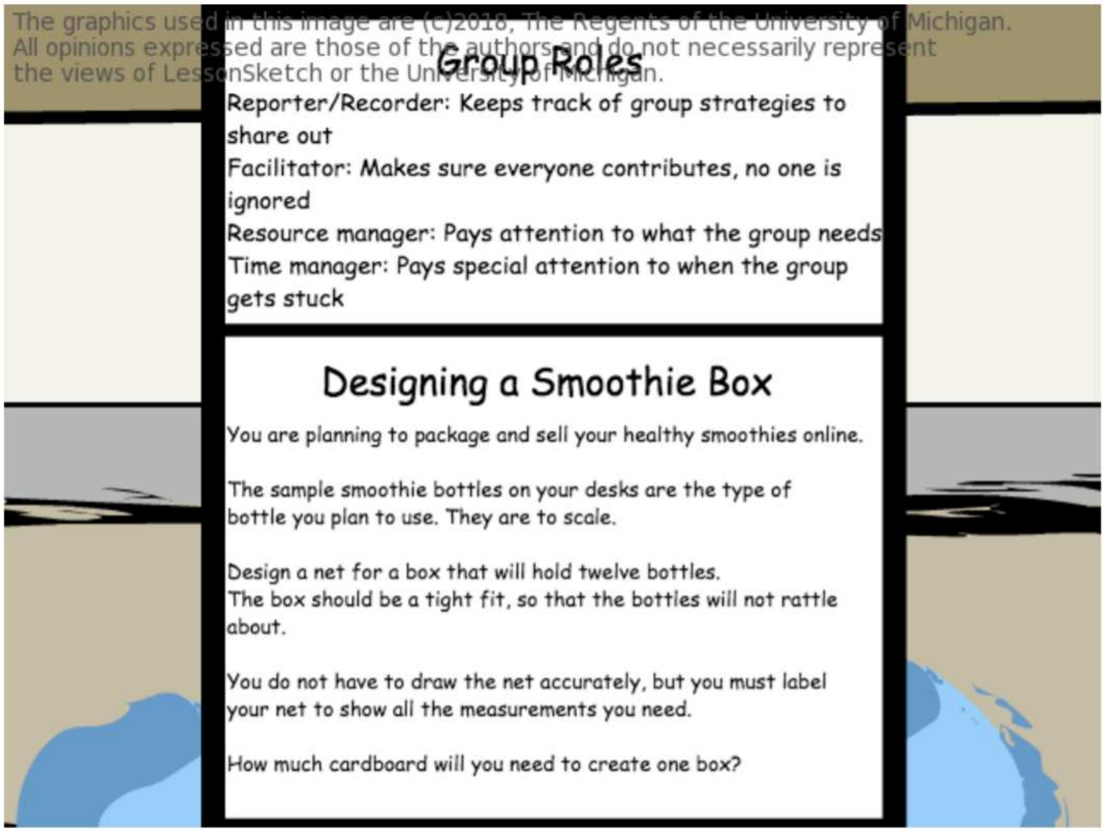
Appendix F: Cartoon Storyboard for LessonSketch Digital Learning Experience

Acknowledgement: The graphics used in these images are © 2019 The Regents of the University of Michigan, all rights reserved. All graphics are used with permission, in compliance with terms of use.

