EXPLORING MIDDLE SCHOOL MATH TEACHERS' PERCEPTIONS OF THE EFFECTIVENESS OF COLLABORATIVE LEARNING TEAMS WITHIN PROFESSIONAL LEARNING COMMUNITIES

by

Molly Rothermel Rawding

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Committee:

_____ Chair

_____

_____

_____ Program Director

_____ Dean, College of Education and Human Development

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at George Mason University

by

Molly Rothermel Rawding
Master of Arts
University of Southern Maine, 2006
Bachelor of Science
State University of New York, Geneseo, 2001

Director: Jennifer Suh, Associate Professor
Department of Education

Spring Semester 2013
George Mason University
Fairfax, VA

DEDICATION

This dissertation is dedicated to my incredible and supportive family: my parents, Hannah and Dan, my sister Robyn, my brother Will, my husband, Tip, and my fabulous, kind, smart son, Owen Daniel. To all of you, thank you for everything you have done to make this possible! I am so incredibly grateful for having each of you in my life! I love you so much!

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Collaborative Learning Team ..... CLT
Professional Learning Community ..... PLC
Chases Pond Middle School ..... CPMS
Harris Middle School ..... HMS

ABSTRACT

EXPLORING MIDDLE SCHOOL MATH TEACHERS' PERCEPTIONS OF THE EFFECTIVENESS OF COLLABORATIVE LEARNING TEAMS WITHIN PROFESSIONAL LEARNING COMMUNITIES

Molly Rothermel Rawding, Ph.D.

George Mason University, 2013

Dissertation Director: Dr. Jennifer Suh

The purpose of this qualitative study was to explore the perceptions of what makes a collaborative learning team (CLT) effective for novice and experienced teachers. Professional learning communities have emerged as one approach for job-embedded professional learning so that teachers have the opportunity to collaborate with the end goal of improving their teaching practices as well as promote continuous school improvement. To explore these issues, the research questions that guided this study included: How do CLTs influence middle school math teachers to explore the nature of the mathematics content and pedagogy? What are the perceptions of novice teachers in terms of effective components of their CLT? What are the perceptions of experienced teachers in terms of effective components of their CLT? How does teaching experience influence perception for effective CLTs? Qualitative data were collected through three interviews from four novice and three experienced middle school math teachers in two

different middle schools in the mid-Atlantic. The school sites were selected because teachers participated in regularly scheduled CLT meeting.

Five factors were found that contributed to a successful and effective CLT: (1) the logistics and structure of the meeting must match teachers' schedules (with only one content focus); (2) there was flexibility within the meeting to support the needs of the teachers on the team; (3) there was shared responsibility and shared learning which is a part of the collective expertise among the participants on the CLT team; (4) there was a sense of belonging and community that influenced their work to be more enjoyable; and (5) the meeting content directly related to what is happening in teachers' classrooms. These five factors represented what participants in this study perceived as contributing to effective work within their CLT. When these features were present and incorporated into the work of a CLT, the team had better opportunities for both teaching and learning mathematics.

CHAPTER ONE

The purpose of this study was to explore the perceptions of middle school mathematics teachers' of the effectiveness of collaborative learning teams (CLTs) within professional learning communities (PLCs). This study also explored how discussions within CLT meetings influence teachers to think about the content of mathematics and pedagogy of mathematics. Both novice and experienced teachers participated in this study so that a comparison between these groups could be explored.

The Challenge and Opportunity for Teachers

A more complex, knowledge-based and multicultural society creates new standards, opportunities and expectations for teaching (Darling-Hammond, 1996). According to Darling-Hammond, teachers must know their subject areas deeply, and they must understand how students think. With limited time for planning each week, often inadequate support from a mentor and challenges of classroom management, teachers face many challenges before they even tackle the content they want to teach. Teaching is complex and demanding work. For beginning teachers, the challenges are new and likely can be overwhelming. Likewise there are challenges on experienced teachers with changing state standards, diverse student populations, and how teachers are supported t grow as individuals while also collaborating. In many schools, it is a challenge for teachers, regardless of experience level, to get the professional development support that

they need (inhibitors are generally cost, location, ongoing support). It is difficult to maintain support for teachers after an institute or workshop (Dalgarno & Colgan, 2007).

Teachers are leaving the profession at an alarming rate: 14% of new teachers leave by the end of their first year, 33% leave within three years, and 50% leave within five years (Ingersoll, 2003). The issues behind what is driving these statistics are important to address to determine ways to support novice teachers so that they are supported, feel supported, and stay in the profession. Beginning teachers need opportunities to reflect on their practice by participating in honest conversations with teacher colleagues (Park, Oliver, Johnson, Graham, & Oppong, 2007). Teachers new to the profession who feel supported by their colleagues and administrators are likely to be more invested in their school community.

Professional Learning

Teacher professional development programs seek to increase teachers' professional knowledge, improve classroom practices, and ultimately foster student learning and achievement gains (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). Three major goals of professional development are: (1) change in the classroom practices of teachers; (2) change in their attitudes and beliefs, and (3) changes in the student learning outcomes (Guskey, 2002). As Guskey notes, high-quality professional learning is a central component in nearly every proposal for improving and enhancing education. For the vast majority of teachers, becoming a better teacher means enhancing student learning outcomes. To enhance one's skill set as a teacher, meaningful, relevant, thoughtful professional development plays a crucial role. According to Fullan and Miles

(1992), what most teachers want from professional development are specific, concrete, and practical ideas that directly relate to what is going on in the classroom. Teachers seek out professional development that will expand their knowledge and skills, contribute to their growth, and improve their effectiveness with students. Professional development that does not address teachers' needs is unlikely to succeed (Guskey, 2002). Teachers and administrators face the challenge of finding professional development that can be sustained over time especially because changes in beliefs and practices can take years (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996). Workshops lead teachers to use new skills 10% of the time. When coaching is introduced, adoption rates passed 90% (Gawade, 2011).

Recent research (Desimone, 2009) identifies characteristics of professional development that are critical to increasing teacher knowledge and skills and improving their practice: (a) content focus, (b) active learning, (c) coherence, (d) duration, and (e) collective participation. Likewise, these characteristics are mirror characteristics of quality instruction in a classroom. Depending on the structure, the direction of the school, or the focus of the group, the members of a CLT may focus on one of the above areas or work in a cyclical manner that incorporates a variety of knowledge and skills to improve their practice such as common assessments, interventions for students who need more support, or unpacking standards.

An important factor in professional development is considering the process of teacher change. Guskey (2002) notes that professional development activities may be designed to initiate change in teachers' attitudes, beliefs, and perceptions. According to

Guskey, significant change in teachers' attitudes and beliefs occurs primarily after they see evidence of increased student outcomes. The important factor is when teachers use a strategy, skill, or activity and they see the impact on student learning. This cycle continues that the teacher seeks out more professional development that influences what is happening in the classroom, and sees an improvement in student learning. "They believe it works because they have seen it work" (Guskey, 2002, p. 383). Beliefs and attitudes about learning and teaching can be attributed to classroom experiences.

According to Kruse and Louis (1995), teaching and learning do not occur within a single classroom or plan lesson; "each is a complex continuum of experiences taking place within a community" (p. 2). Kruse and Louis continue that professional community in a school strong when teachers demonstrate five critical elements: (1) reflective dialogue; (2) teachers sharing their practice with others publicly; (3) collective focus on student learning; (4) collaboration; and (5) shared norms and values. With a strong community of learners, both teachers and administrators can examine and reflect upon their practice with a shared goal of improving instruction and ultimately student performance (Kruse & Louis).

In some approaches to professional development in North America, the knowledge domains of mathematics content, mathematics pedagogy and student thinking tend to be treated separately (Silver, Clar, Ghousseini, Charalambous, Sealy, 2007). Although there is general consensus on the elements of what effective professional development looks like for mathematics teachers, the challenge is how to design and implement a program that is sustainable and embodies the principles of quality

professional development which make the experience meaningful and relevant for teachers (Loucks-Horsley, et al., 2003). Borko and Jacobs (2008) point out that, unfortunately, there is little agreement how to assess the quality of professional development. There is a fine line between influencing and demanding change for teachers. Change often brings a certain amount of anxiety for teachers. Guskey (2002) notes the importance of recognizing that no professional development program or innovation will be implemented uniformly. Depending on the dynamic of the group of teachers, the personality of the facilitator, the support from administration, there are many factors that influence how new information is explored, discussed, and promoted. There is much to understanding the complexities of professional development.