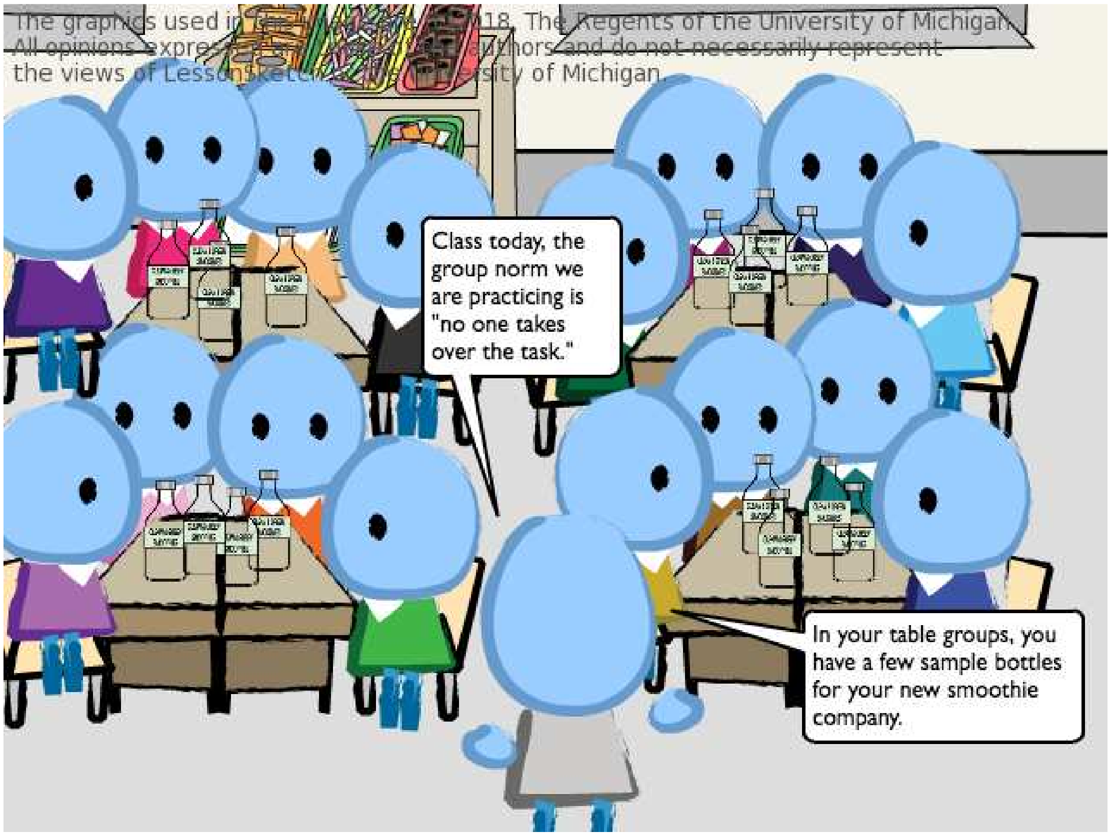
Slide 1. Title Slide



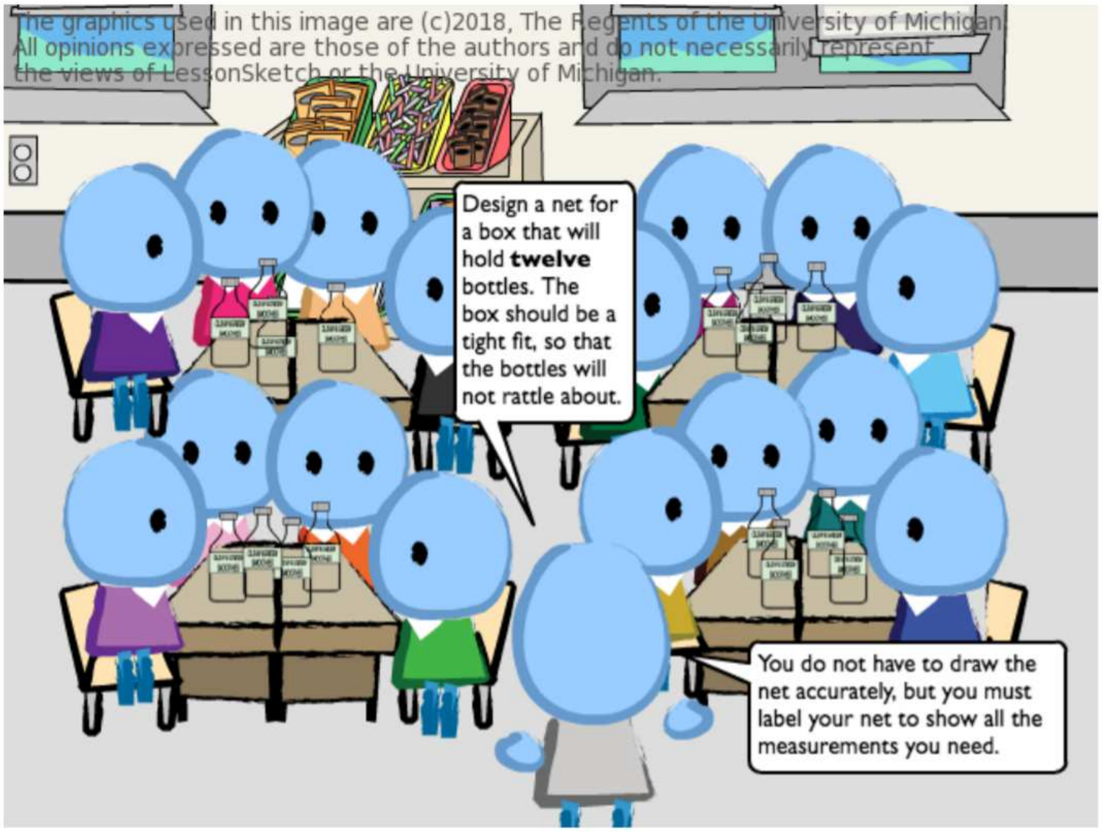
Slide 2. Group Roles and Task Card