Professional Learning Communities

A Professional Learning Community (PLC) is composed of collaborative teams whose members work interdependently to obtain common goals in order to aide in learning for all (DuFour, DuFour, Eaker, and Many, 2006). According to Morrissey (2000), PLCs provide an infrastructure that promotes a collegial atmosphere and gives teachers and leaders an opportunity to reflect deeply into the process of teaching and learning and how to influence greater student achievement. DuFour (2004) writes that educators, in order to create professional learning community, should focus on learning as opposed to just teaching, work collaboratively and hold one another accountable and successful for results. DuFour identifies three big ideas for professional learning communities: 1) ensuring that students learn, 2) a culture of collaboration, and 3) a focus on results. Student learning is at the center of the work of teachers and educators and

together with a focus on both teacher growth and learning, and student growth and learning, teachers can influence change in their classrooms. As Newman and Wehlage (1995) wrote "if schools want to enhance their organizational capacity to boost student learning, they should work on building a professional community that is characterized by shared purpose, collaborative activity, and collective responsibility among staff" (p.37).

There are many definitions of PLCs—with varying degrees of DuFour's big ideas embedded within them. Findings suggest that wide variation in professional community exists between schools, much of which is attributable to structural features and human resources characteristics, as well as school level (Louis, Marks, Kruse, 1996, Hamos et al, 2009).

Annenberg Institute for School Reform (AISR) (2004) note that PLCs have the potential to enhance the professional culture within a school district in four key areas; they can

- Build the productive relationships that are required to collaborate, partner, reflect, and act to carry out a school-improvement plan;
- Engage educators at all levels in collective, consistent, and content-specific learning;
- Address inequities in teaching and learning opportunities by supporting teachers who work with students requiring the most assistance; and
- Promote efforts to improve results in terms of school and system culture, teacher practice and student learning.

Senge (2000) has acknowledged the importance of learning communities in schools. He noted that schools were "a meeting ground for learning—dedicated to the idea that all those involved with it, individually and together, will be continually enhancing and expanding their awareness and capabilities" (p. 6).

A professional community has connotations relevant to a variety of fields, but Newmann and Welhage (1995) identify three general features related to a professional community within education:

- Teachers pursue a clear shared purpose for all students' learning.
- Teachers engage in collaborative activity to achieve the purpose.
- Teachers take collective responsibility for student learning.

DuFour (2004) argued that rather than treating professional development as a distinct and separate element of the job, teacher growth and development should occur where staff can grow and learn as a part of their daily or weekly work routines. When teachers work together to develop curriculum that focuses on the essential knowledge and skills that students need, when teachers collaborate and work together to create common assessments, when teachers collectively analyze results from those assessments, and when teachers collaborate and share ideas and strategies to address the data, there is potential for powerful professional development that is ongoing and sustaining (DuFour).

DuFour's (2004) description of collaboration focused around teachers of the same subject area focused on one curriculum, common assessments tied to that curriculum, and the subsequent data gleaned from common assessments to inform instruction. The

structure and routines of these teams can vary depending on the level of implementation, support from administration, and commitment from participants.

A PLC is a type of job-embedded professional development for educators. Within a PLC are CLTs. These CLTs are teams of teachers that are grouped together because, for the most part, they teach the same subject. Effective professional development with a goal of improving classroom practices focuses on high learning standards as well as data that illustrate students' learning (AISR, 2004). A learning community has a focus on and commitment for enhancing the learning of every student. When a school or district functions as a PLC, educations embrace high levels of learning for all students (DuFour et al, 2006). Educators make commitments and use results-oriented goals to mark their progress. DuFour et al. (2006) notes that educators involved in a PLC engage in an ongoing cycle of:

- Gathering evidence of current levels of student learning
- Developing strategies and ideas to build on strengths and address weaknesses in that learning
- Implementing those strategies and ideas
- Analyzing the impact of the change to discover what was effective and what was not
- Applying new knowledge in the next cycle of continuous improvement (p.4-5).

The goal of a PLC is to create conditions for perpetual learning that influences teacher reflection, teacher growth and student achievement. The discussions that can come from

PLTs can be powerful, rich, and can influence instruction. The opportunity for educators to have time to collaborate, reflect, and discuss their practice does not happen by accident. These opportunities must be carefully planned and the leadership behind PLCs influences the success for the school community. In order for teachers to rise successfully to the challenge of adapting their teaching practices to meet the needs of their students and the various demands from reform initiatives, they must have opportunities to participate in dialogue with other teachers to both support and challenge one another (Tschannen-Moran, 2001). In addition to a specific structure and vision to PLCs, trust among colleagues is essential to build capacity and grow as a community. DuFour (2004) points out that "educators who are building a professional learning community recognize that they must work together to achieve their collective purpose of learning for all. Therefore, they create structures to promote a collaborative culture" (p. 9).

There are many challenges and opportunities as districts begin to implement PLCs. The AISR (2004) points out key elements where some districts have seen success through PLCs. One of these areas is that adult learning theory strengthens PLCs. The PLC approach is grounded in adult learning theory and demonstrates several characteristics that are essential to adult learners (AISR, 2004). The report by AISR notes that with learners of any age, experiences shape thinking and beliefs. Adult learners are most interested in learning that has immediate personal or professional relevance. A second element is structural conditions must be in place; this involves a regular time and place to meet (AISR, 2004). Routines and structures of the school impact the success of a team, and consequently the entire learning community.

Some of the concerns that AISR (2004) has noted in its earlier research of PLCs include the conclusion that focusing on process diverts attentions from instructional content and approaches, teachers may be reluctant to make work public because of trust issues, and structural changes do not ensure that there is a change in classroom practices. Depending on the composition of the team within the PLC, more attention is necessary on content issues or instructional approaches. Also, depending on the length of time that individuals have worked together and their other experiences, trust may still be developing (Tschannen-Moran, 2001). And while structural changes are important, they alone do not ensure that there will be a change in practice (AISR, 2004).

A school's success depends on the commitment and competence of the individuals within the staff and how they work together with a common purpose in mind (Newmann and Wehlage, 1995). As one means of professional development, PLCs offer schools and districts job-embedded support that has the potential to influence teaching and learning in powerful ways. The history, cultures, and contexts of each school are different and must be taken into consideration when planning and implementing PLCs (DuFour, et al, 2006). Identifying ways to give teachers opportunities and influencing them to observe and talk about each other's practices is one way toward establishing a community of learners (Scribner, 1999). PLCs are one avenue to increased collaboration and improved learning opportunities for both teachers and students.

Teacher Collaboration and Trust

Collaboration is increasingly a focus as an important feature in the management of excellent schools (Tschannen-Moran, 2001). A central component of collaboration is

trust and Hoy and Tschannen-Moran point out “trust is the critical element in all human learning, in cooperation, in leadership, in school effectiveness and in emerging organizational cultures. Trust functions as a way to keep participants in a community integrated and cohesive” (1999, p. 184). As Meier (2002) writes, “just as we want kids to keep company with adults because it’s the best and even most efficient way for them to become educated, so too do teachers need to keep company with each other for the sake of their teaching, not just to make life smoother, more comforting, and more humanly decent, although these are outcomes are desirable” (p. 59). The kind of trust that fosters productive collegiality is critical to teachers in schools who want to learn from their own practices (Meier). Trust is an essential element to explore when understanding the level of collaboration and respect among teachers.

Achinstein’s study (2002) challenges current thinking that a community must be harmonious and reach consensus for all discussions. Differences of opinions and ideas are important to a community, as well as how teachers suppress or embrace their differences. According to Achinstein, an essential component of a teacher community is to actively engage in discussions about different perspectives and to have a dialogue about differing opinions. How teachers work together, amid differences, impacts teacher beliefs and attitudes, and teacher actions in the classroom.

Baynard (2011) found in her study that teachers benefitted from their participation in their PLC, but did not necessarily view meetings as the best method for collaboration. Teachers reported enjoying the benefits from honing their teaching through discussions

about data, sharing student work, collaborating on communication with parents and the feeling of support from one another within the PLC (Baynard).

Exploring Content and Pedagogy

For beginning teachers, there are many factors and challenges that they are faced with in the first year of teaching. Learning the math content may or may not be the focus. Likewise for experienced teachers, there is a variety of what subject teachers teach, and to what extent they understand what math precedes a specific subject and what math follows. In Hong's study (2010) in-service teachers have specific concerns such as class control, conveying content knowledge, and relations with parents, colleagues, and administrators as compared to pre-service teachers' concerns which these areas were not areas of concern.

Because PLCs are often content-focused, one question to consider is: to what extent are teachers doing math and talking about the math which they teach as a community of learners? Are teachers aware of the math that was taught in previous grade? Are teachers aware of what foundational pieces they are laying for more advanced math? Because pre-college and college math experiences and understandings tended to be rule-bound and thin (Ball, 1990), there is room to explore how CLT discussions can impact math content knowledge for beginning and experienced teachers. Ball et al. (2001) identify the issue that many people graduate from school able to read and write successfully yet many fail to develop a similar level of proficiency in mathematics. Ma (2010) points out that even though elementary and middle school mathematics may be categorized as "basic" mathematics, teachers need more than just an awareness of

mathematics. With a greater understanding of the mathematics being taught, teachers can reinforce the mathematics that has already been learned as well as lays the groundwork for mathematics to come.