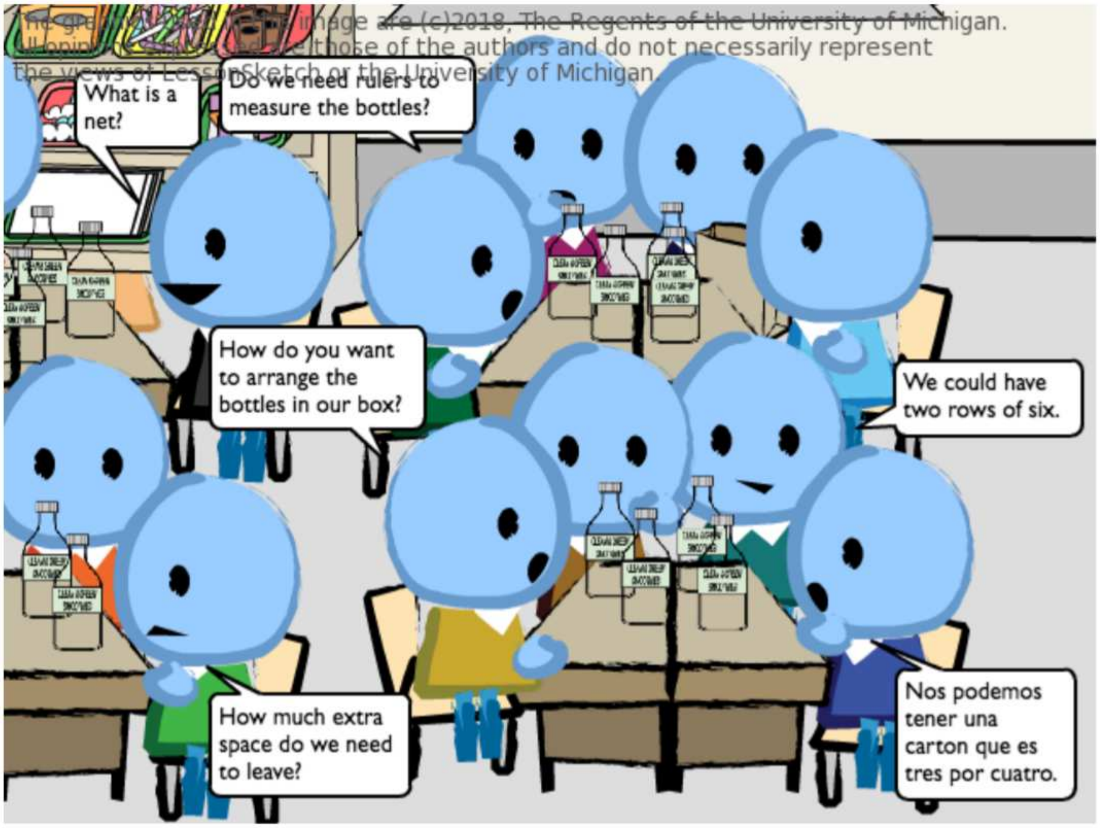
Slide 3. Teacher Introduces the Task Part 1



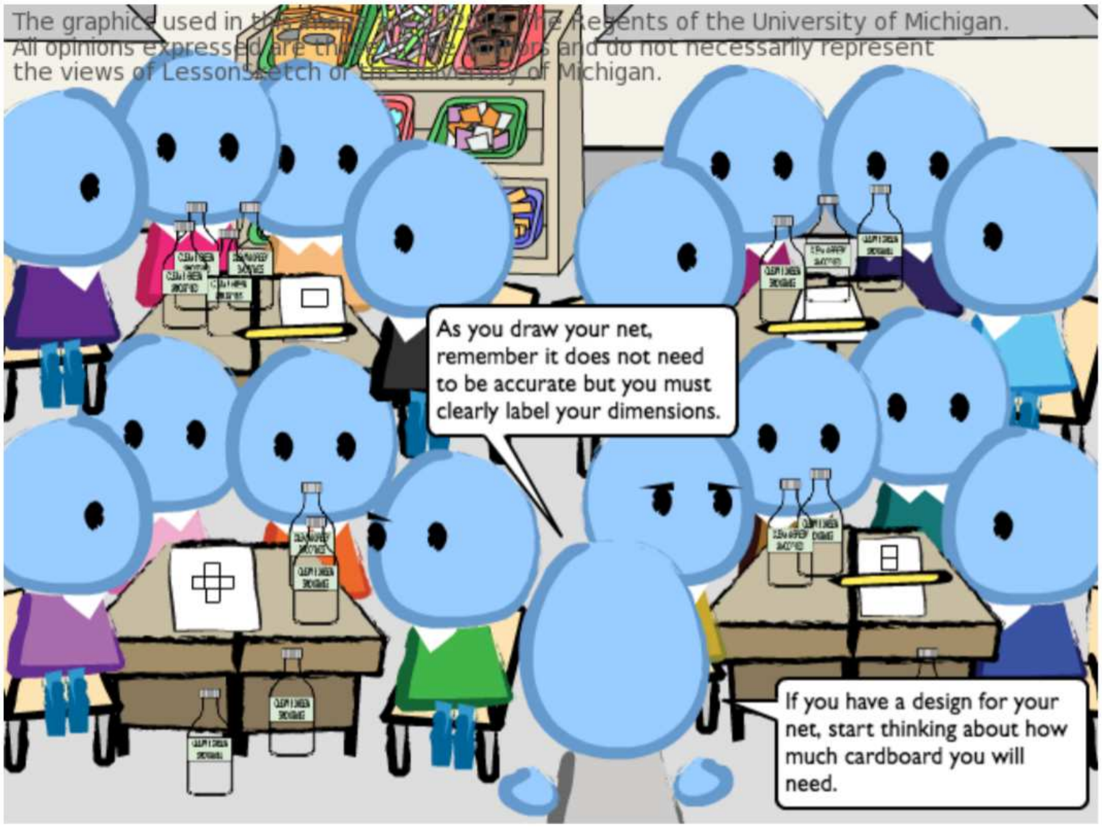
Slide 4. Teacher Introduces the Task Part 2