A learning community can bring mathematics teachers together to do mathematics and discuss mathematics in a meaningful way that influences better understanding and consequently better instruction. Teachers doing math together and having discussions about specific problems or questions can influence teachers to think more deeply about the content which they teach.

Significance of the Study

Professional learning communities can be an avenue for professional learning to enhance collaboration, improve instruction and student achievement (DuFour et al., 2006, DuFour, 2004, Hamos et al., 2009); however, they can also be seen in a punitive, unsupportive means of professional development (Baynard, 2011). Throughout their careers, teachers may experience being a member of a collaborative, successful, productive PLC and conversely, may experience being a member of a punitive, unsupportive, unproductive PLC. These experiences can influence a teacher, whether novice or experienced, to reflect upon their practice and hone their skills as a teacher. It is important to understand what beginning teachers and experienced teachers perceive as effective within their PLC and how facilitators, administrators can support teachers of varying experiences.

Teachers involved in meaningful, productive professional development can optimize their performance by focusing on student achievement as a collaborative goal.

This type of professional development encourages all involved to learn and highlights the contributions that both beginning and seasoned teachers bring to the discussion. Considering that teachers are at various stages in their careers, it is important to identify what their individual needs and expertise are and what type of professional development will best support the goals of enhancing instruction (Colunga, 2011). The embedded structures within a school can support teacher collaboration which can support stronger instruction as well as deeper content knowledge. One way that many school districts across the country are addressing this need for job-embedded professional development is through PLCs. By developing PLCs and increasing the culture for teachers to collaborate and work together, there is potential for increased learning.

At the school level, professional learning must be embedded in the culture of the school (Scribner, 1999). "Creating school cultures that value professional learning will require school leaders to initiate changes that place professional development at the core of teacher work to ingrain the value of continuous professional learning throughout teachers' careers" (Scribner, 1999, p. 261). If educators in a school are serious about enabling teachers to really change the way they work then teachers must have opportunities to discuss, think about, try out and hone new practices (Lieberman, 1995). Lieberman suggests a variety of ways that teachers can be involves in learning about, developing, and using new ideas with their students: (1) by building new roles (e.g. teacher leader, peer coach); (2) by creating new structures (e.g. problem-solving groups, decision-making teams); (3) by working on new tasks (e.g. journal and proposal writing, learning about assessment, creating standards); and (4) by creating a culture of inquiry,

where professional learning is expected, sought after, and an ongoing part of teaching and school life. Professional learning is complex and multifaceted and requires teachers and administrators to negotiate how professional development can best support teachers.

Careful planning and follow-through of professional development can contribute to enduring change in teacher learning and student outcomes. With an emphasis on PLCs in many districts across the country, it is important to explore what novice middle school mathematics teachers' perceptions about PLCs as job-embedded professional development. Nearly $1.5 billion is spent annually on professional development for teachers (Desimone, 2009). It is important to know to what extent a district's time and monies focused on professional learning is having a positive impact on teacher growth.

Research Questions

1. How do CLTs influence middle school math teachers to explore the nature of the mathematics content and pedagogy?
2. What are the perceptions of novice teachers' in terms of effective components of their CLT?
3. What are the perceptions of experienced teachers' in terms of effective components of their CLT?
4. How does teaching experience influence perception for effective CLTs?

The literature review that follows shows what research has been explored related to professional development, including PLCs, as well as what influences the perceptions and attitudes of teachers towards those experiences. Further, the literature review that follows will show that research is needed to determine to what extent PLCs influence

math teachers think about the content. Professional learning communities are a relatively new structure for schools and thus, more research that examines novice math teachers' experiences and perceptions of PLCs during the first years of teaching would benefit educators and policy makers.

Definitions

Professional Learning Community (PLC): A professional learning community is a group of educators working together to improve overall student learning for a shared group of students (DuFour, et al., 2006). For the purposes of this paper, the professional learning community is analogous to the entire school community which is made up of teams.

Collaborative Learning Team (CLT) A group of teachers whose focus is a specific content area (mathematics in the case of this study). Collaborative Learning Teams engage in collective inquiry into both best practices in teaching and best practices in learning. CLTs explore and reflect upon their present practices and the levels of achievement of their students. (DuFour, et al., 2006).

Collaboration: Collaboration refers to two or more people working together towards with a common purpose (DuFour, et al., 2006).

Novice/Beginning Teachers: Novice or beginning teachers will be defined as teachers who have fewer than three full years of teaching experience. As noted by Darling-Hammond, Chung and Frelow (2002), since teachers' practice and views are affected by other professional development the longer they are in the profession,

novice/beginning teachers will be examined if they have been teaching for less than three years.

Experienced Teachers: Experienced teachers will be defined as teachers who have three or more years of teaching experience.

CHAPTER TWO

This chapter describes research related to teachers' professional learning, professional learning communities (PLCs), teachers' experiences in those settings and the impact of teachers exploring the content and pedagogy of teaching mathematics in middle school.

A school with a positive and effective learning culture:

- Has a clear mission. Teachers value exchanging ideas with colleagues. Values exist that support a safe and secure environment. There are high expectations of everyone. There is strong, not rigid, leadership (Deal & Peterson, 1990).
- Encourages teachers to work collaboratively with each other and with the administration to teach students so they learn more (Fullan, 1993).

"Support coupled with pressure is essential for continuing educational improvements" (Guskey, 2002, p. 388). Educational leaders can provide encouragement and the opportunities for teachers to continue to learn about how to improve student outcomes. It is important for leaders in education to determine ways to support teachers—both novice and experienced. Improving collaboration opportunities, content and pedagogical knowledge, and student achievement are priorities for school leaders. To support novice teachers in mathematics, it is important to explore what their beliefs and

perceptions are in regards to job-embedded professional development. As Guskey (2002) points out that when teachers see evidence of progress and increased student outcomes because of a new innovation, program, or strategy, change in their attitudes and beliefs can and will follow.

Louis and Marks (1998) found that when a school is organized into a professional community, the following occurs:

- Teachers set higher expectations for student achievement.
- Students can count on the help of their teachers and peers in achieving ambitious learning goals.
- The quality of classroom pedagogy is considerably higher.
- Achievement levels are significantly higher.

PLCs challenge the stereotype that teachers work in isolation and, instead, share ideas with one another so they can discover ways to improve their craft through group effort, discuss with others ways to improve the education for all students, and create a culture of mutual support within a school (Hamos et al., 2009).

Teacher Preparation

As teachers enter the profession, they come with a variety of experiences as both a student and a teacher. Beginning teachers often remember their own experiences as learners, assuming that students they will teach will have similar learning styles and experiences to their own (Kagan, 2010). Thus, there may be a disconnection between learning math and teaching mathematics. Fennema and Franke (1992) note that it is reasonable to conclude that most teachers' knowledge of advanced mathematics has been

learned in typical classrooms where mathematics has been explained to them; they practice problems, often in isolation, and complete related homework. The following studies explore various teacher preparation programs.

Questions have been raised about whether and how teacher education makes a difference in teachers' practices, effectiveness, entry and retention in teaching (Darling-Hammond, Chung & Frelow, 2002). Growing demand for teachers in a labor market with funding inequities and distributional issues has led many districts and states to lower their standards for new teachers (Darling-Hammond et al.). Increases in teacher demand have translated to a growth of alternative teacher certification programs. According to Darling-Hammond et al., teachers are recruited from a wide variety of teacher preparation programs in New York City, as it is in the largest and most diverse school district in the country. The analysis of 3,000 beginning teachers focused on the individual pathways they following to enter teaching. The focus was understanding the teachers' views of their preparations for teaching, their beliefs and practices, and their plans to remain in teaching.

The findings of this study (Darling-Hammond et al.) indicate that beginning teachers who have experienced the different teacher education programs into teaching feel differently about their preparation, that those feelings are similar among teachers within the programs and there is substantial variation of perceptions across programs. Darling-Hammond et al. explain that teachers prepared in a single formal program of preparation feel better prepared than those who take a series of courses from different institutions. The latter feel better than those who enter through an alternative program

that generally does not include student teaching or pre-service training. “Measures to improve teacher education programs will do little to improve teacher quality if states allow schools to hire teachers without preparation, as more than 30 currently do” (Darling-Hammond et al, p. 297). With more support and increased retention rates of well-prepared teachers may actually save money over the costs of hiring, inducting and replacing underprepared recruits who leave the profession early on in their career (Darling-Hammond, 2000). Clearly, the challenge is to find better way to support teachers before they enter and how to support them throughout the stages of their career.

Mathematics teachers face their own challenges when entering the challenging profession of teaching. Middle school mathematics teachers’ experiences and perceptions of teaching math vary substantially. Hiebert and Morris (2009) note that lasting improvements in teacher education rest on building a useful and cumulating knowledge base but according to Cochran-Smith & Zeichner (2005) a knowledge based does not exist yet. The absence of a shared knowledge base for teacher education forces new teacher educators to start from scratch when they begin teaching (Hiebert & Morris). The authors continue that “The U.S. educational system simply has not learned to record, vet, and accumulate knowledge for effective teaching—in school classrooms and in university teacher preparation courses” (p. 476). At the University of Delaware (UD) where Hiebert and Morris explored preparation for math teachers, there is no clear agreement on the teaching competencies needed to teach mathematics well. “Indeed, with agreements on essential teaching competencies, there can be no agreements on learning goals. Recognizing this is a start to understanding why a knowledge base for teacher education

does not exist and to appreciating what must be achieved as a first step toward its creation (Hiebert & Morris, p.478). Educators at UD are exploring ways to support teacher preparation and included are the following features: (1) shared goals across the system; (2) visible, tangible, changeable products (such as specific daily lesson plans); (3) small tests of small change; and (4) multiple sources of innovation from throughout the system. The challenge lies is unifying educators to come up with a common base of understanding for teaching mathematics at any given level. "The work required to understand, agree on, and commit to a shared set of learning goals is likely to be intense and long term, but, the outcome would be communities formed around common learning goals, communities that would share the daily, pressing problems of their practice" (Hiebert & Morris, p. 486).

Most college and universities have well-established programs that students follow to earn secondary certification in mathematics. The students who enter these programs already have a strong interest and desire to do well in mathematics therefore the real challenge for universities is to prepare and develop teachers in grades K-8 (Buck, 2004). As Buck explains, this latter group of prospective teachers is generally "math-reluctant" due to their own weak backgrounds in mathematics (p. 144). At Slippery Rock University (SRU), Buck notes that the education department experimented with pairing a content course with a methods course and team teaching the classes. This worked well until the regulations from the state of Pennsylvania dictated that the mathematics content courses are completed prior to students enrolling in math methods courses. The SRU Mathematics Department put together a certification program to support in-service

teachers that is similar to the program for education majors who pursue a minor in mathematics. Buck notes an important aspect of the certificate is that teachers are provided with a structured program of additional mathematics courses and if completed, the program meets the requirements for the middle school certification in Pennsylvania (Buck). Buck notes the need for more, qualified mathematics teachers at all levels—and universities need to support creative programs that support prospective math teachers. The level of preparedness that middle school math teachers enter the profession varies greatly and one challenge for educators to find way to collaborate with and support novice math teachers.

In a study by Harkness, Ambrosio and Morrone (2007), pre-service teachers were interviewed about their experiences during a social constructivist mathematics course where the focus was on mastery goals. In this course, students learned about working hard to achieve understanding—not just memorizing algorithms and procedures. The teacher expected students (pre-service teachers) to work hard to understand the mathematics embedded within the tasks. They were free to share their ideas and strategies, to make mistakes and to ask questions. One question that came from the study was "how much struggle is good?" and at what point does struggle result in total frustration. In this study, students preferred moderately challenging tasks and were willing to put forth more effort to complete these tasks (Harkness et al. 2007). The structure and support (notably, the level of trust) of the classroom influences how much effort (or "risk") a person is willing to make.

The findings from Harkness et al. suggest that students entered the course with a wide variety of feelings about mathematics and their own mathematical ability. At the end of the course, students wrote about what lead to their growth over the semester. The themes that emerged from the data include struggle, construction of meaning, working in groups, change in self-efficacy and change in math self-concept and the teacher role. Too much struggle can make students want to give up but struggle with support—choosing the right tasks, pressing for understanding, and the establishment of a cooperative classroom structure—led to motivation (Harkness et al.). As Harkness et al argues the goal of teacher preparatory programs is to have future math teachers to have a positive disposition and attitude toward mathematics and teaching mathematics, there need to be opportunities for those teachers to experience math in a way that influences thinking about and understanding of the mathematics.

The purpose of the study completed by Turner, Drake, McDuffie, Aguirre, Bartell, and Foote (2011) was to investigate how various teacher preparation programs addresses and advanced teacher learning of children's understandings and experiences that have the potential to shape and support their mathematics learning. In the study completed, the researchers surveyed approximately 200 prospective teachers (PSTs) from 11 methods courses across the six universities at the beginning and end of their mathematics methods course. The surveys included Likert-type items, short answer questions, instructional scenarios, and questions related to the effectiveness of course activities. Twenty-four volunteers (from the 200 PSTs) were interviewed and asked to elaborate on their survey responses. The researchers found that as teachers make

meaningful connections, these connections then facilitate ongoing and purposeful incorporation of multiple mathematical knowledge bases. These teachers demonstrate dispositions that support attending to children's mathematical thinking and their home and community-based knowledge as well as knowledge in the form of awareness about how children, their families and communities are valuable resources for school mathematics learning.

How a teacher teaches and feels about math impacts her students—whether there is excitement, apprehension, an affinity for conceptual understanding, or an inclination to procedural learning. A study completed by Brady and Bowd (2005) explored the relationships between pre-service teacher education students' experience with formal mathematics instruction and their future professional practice. The researchers explored mathematics anxiety, prior experiences and confidence to teach mathematics among pre-service education students. Math anxiety can negatively affect both a teacher's performance as a teacher and students' performance as a learner (Brady & Bowd).

Two hundred thirty eight education students participated; all were either in the final year of a four year concurrent, or one year consecutive, teacher education program designed to prepare them for teaching at the elementary school level. This mixed methods research study used a survey questionnaire with two parts. The first section was designed to elicit information regarding respondents' highest level of formal math education, past experiences with math education, perceptions concerning the utility of math, etc. The second part of the survey instrument used the Mathematics Anxiety Rating Scale and consisted for 98 Likert format items designed to measure mathematics anxiety in a

variety of academic and non-academic situations. The questionnaire also included an open-ended question for "other comments."

This study by Brady and Bowd (2005) suggests a relationship between participants' level of mathematics anxiety and the apprehension they experienced when faced with teaching mathematics in their practicum. This anxiety appeared to be related to two factors: the highest level of formal mathematics instruction attained and subjects' prior experiences with formal instruction at the elementary and secondary levels. The results of this study suggest a need for a variety of changes in current practices to reduce the development of math anxiety for pre-service teachers. The anxiety associated with teaching mathematics experienced by many of the pre-service teachers that participated in this study could be classified as a cyclical phenomenon.

Novice Teachers

"New teachers want more than a job. They want to contribute to a group" (Wong, Britton, & Ganser, 2005, p. 384). Beginning teachers start their first year of teaching with various personal beliefs and attitudes towards classrooms, their role as teacher, the students they will teach, and images of what they think teaching will be. For the most part, these prior beliefs, attitudes and perceptions are based on their own experiences: his or her experiences—as a student or as a student-teacher, his or her experiences in the classroom, relationships with teachers and other authority figures, and memories of how it felt to be a student in school (Kagan, 2010). Kagan points out that beginning teachers often remember their own experiences as learners, assuming that students they will teach will possess aptitudes, problems, and learning styles similar to their own. The personal

beliefs and attitudes that pre-service teachers bring to teachings usually remain "inflexible" (p. 154).

Kagan (1992) reviewed 13 studies of novice teachers from varying disciplines and identified three major themes that emerged from the results: their self-image as teacher, the role of their school culture, and their growth in problem solving skills. Within her review, Kagan noted many instances where beginning teachers did not feel prepared for their first-year experience, because "little of the knowledge acquired in university courses proved to be directly applicable to the classroom" (p. 152). Other teachers found that the job of parenting pupils was taxing, time consuming and often the teachers chose to be disappointed. Another example of a challenge first year experience was that where a secondary science teacher who came to the classroom from a prior career: he brought a passionate commitment for science but only a vague image of self as teacher. His first year was "disillusioning and frustrating" (p. 152).

Support for novice teachers. School districts have different ways of supporting beginning teachers. The extent to which these programs have an influence on teachers varies. Bianchini and Brenner (2009) investigated how an induction program supported and constrained beginning teachers' efforts to teach science and mathematics. The study focused on the teaching and learning of equitable instructional practices including differentiated, instruction for English learners, attention to students' experiences, and reform-minded science or mathematics strategies. The study focused on two beginning teachers (one who taught high school mathematics and one who taught middle school science). Over two years, the two teachers attended a state-mandated K-12 induction

program. Bianchini and Brenner (2009) concluded that the induction program had little, if any, impact on the teachers' learning. The two beginning teachers did not attribute their substantial new learning to their induction program. The teachers pointed to their previous teacher education experiences and current school communities as more powerful forces in influencing their pedagogy. The researchers suggest that a mentor is best suited for a mentee if they teach the same content; without deep understanding of a particular content, a teacher may not feel confident providing suggestions for instructional strategies. The researchers noted that there is a possibility that teacher communities will reinforce the status quo rather than push for changes toward reform-minded teaching. The researchers noted that although teacher learning communities are often considered important avenues for teachers to improve their practice, but collaboration does not always lead to more or better reform-minded instruction (Bianchini & Brenner).