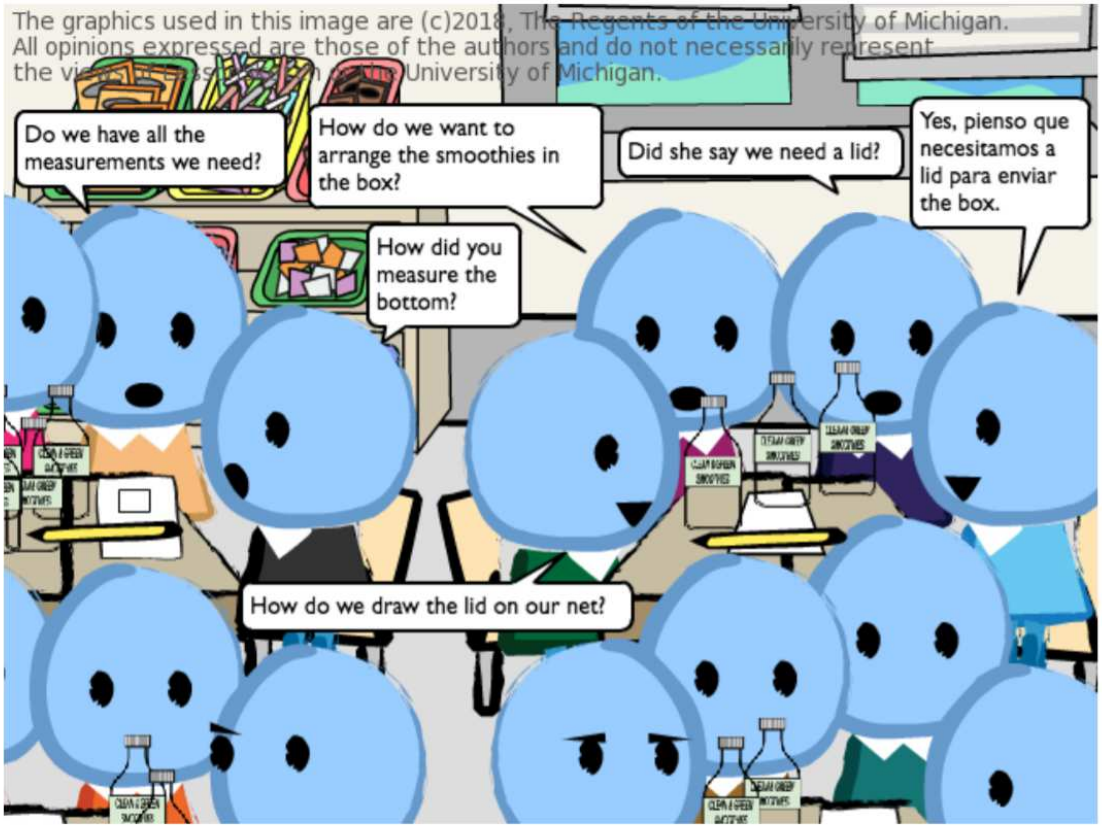
Slide 5. Initial Small-Group Discussion



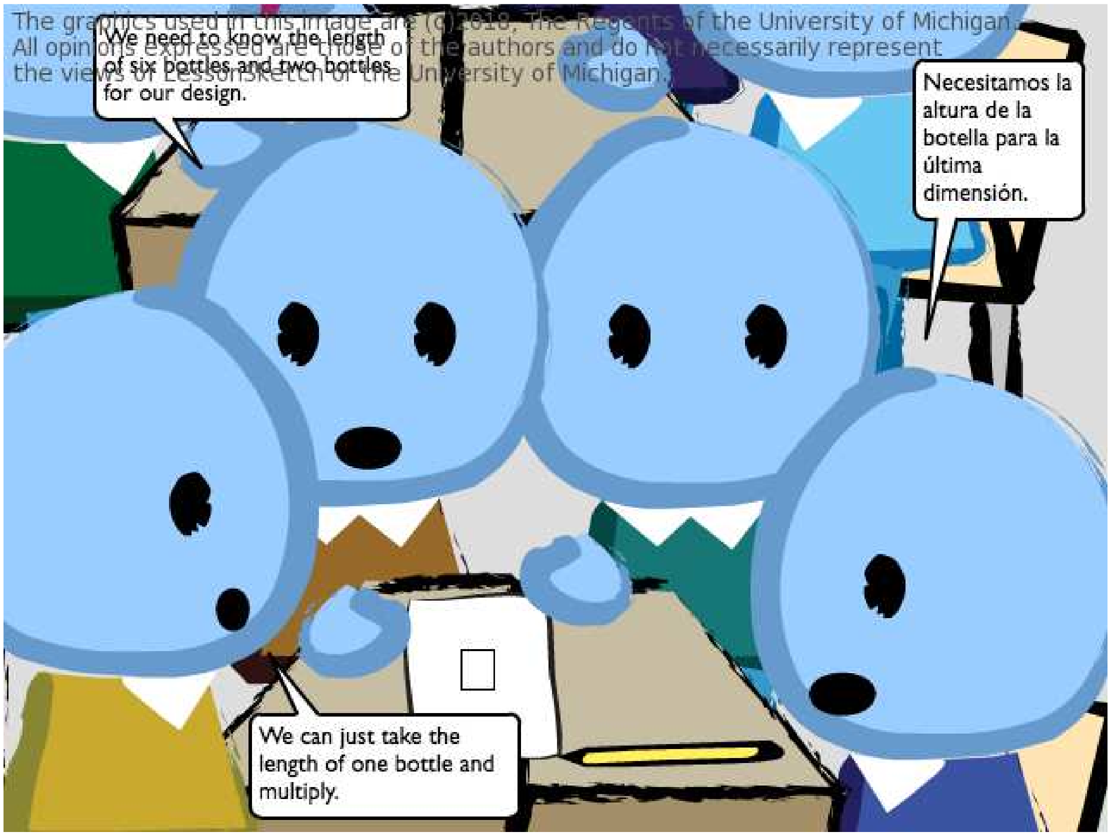
Slide 6. Teacher Gives Additional Directions for Task