Another avenue for support for new teachers is an online community. Dalgarno and Colgan (2007) investigated the needs and supports as identified by 27 novice elementary mathematics teachers who were part of an online mathematics community. This study explored what types of supports these teachers most valued beyond graduation. The teachers used an online community, Connect-ME (http://educ/queensu.ca/connectme) to connect experienced teachers with novice teachers. Resources and ideas were shared within this community. For novice teachers, the researchers noted that one challenge was to keep the momentum of novice teachers' experiences prior to teaching and build upon young teachers' pre-service education-inspired beliefs and statements of intended practice.

In this qualitative study, data were collected using two focus groups and telephone interviews. The qualitative inductive data analysis used for this study focused on four phases for the analysis of the transcripts. The four phases included: (1) continual discovery throughout the research in order to tentatively identify patterns; (2) categorizing and ordering data; (3) refining patterns through determining the trustworthiness of the data; and (4) synthesizing themes. This resulted in nine topics which identified the subject of the segments and included content, structure, reflection, risk, resources and ideas, growth, frequency, connection and on-line. The second level of analysis included creating themes by categorizing the nine topics. Five themes emerged as a result of the topics includes formal and informal, personal teaching experiences, sharing, communicating and access to quality resources. From there, the researchers investigated the relationship among themes and found three patterns: forms of professional development, professional community components, and access to knowledge.

Findings from Dalgarno and Colgan (2007) indicate the need for alternative professional development for teachers. The results suggest that teachers actively seek both formal and informal professional development opportunities for sharing and communicating ideas surrounding pedagogy as well as accessing quality resources. The participants communicated a need for alternative teacher professional development, for a community of practice, and for access to technology-facilitated learning. The majority of participants who taught more than two years found that knowledge acquisition and reflection resulted from their own teaching experiences. The more teaching-related

experiences the participants had, the more confident they felt, and the more likely they were to engage in activities that may be different or reform-minded. Many of the participants in this study viewed the online sharing and communicating that Connect-ME offered as a support to their own learning.

Dalgarno and Colgan (2007) concluded that this group of novice elementary mathematics teachers want and actively seek alternative forms of professional development that are on-going and long-term, are in context to their own teaching experiences, provide control over their own learning experiences, and include both online and face-to-face opportunities. In addition, the researchers concluded that a community of practice could be viewed as a powerful means of professional development because it promotes sharing ideas and quality resources, it offers a way of communicating and reflecting with others who teach the same grade/content and it may prevent feelings of isolation. The findings from this study indicated that these novice teachers need personal and emotional supports.

Within a school, there may be structures in place to support novice teachers, however it is important to acknowledge and recognize the beliefs and philosophies that teachers bring with them. Simmons et al. (1999) completed a three-year exploratory study to learn about the perceptions, beliefs, and classroom performances of beginning secondary teachers as related to their philosophies of teaching and their content pedagogical skills. The researchers examined how beginning teachers view learning and teaching and thus were able to gain greater insight into the kinds of experiences on which teacher educations programs should be built to promote student-centered instruction as

well as to promote inquiry-based teaching. The data were gathered through the use of an in-depth interview protocol to collect self-report data about teacher beliefs and philosophy of teachings, a classroom environment survey to assess self-perceptions of the teacher, and classroom observation instruction to assess teaching performance. Simmons et al. (1999) compared data to generate categories and then triangulated until the categories and relationships among them were saturated and the characteristics of the teachers understood.

The knowledge and beliefs of beginning teachers were assessed in five areas: teacher understanding of content and process, teacher actions, student actions, philosophy of teaching, and view of self as teacher (Simmons et al., 1999). If more than 50% of a teacher's knowledge and beliefs was coded into a specific category of teaching styles, he or she was described as holding a teacher-centered, conceptual, or student-centered teaching style. Observations of teachers' practices contrasted with teacher beliefs. While teachers professed student-centered beliefs, they behaved in teacher-centered ways. Beginning teachers in their first year vacillated in their beliefs about their understanding of content and process; however their classroom behaviors reflected more teacher-centered behaviors of their understanding of content and process in the classroom (Simmons et al.).

Simmons et al. (1999) noted that as teachers gained experience in the classroom, they were less likely to wobble in their beliefs systems about their content understanding. However, over time, the percentages of teachers who wobbled in their beliefs about their actions as a teacher, their philosophy of teaching and their views of themselves as

teachers increased. These findings may reflect teachers' enculturation within a school, where they articulated a variety of beliefs. Beginning teachers graduated their teacher preparation program with a wide variety of knowledge and beliefs about (a) how teacher should interact with subject content and processes, (b) what teachers should be doing in the classroom, (c) philosophies of teaching and (d) how they perceived themselves as classroom teachers. Influencing change toward student-centered instruction and more inquiry-oriented teaching approaches in complex and challenging. This type of change requires teachers learn, reflect, rethink, and adopt different knowledge, thoughts, and practices related to teachings. For teachers to develop from teacher-centered instruction to student-centered instruction, educators need to rethink how they come to understand and how to act on that understanding (Simmons et al.).

Regardless of the content which teachers teach, there are many challenges that are universal for beginning teachers. Kuster, Bain, Newton, & Milbrandt (2010) explored the experiences of 11 novice art teachers during their first year of teaching. The participants were purposefully selected to identify participants which the researchers could learn the most about novice art teachers' experiences. The focus of the study was to answer the questions, "what successes do first-year art teachers experience?" and "what challenges do first-year art teachers experience?"

Kuster et al. (2010) found that first-year teachers felt that their jobs were nearly overwhelming at times. They described many challenges including exhaustion, time management, motivating students, instructional interruptions, classroom management and lack of resources (Kuster et al.). The researchers found the most common problem first-

year art teachers experienced was learning how to balance time and energy to fulfill their duties. Another major concern voiced by the novice teachers was motivating their students. Further, the teachers in this study recognized that classroom management was a major concern. They recognized that they should not take students' comments or criticism personally, but the teachers said that was easier said than done. One other challenge faced by the majority of teachers in this study was trying to fit in or assimilate with the school culture.

Some of the successes that the new teachers felt included building trust and a sense of community with their students (Kuster, 2010). Results indicate that as novice art teachers assimilated into their respective schools cultures, logistical and classroom management issues were of primary concern. Successes reported included a sense of community with their students, improving dialogue about art, and showcasing their art program. Novice teachers, regardless of the subject they teach, face many of the same challenges. Among the most frequently discussed concerns or challenges was the demands of their teachings on their energy level and time (Kuster et al, 2010). Kagan's (1992) review of research on novice teachers' professional growth noted the nature of the teaching assignments, support from colleagues, and relationships with students' parents as determinants of growth and success.

Novice Versus Experienced

With experience, teachers evolve in their beliefs and there may be changes in actions. As Ball and Cohen (1999) note, it has become popular to talk about teachers as lifelong learners, but what distinguishes learning from and improving one's practice from

simply “becoming experienced”? (p.10). Ball and Cohen recommend asking the questions “What might it take to learn in practice and to learn from practice?” The authors argue is that a mindset of inquiry is central to the role of teacher regardless of years in the classroom.

Meyer (2004) investigated the concept of prior knowledge in a comparative study of novice teachers and expert teachers. The goal of the comparative case studies of the novice and expert teachers was to determine how teachers understand the concept of prior knowledge and how they use this knowledge to make instructional decisions. Six teachers (two pre-service, two first-year, and two expert) were selected to participate in the case studies and all participants completed two semi-structured interviews; the first interview investigated their understanding of prior knowledge. In the second interview the participants discussed planning to teach a unit on density. They were asked to anticipate what their student knew about density before teaching it. The lesson plans, hand-outs, and other planning materials were collected following the observation.

When novice (pre-service and first-year) teachers discussed how students’ prior knowledge facilitates learning, they expressed a limited view of its importance. Novice and expert teachers did agree that prior knowledge could either facilitate or hinder new learning depending how closely the students’ prior knowledge aligned with the learning expectations of the teacher. The expert teachers were more likely to ask students to use previous instruction to explain real life situations before going on to new material. Unlike the novices, the expert teachers spoke of prior knowledge as a bridge to understanding and integrating new information to develop better explanations.

Meyer (2004) was not surprised by the difference between the novice and expert teachers about prior knowledge and how to make use of it in their teaching. Results that were unexpected were the novice teachers' lack of strategies for finding out their students' prior knowledge. From the observations, it was evident to the researcher that the novice teachers learned about their students' prior knowledge through unintended classroom interactions.

Meyer's study (2004) suggests the pre-service science teachers need a more complex view of knowledge and prior knowledge. More opportunities for teachers to develop and understand these concepts need to be available for novice teachers. These opportunities need to model a wide variety of pre-assessment activities to elicit novice teachers' prior knowledge. Furthermore, novice teachers need experiences where they can be exposed and learn about how their ideas about instructional fit together with what others know and do in the classroom.

Another study comparing novice and experienced teachers by Borko and Livingston (1989) investigated the nature of pedagogical expertise by comparing the planning, teaching, and post-lesson reflections of three student teachers with those of the cooperating teachers with whom they worked. The novice teachers who were selected for the study were identified on the strength of backgrounds in mathematics and performance in mathematics methods courses. With these selection criteria, the researchers felt these characteristics would be indicative of their potential strength as teachers and wanted to compare expert teachers to strong novice (rather than weak novices). The participants

were observed teaching mathematics for one full week. For each mathematics lesson, the teachers were interviewed prior to and following each lesson.

The results of this study indicate that novice teachers showed more time-consuming, less efficient planning and encountered problems when attempting to address student questions that may not have been anticipated. There were many similarities in the planning of the three novice teachers. Similar to the expert teachers, the novice teachers had an agenda for their lessons; the agendas were flexible with respect to some of the same instructional elements as the experts': timing, pacing, instructional examples and problems for students (Borko & Livingston). Also the agenda were similar; the processes by which they were created were quite different. The planning done by the novice teachers was much more short-term planning without reference for planning for the chapter or unit.

Further, the novice teachers reported a greater variety and less selective reflections than experts; the experts' post-lesson reflections were narrowly focused. For these differences, Borko and Livingston (1989) point to novice teachers' understanding of teaching is less interconnected and their pedagogical reasoning skills are less developed.

Data from this investigation by Borko and Livingston (1989) revealed, not surprisingly, several differences in planning, teaching, and post-lesson reflections of expert and novice math teachers. Their analysis suggests that novices may not have the necessary knowledge and skills to adopt the complexities of teachings as displayed by expert teachers. To support novice teachers, experiences and opportunities are needed to

continue developing their skills as a teacher however it is important that there is a match between learner readiness and task demands (Borko and Livingston).

Schools can enhance the beneficial effects of strong initial preparation with strong induction and mentoring in the first years of teaching (Darling-Hammond, 2003). Novice teachers who are preoccupied with logistical concerns may not feel comfortable speaking up and asking for support or mentoring (Darling-Hammond, 2003). Kuster et al. (2010) found that novice teachers are unlikely to "buck the system" (p.52) so there may be a need in pre-service programs for more time allocated to honing communication skills so that novice teachers feel equipped to express their needs and limitations better.

Collaboration and Trust

Trust is a critical element of productive individuals focused on learning and leading (Hoy & Tschannen-Moran, 1999). "Trust means many things. Everyone knows what it is; yet articulating a precise definition of trust is no simple matter" (Hoy & Tschannen-Moran, p. 185). Teaching is personal—educators put their ideas, energy, and time into their profession and consequently, teaching can put educators in a vulnerable place. When teachers seek to grow by sharing ideas or asking questions, trust between educators is essential. Trust is embedded in relationships and for teachers to share and be open with one another; openness and trust are essential elements. (Hoy & Tschannen-Moran). As beginning teachers enter the field of education, openness and trust play an important role in their development as learners and as colleagues.

In his doctoral dissertation, Straughter explored how staff members get to know one another professionally (2001). The teachers noticed that despite their intentions, their

physical proximity, all-school curriculum themes, few teachers visited colleagues' classrooms. When Straughter interviewed teachers about this, they told him that they did not feel comfortable to critique a colleague. They all agreed that they had to overcome this reluctance to observe and critique each other (Straughter). Eventually, teachers began to share more than just resources—they shared ideas and their thinking behind the resources. One question that arose from Straughter's study was "how open and frank are we about what we don't like or are worried about?" As a collaborative team, this is an important idea to reflect upon and consider. "We must learn, or relearn, that openness to advice or criticism isn't the same as accepting it, and that disagreement isn't necessarily proof of being ornery or resistant to change. Teachers have long been used to be accused of "*resistance"* whenever they don't go along with the latest professional fad" (Meier, p. 69-70). It takes time for a collaborative team to build trust where there can be alternate viewpoints without hurt feelings or anger. As Meier notes "it's then, when such differences surface, that the tough part begins" (p. 70). To make progress and move forward, a collaborative team needs to provide a place to safely pose questions, discuss differences, try out ideas, and revise along the way. Kruse and Louis (1995) note that teachers who work together on collaborative teams comment on the family-like nature of trust and concern that the teams can inspire. The authors continue "unfortunately that also means that teams can duplicate the negative side of family relationships too…they may choose to avoid serious reflection on practice, for example, because they don't want to hurt a colleague's feelings or to risk being hurt themselves" (p. 7). Teachers end up acting in a way that is comforting rather than really focusing on critical analysis of their

work (Kruse and Louis). It may be a challenge for a team of teachers to strike a balance so that the team works collaboratively and can be honest and reflective as well.

Barth (2006) identifies four types of relationships found in a typical school: parallel play relationships, adversarial relationships, congenial relationships, and collegial relationships. The signature of a parallel play relationship is the self-contained classroom, with the door shut. “The cost of concealing what we do in isolation from colleagues who might cause us to examine and improve our practices” (p. 10). An adversarial relationship is noted by animosity towards other teachers—it may be blatant or more subtle. Barth notes the guiding principles of competition are “The better you look, the worse I look,” and “The worse you look, the better I look.” Congenial relationships are personal and friendly, but do not propel the work of educators forward. Of the four relationships collegiality is the hardest to establish (Barth). When schools are full of good teachers, the challenge comes in having those teachers work together toward growing as a professional learning community. Four signs of evidence that Barth looks for as evidence of collegiality among teachers and administrators are:

- Educators talking with one another about practice
- Educators sharing their craft knowledge
- Educators observing one another while they are engaged in practice
- Educators rooting for one another’s success

Teacher learning is seen as a process of moving away from the status of novice to that of expert (Cochran-Smith & Lytle, 1999). The researchers continue that expert teachers continuously update their knowledge of the content. The expert teacher is

defined as one who is able to articulate the content and pedagogical knowledge for novice or less accomplished teachers. Novice teachers can learn effective practices by "imitating the strategies of their more competent colleagues" (p.292). Working together in communities, both novice and more experienced teachers can pose problems, challenge common routines, and reflect on teaching and learning mathematics. In this case, teachers with any number of years experience, are lifelong learners and inquirers (Cochran-Smith & Lytle). Collaboration and trust between beginning teachers and more experienced teachers takes time to develop so that individual teachers feel their contribution is appreciated while they continue to grow as a learner.

PLCS as Professional Development

"What everyone appears to want for students—a wide array of learning opportunities that engage students in experiencing, creating and solving real problems, using their own experiences, and working with others—is for some reason denied to teachers when they are learners" (Lieberman, 1995, p. 591).

Professional development must provide opportunities for professional growth for teachers and influence them to develop knowledge, skills, and dispositions they need to teach mathematics well (Sowder, 2007). Educators in the United States have relied far too much and with unproductive results on a failed model of improving instructional practice through workshops that have no immediate plan for translating the information to classroom practice (Schmoker, 2006). Training often implies that teachers are dependent on external support, however with PLCs Schmoker and DuFour et al. (2006) urge educators to merge their practical knowledge by working in teams. "Effective team-

based learning communities—not workshops—are the very best kind of professional development" (Schmoker, p. 109). One reason that working in teams is so effective is because they tap into the teachers' existing capabilities and potential. Professional development opportunities should be designed to address the needs of teachers (Sowder).

Schmoker (2006) highlights fundamental characteristics of collaborative learning communities. First, PLCs require that teachers establish a common, concise set of essential curricular standards and teach them on a similar schedule. Teams must also meet regularly and this time must be extremely focused; most of the time spent talking about specific aspects of instruction. Schmoker recommends that teachers use common assessments. "Failed attempts to establish professional learning communities can usually be traced to a lack of fidelity to these fundamental concepts" (Schmoker, 2006, p.107)

Because of a consensus among researchers (Hiebert, Gallimore & Stigler, 2002, Loucks-Horsley et al., 2003) that traditional strategies of PD, based on one-shot workshops and lectures from outside authorities, offer very limited growth opportunities for teachers. Hiebert et al. (2002) and Loucks-Horsley et al. (2003) note that research has shown that professional development is most effective when it is job-embedded, sustainable, collaborative, and linked to the standards and curriculum that teachers teach. Different professional development strategies have been employed to incorporate at least some of these principals. The choice of strategy depends upon the particular purpose of the PD—whether it is to bring about awareness of a new approach or strategy, to build content knowledge, to practice new teaching strategies, or reflect on teaching and learning (Owston et al., 2008). Loucks-Horsley et al. (2003) emphasizes those current

conceptions of professional development that focus on teacher collaboration and experiential learning mirror contemporary forms for mathematics education.