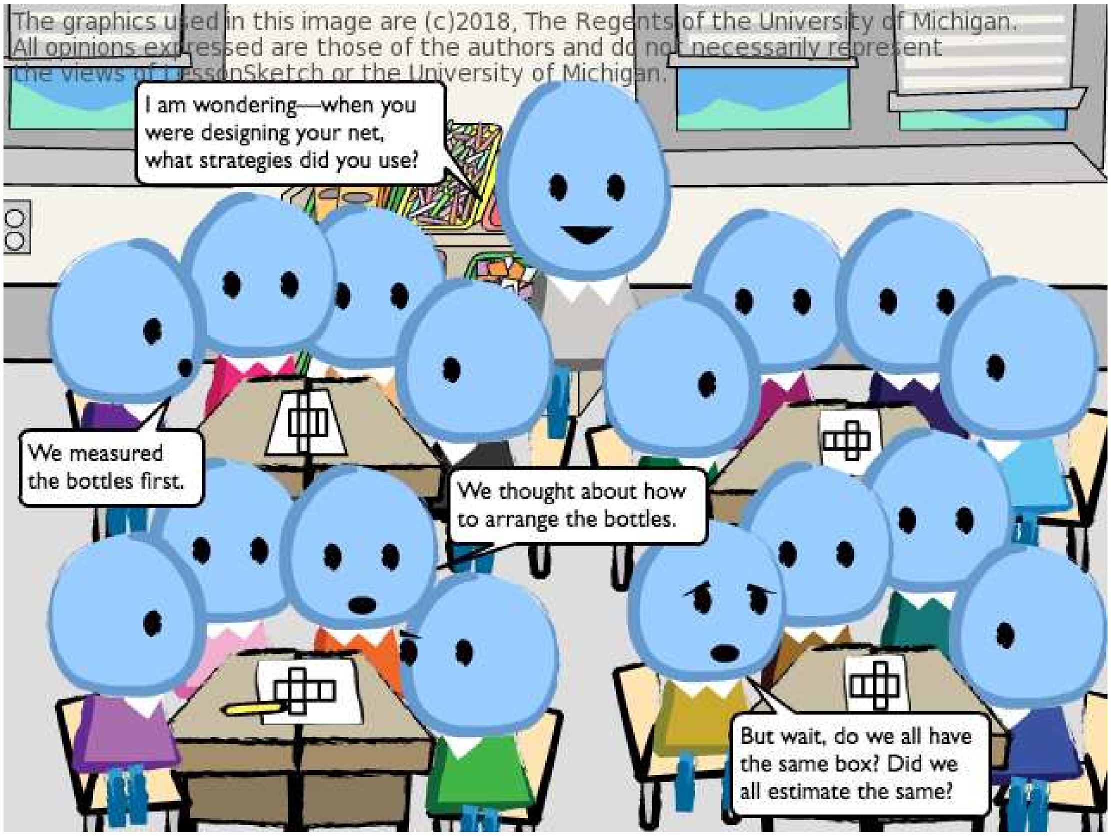
Slide 7. Second Small-Group Discussion



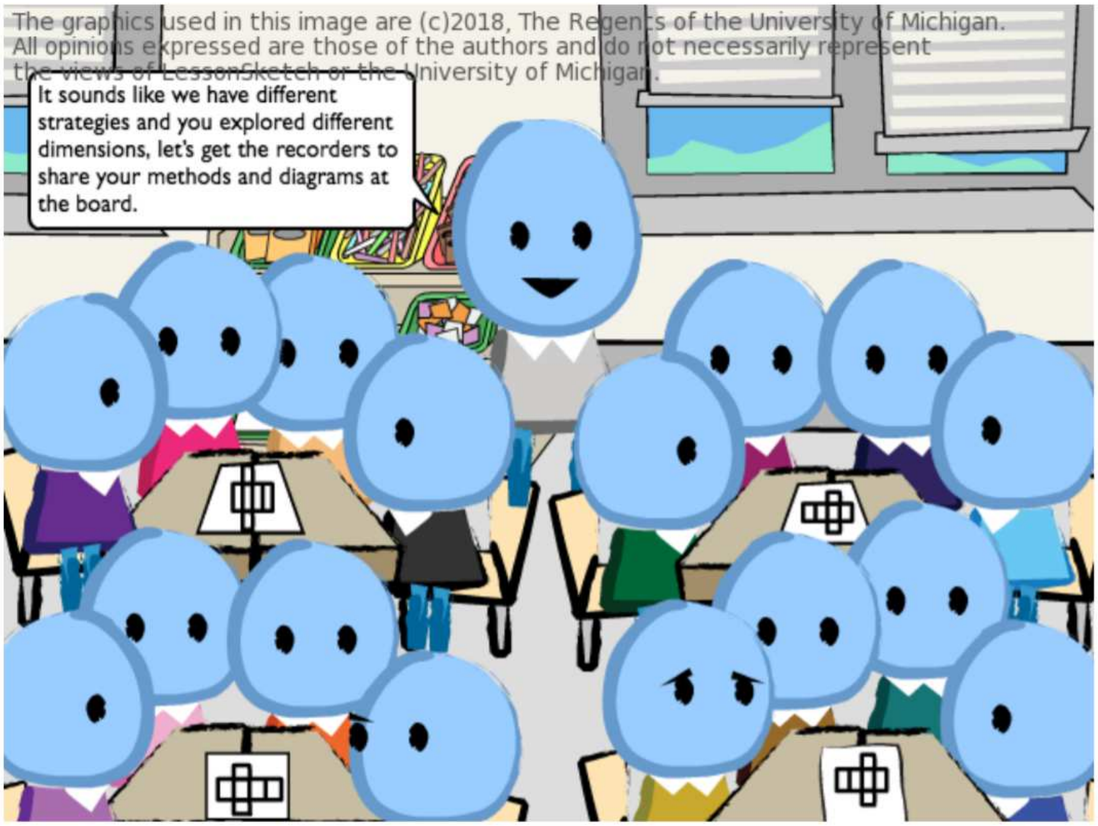