Cochran-Smith and Lytle (1999) identify important dimension that influence a professional community as one who focus on inquiry. One element is the importance of time as a community: educators need sufficient chunks of time and longevity to work as a group over time (Cochran-Smith & Lytle). Over time, teams that work together develop their own culture and build trust as they work with a common purpose. Another important dimension of a learning community is the nature of the discourse and how teachers describe, discuss and debate teaching (Cochran-Smith & Lytle, 1999).

When teachers have the opportunity and desire to explore and reflect on their teaching and the content, rich discussions and, subsequently, actions towards improvement teaching and learning can occur. Lieberman (2009) investigates how Lesson Study can serve as a vehicle for developing teacher learning communities by developing or redeveloping teachers' professional identity to include continual improvement. In general, the work of teachers is personal and quite private. With limited opportunities to observe one another, teachers have little opportunity to learn from one another (Lieberman, 2009). However, Lieberman poses the question: what do teachers actually learn when they are part of a strong community? (p. 87). In addition to learning how to teach their subject, they can learn one of two things: colleagues regularly discuss their teaching and observe each other or that such conversations and observations are considered instructive and unwelcome. When collegial interaction is the norm, teachers can learn much from one another. Teachers in a learning community not only learn about

what it means to teach mathematics but also what it means to be a contributing member to a community.

"Teachers in a learning community also learn that doors are always open, and that, in an informal way, modeling is a part of teaching" (Lieberman, 2009, p. 89). Lieberman continues that as experienced teachers' model openness, vulnerability and collaboration, beginning teachers will learn that these are norms of the community. When an experienced teacher reveals weaknesses to colleagues, a sense of openness develops. With openness, teachers increased their ability and willingness to learn with and from each other.

Learning communities provide an opportunity for teachers to learn more about the craft of teaching as well as the mathematics which is being taught. PLCs can be a vehicle for delving into the content in a way that is meaningful for teachers which also has affects on classroom instruction.

Lieberman (1995) points out that as opportunities increase for professional learning that moves away from the traditional one-shot deal toward long-term, continuous learning in the context of school and classroom and with the support of colleagues, professional development takes on even greater importance. If teacher learning takes places within the context of a professional community that is both nurtured and developed, then the effects may be more than just an expanded conception of teacher development. "Indeed, such teacher learning can bring about significant and lasting change" (Lieberman, p. 596).

PLCs and common assessments. There are many potential outcomes for a PLC which may depend on the structure and focus of the team. Baynard (2011) used a mixed methods study to describe teachers' beliefs and practice of peer collaboration and their opinion of using common formative assessment. Seventy-six middle school teachers from two middle schools were purposefully selected to complete an online survey about teacher characteristics, collaboration, and common formative assessments. The findings from this study indicate that teachers believe collaboration benefits instruction and assessment informs instruction. Baynard also found that age may play a role in the relationships between assessment and teacher belief. Findings also suggest that the degree to which teachers get along with each other influences the success of a collaborative group and that collaboration can be found in a variety of places—not just a PLC meeting.

Doing Math Together

Teachers need to understand the subject matter they teach, in ways quite different from those they learned as students (Ball & Cohen, 1999). For example, they need to know the meanings and connections, not just the procedures and information; explaining, for example, why the multiplication algorithm works is very different from being able to execute it correctly (Ball & Cohen). The transition from learning mathematics to teaching mathematics may initially seem, to prospective teachers, like an easy transition, but there are myriad challenges when teaching mathematics for mastery and deep understanding. Lampert (1992) identifies issues with doing real, authentic mathematics in school, and the importance of teachers are having these experiences as well. Some areas of focus that Lampert point out include public justification of knowledge,

communication, establishing a culture of inquiry, and the "messiness of it all" (p. 310). These areas are important for teachers to explore as learners alongside others—not in isolation. The extent to which teachers are involved, invested, and excited about the mathematics they teach can influence the work that is done in classrooms (Lampert).

Sowder (2007) points out that the ways present and future math teachers need to know mathematics differs from the ways other mathematics students in college need to know mathematics. The experiences teachers have working together collaboratively focused on a math problem or concept can uncover the mathematics behind the problem. These discussions take time and teachers need to see a purpose to the work they do and how it connects to the classroom. Even though elementary mathematics is "basic" mathematics, teachers need more than just an awareness of mathematics, Ma (2010) suggests they need a profound understanding of mathematics that has breadth, depth and thoroughness. Through sustaining professional learning, teachers can have discussion about the math they are teaching as they explore the math together. With a greater understanding of the mathematics being taught, one can reinforce the mathematics that has already been learned as well as lays the groundwork for mathematics to come.

During a professional development experience with teachers overseen by Lampert and Ball (1998), teachers talk about and explore the mathematics they are teaching to students. The opportunities for teachers to learn are not only centered on mathematics: a second potential lies in experiencing the mathematics lesson different from ones that teachers remember when they experienced math in school. In a community of learners, teachers are encouraged to represent their thinking, to discuss their reasoning, to listen to

classmates' ideas (Lampert & Ball). Another opportunity is the experience of learning to listen and make sense of others' ideas. With deliberate effort and focused purpose, these experiences for teachers can be translated to experiences for students in the classroom. "The experience of learning and doing mathematics in this way comes full circle to serve simultaneously as instruction in mathematics and quintessential preparation to teach mathematics" (Lampert & Ball, p. 137).

Lampert (1992) identifies two kinds of practices of pedagogy: the practice of teaching and the practice of doing mathematics. Teaching involves the teachers in communicating with learning about something that the teacher knows and the students are supposed to be learning. Doing mathematics involves both teacher and learner thinking about quantitative relationships; it is not just the teacher's knowledge but how the students understand and grapple with the context of the problem in relation to what they know (Lampert).

PLCs may be a place where teachers have the opportunities to explore rich math problems or what Ball and Cohen (1999) refer to as a professional learning task (PLT). PLTs are complex tasks that create opportunities for teachers to explore and examine pedagogical problems and their potential solutions through processes of reflection, sharing of ideas and building a knowledge base (Silver et al., 2007). In a study by Silver et al. (2007), teachers had significant opportunities to learn mathematics—to build and strengthen comings among mathematical ideas and consider the pedagogical implications. When teachers work on a math tasks, there are opportunities for teachers to rethink and reorganize the mathematics that they teach which broadens their

mathematical knowledge and understanding (Silver et al., 2007). The dialogue that comes from a group of teachers discussing math tasks can reveal more connections among the mathematics as well as reveal potential misconceptions students may have.

As Lampert and Blunk (1998) point out, mathematics has its own vocabulary and ways of thinking about the world that mark it is as "mathematics" (p. 165). Mathematics teachers are a part of a certain community where the focus of the discourse is primarily mathematics. According to Lampert and Blunk (1998) and Ball et al (2001), this discourse community has been noted by its focus on algorithms and a lack of depth to the discourse. Therefore it is important that teachers in a collaborative team can communicate with each other about the mathematics, and then transfer that ability to influence communication within their classroom. As noted by Lampert and Blunk, teachers have traditionally been seen as the authorities of mathematics in the classroom; this phenomenon may be mirrored in professional development as well. In a collaborative team setting such as PLC, teachers can work together to understand both teaching and learning mathematics in a deeper, meaningful way. Over time and with practice, teachers can become better communicators about the mathematics and teach.

Ball et al. (2001) note that the weak impact of professional education on teachers influences because teachers are thought "to need *updating* rather than opportunities for serious and sustained learning about curriculum, students, and teaching" (p. 437). The challenge for educators is to find the appropriate and best-suited support for teachers to develop their skills in a sustainable, meaningful way.

Hill and Ball (2004) note that teaching mathematics requires an appreciation of mathematical reasoning, understanding the meaning of mathematical ideas and procedures as well as knowing how ideas and procedures connect. Hill and Ball studied California's Mathematics Professional Development Institutes (MPDIs), which is a statewide program designed to provide subject matter professional development during sessions that lasted one to three weeks in duration. This program served over 23,000 K-12 teachers in the first three years it was established. Hill and Ball studied this program because of its size as well as the scope of emphasis on improving teachers' knowledge of mathematics. Complete pretest and posttest data from nearly 400 teachers were collected from 15 different locations.

During the institute, teachers had the opportunities to work together on math problems to address problems that arise when teaching mathematics content. Another observation by Hill and Ball (2004) was the institutes were taught by mathematically knowledgeable individuals including university mathematicians and mathematics educators. The researchers found a clear effect of length of institute on the size of the difference between pre- and post-assessments, with longer institutes tending to have higher gains. Their results show that teachers can learn mathematics for elementary school teaching in the context of a single professional development program however there are many factors that are at play here. The findings reinforce growing signs that the focus on content learning opportunities for teachers may have important effects on the development of their mathematical knowledge for teaching (Hill and Ball, 2004). Further, the findings suggest that the opportunity to engage in mathematical analysis,

reasoning, and communication can improve teacher knowledge suggests curriculum may play important role in quality professional development. Finally, Hill and Ball recognize that a measure of professional learning does not rely solely on teacher perception of the program, but focuses on the content knowledge needed to teach mathematics and how growth can be measured and improved.