Slide 8. Small-Group Discussion



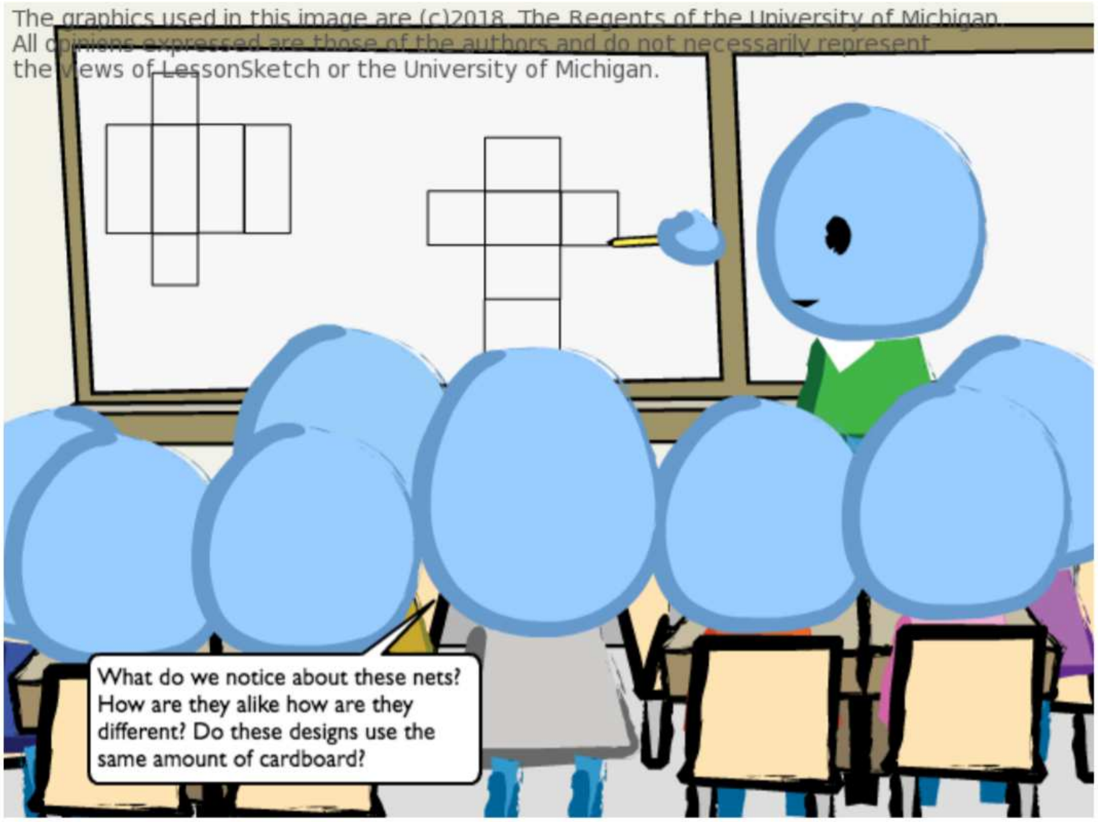
Slide 9. First Whole-Class Discussion



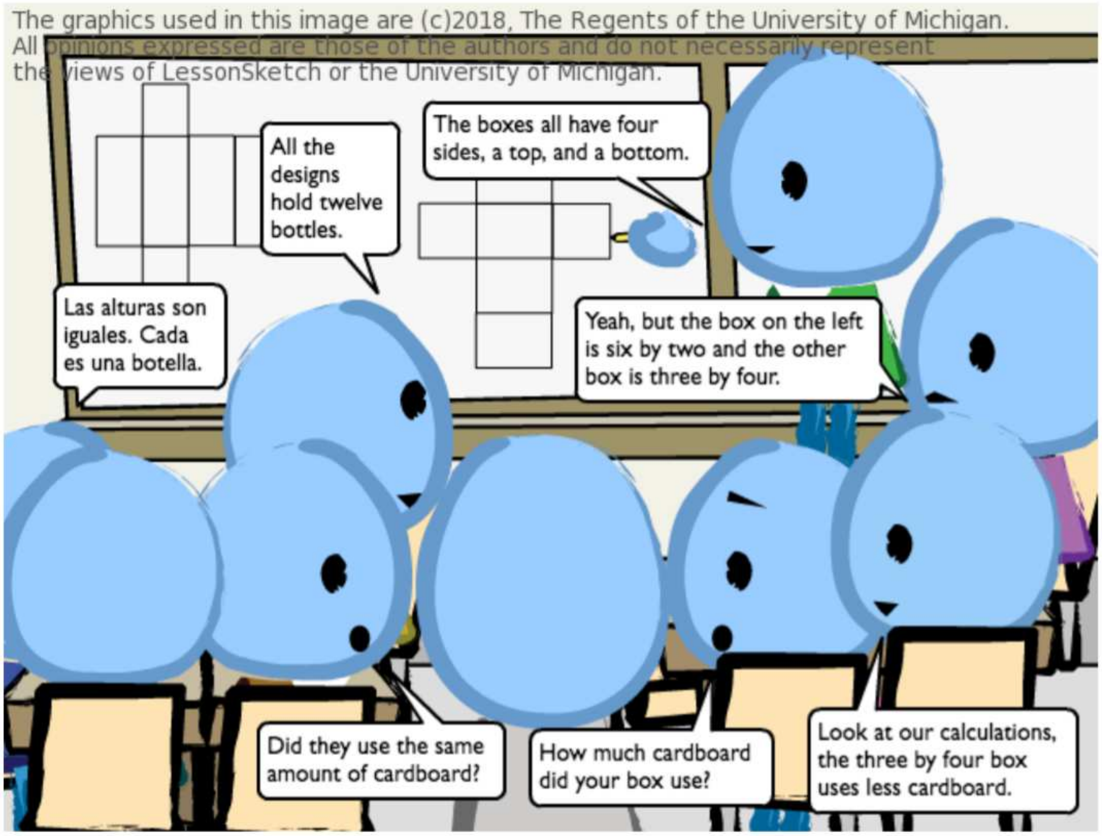
Slide 10. Teacher Summary of Whole-Class Discussion



Slide 11. Second Whole-Class Discussion



Slide 12. Third Whole-Class Discussion



Appendix G: Alicia's and Marissa's Lists of Mathematical Strengths

Alicia Allen's List of 8-10 Mathematical Strengths

1. being able to understand what they are looking for

2. work well in collaborative setting and be able [to] s"hare their mathematical thinking

3. be able to reason with others

4. identify what the issue is before solving the problem

5. paying close attention to the small details of the problem

6. properly reading all the directions

7. work through each step of the problem

8. ask questions when necessary

9. showing all their work

10. break down a problem and figure out each part.

Marissa Young's List of 8-10 Mathematical Strengths

-Ability to check work

-Ability to make a representation (or several representations) of the math problem given to them

-Ability to explain their mathematical thinking

-Ability to make connections between multiple representations of a math problem

-Ability to connect multiple mathematical concepts together

-Ability to explain their mathematical representation to the class

-Ability to label diagrams and representations in the context of the problem given to them

-Ability provide a correct response to the task given to them

-Ability to correctly calculate their answers and explain them in the context of the problem given to them

-Ability to understand and explain the methods used by in the class

Appendix H: Prompts for Alicia's and Marissa's Transcripted Lessons

Prompts for Lesson featured in Transcript 1 (Alicia)

1. List as many observations as possible with the information given in the graph above.

2. Dayne figured out that the pump he uses drains water at a rate of 1000 gallons per minute and takes 24 minutes to drain.

   a. Based on this new information, correctly label the graph above.

   b. For what values of *x* make sense in this situation? Use interval notation to write the domain of the situation.

   c. Determine the range, or output values, that make sense in this situation.

3. Based on the graph and corresponding equations for each pool, answer the following questions.

   a. When is *a(x)* = *d(x)*? What does this mean? After 10 minutes the amount of water in a(x) and d(x) is equal

   b. Find *a(*10*)*. What does this mean?

   c. If *d(x)* = 2000, then *x*=____. What does this mean?

   d) When is *a(x)* > *d(x)?* What does this mean?

Prompts for Lesson featured in Transcript 2 (Alicia)

1. If Optima adds 3 inches to the side of the square, what is the area of the square?

2. Use both the diagram and the equation, $A(x) = (x + 3)^2$ to explain why the area of the lock square, A(x), is also equal to $x^2 + 6x + 9$.

For each of the following quilt blocks, draw the diagram of the block and write two equivalent equations for the area of the block.

3. Block with side length: x + 2.

4. Block with side length: x + 1.

5. What patterns do you notice when you relate the diagrams to the two expressions for the area?

Prompts for Lesson featured in Transcript 1 (Marissa)

1. What method did Edwin use? What method did Ana use?

2. Does one approach have an advantage over the other? Why or why not?

3. What method did Benji use? What method did Karen use?

4. Does one approach have an advantage over the other? Why or why not?

5. What strategy did Jackie use? What strategy did Sabien use?

6. Do you have a preference for one strategy over the other for solcing this particular equation? Give a reason for your answer.

Identify an appropriate method to use to solve each equation below. Then solve each equation.

Prompts for Lesson featured in Transcript 2 (Marissa)

1. How high will Carlos be when he is at the top of the wheel?

2. How high will he be when he is at the bottom of the wheel?

3. How high will he be when he is at the positions farthest to the left or the right on the wheel?

4. Find the height of each of the points labeled A-J on the Ferris Wheel diagram on the following page. Represent your work on the diagmra so it is apparent to others how you have calculated the height at each point.

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