Unlike the study by Hill and Ball (2004), some PLCs are teacher-led, without the direction or support of a person without a mathematics educator. These groups may have different challenges when faced with exploring the content. Whose perception of what mathematics looks like is heard or explored? What are the strategies about teaching mathematics? At the middle school and high school level, when exploring mathematics teachers, their perceptions of what math looks is likely to differ—these are important discussions to have as a team. Likewise these discussions need to happen in a place where various viewpoints can be shared, critiqued and questioned in a respectful, trusting way.

"A mathematics teacher should keep his or her enthusiasm for doing mathematics" (Ma, 2010). Ma indicates that it is important for teachers to go back and forth between doing mathematics and understanding why they are doing mathematics. Why does the math work? How does the algorithm relate to the conceptual understanding of a problem? Ma reports that analysis from teacher interviews indicate teachers acquire mathematical knowledge from various interactions including learning from colleagues, learning mathematics from students, learning mathematics by doing problems, teaching, and studying teaching material intensively (Ma, 2010). Just as students do not

automatically begin talking about mathematics in meaningful ways, teachers need practice working collaboratively to hone discourse skills for how to talk with one another about mathematics. For meaningful, productive discourse to occur, there need to be strategies in place to support mathematical discourse which include appropriate tasks, routines and opportunities for talk (Lampert and Blunk, 1998). Opportunities for teachers do math problems and have rich discussions about math are avenues for developing one's content knowledge, and thus one's ability to teach mathematics.

Conclusion

Beginning math teachers face many challenges and opportunities as they enter the field of education. From the start of their career, teachers have a variety of options for professional learning. One structure that is in place in many school districts is PLCs. Gradually, the communities shift into a partnership that focuses on growth and learning as they share material, social, and intellectual (Francis, 2011). However, there is more research needed to determine the perceptions and impact of PLCs on novice math teachers. The literature presented here explores PLCs, but more insight is needed to explore to what novice math teachers' perceptions and attitudes toward this professional learning as well as to what extent the content is being discussed and analyzed to support teacher understanding of the standards.

This study is driven by the following research questions:

1. How do CLTs influence middle school math teachers to explore the nature of the mathematics content and pedagogy?

2. What are the perceptions of novice teachers' in terms of effective components of their CLT?
3. What are the perceptions of experienced teachers' in terms of effective components of their CLT?
4. How does teaching experience influence perception for effective CLTs?

This study is significant because educators and policy makers need to know what impacts both novice teachers' and experienced teachers' perceptions of professional learning. In a time when collaborative teams are increasing in number across many school districts, it is important to determine how teachers with different experiences (both in years of teaching and in years working within a PLC) can benefit from and contribute to these teams to support teacher growth and development. The researcher from this study adds to the current body of research by focusing on both novice and experienced middle school math teachers, a niche that would benefit from further exploration.

CHAPTER THREE

This qualitative study was designed to understand novice and experienced math teachers' perceptions toward what teachers perceive as in effective components of their work with collaborative learning teams (CLT). Further, this study investigated to what extent the content and pedagogy was explored during CLT meetings. This chapter begins with a review of the research questions and then proceeds to a description of the research design, setting, and participants of the study. Next the procedures for data collection and data collection instruments are shared, in addition to how the analysis was completed.

Research Questions

The purpose of this qualitative study was to explore the perceptions of what makes a collaborative learning team and related meetings effective for novice teachers and experienced teachers as well as to examine the nature of the mathematics content and pedagogy explored within this collaborative context and its impact on teachers' perception of mathematics teaching.

This research study was focused on the following questions:

1. How do CLTs influence middle school math teachers to explore the nature of the mathematics content and pedagogy?
2. What are the perceptions of novice teachers' in terms of effective components of their CLT?

3. What are the perceptions of experienced teachers' in terms of effective components of their CLT?
4. How does teaching experience influence perception for effective CLTs?

In order to answer these questions, the researcher interviewed four novice and three experienced math teachers about their experiences with their CLTs. Qualitative research provides ways of discovering and interpreting aspects of reality and interviews are a formal ways of gathering information about that reality (Rossman & Rallis, 2003). According to Rubin and Rubin (1995) qualitative interviewing is a way to learn about how others see and perceive the world around them. Further, Rubin and Rubin note that qualitative interviews should sort out what is unique and what may be common among responses from participants. Open-ended questions were asked during the interviews so that participants could elaborate on their perceptions and their reality of professional learning.

Because CLTs can look different in different settings (grade level, school, district, etc), a multiple case study was appropriate to observe patterns, trends, and differences among settings. The results were analyzed and illustrated in two ways. First, the results were explored by each CLT which allows the reader to understand the dynamics of each individual CLT. Secondly, the results are explored by the perceptions of the group of novice teachers versus the group of experienced teachers. A multiple case study allows the researcher to analyze within each setting and across settings (Baxter & Jack, 2008). Qualitative research reveals both subtle and distinct differences in teachers' perceptions of a CLT. Comparative studies seek similarities and differences among cases on a

relatively few specified attributes (Stake, 2006). In this study, it was important for the researcher to get a clear picture of what influences novice middle school math teachers' perceptions and what influences experienced middle school math teachers' perceptions of professional learning especially where some professional learning is optional and other is required.

In this qualitative study, the analysis explored the experiences and perceptions of each individual teacher within the setting in addition to being a member of a team; the results are organized with each CLT as a "case". The focus for this study was to explore a niche of teachers where more research would benefit the extant literature. Therefore, duty the school year when the data was collected, the participants taught mathematics in a middle school that already implemented collaborative learning teams.

Participants and Setting

In this study, seven middle school math teachers were interviewed. The participants were from two middle schools in the mid-Atlantic. After Human Subjects Review Board approval from George Mason University, the researcher contacted principals and math coaches/facilitators about teachers who might have been willing to participate in the study. The researcher sent emails to the teachers who meet the criteria and understood the requirements for being a part of this study (three interviews over three months). Initially, the researcher was looking for two teachers from each of three different CLTs. However, multiple avenues for participants were explored, this specific description of participants was not possible to find. Seven teachers volunteered to be in

the study so the researcher chose to interview all seven teachers in case any teachers dropped out of the study.

In this chapter, a brief description of each CLT is given. In chapter four, the profile of each CLT is described in greater detail. The three CLTs were unique because of the composition of the teachers within the group, as well as the school in which it is situated. In the first school, Chases Pond Middle School (CPMS), teachers from two teams participated in the study: the sixth grade and the eighth grade teams. The teachers interviewed from CPMS who taught sixth grade honors mathematics and met as a CLT. All three teachers interviewed in this CLT were in their first year of teaching (novice). Two other teachers were interviewed from CPMS. Those teachers, both of whom were in their fifth year of teaching (experienced), teach algebra to eighth grade students and met weekly as a CLT. The other two participants in this study were teachers from Harris Middle School (HMS). One of the participants was a second year (novice) teacher and the other teacher was in her nineteenth year of teaching (experienced). The two teachers interviewed both teach algebra to eighth grade students. Their CLT is for all eighth grade math teachers at their school, which includes teachers who teach pre-algebra.

To learn more about the team, it is important to know the individuals who make up that team. On the sixth grade team at CPMS, three teachers participated in this study. Beatrice was first year teacher who taught sixth grade. She taught four sections of sixth grade honors math; two of those classes were co-taught with an English Language Learner (ELL) teacher. Beatrice also taught one intervention math class. Beatrice's student teaching experience included teaching calculus and trigonometry to eleventh and

twelfth grade students. Beatrice's bachelor's degree is in secondary education with the concentration of mathematics and holds a teaching certificate for grades seven through twelve, with an endorsement to teach sixth grade. The second participant from this CLT was Heather. Like Beatrice, Heather was a first year teaching who taught four sixth grade honor math classes. In addition, she taught an intervention group to sixth grade students who did not pass the state standardized test at the end of last year. She student taught at both the middle school and high school levels. Her bachelor's degree is in mathematics and her master's degree is in education. The third participant from this CLT was Julia. Like the other two participants, Julia was in her first year of teaching. She co-taught two sections of mathematics, she taught one class of self contained mathematics, and she co-taught one class of social studies. Her undergraduate degree was in childhood education grades one through six and special education grades one through six.

The CLT that included Beatrice, Heather, and Julia was facilitated by Ben, the instructional coach for the school. One of the responsibilities of his job was facilitating CLT meeting at his school. Prior to become an instructional coach he taught middle school mathematics for five years. An ELL teacher also participated in the CLT meetings but she did not participate in this study. This group was unique because three out of four teachers on the team are first year teachers.

The other participants in this study that taught at CPMS were on the eighth grade CLT. This team was different from the sixth grade CLT because all of the teachers (even those not interviewed for this study) were experienced teachers. Sarah had been teaching for five years (all at Chases Pond Middle School) and had always taught eighth grade

students. During the school year 2012-2013, she taught three sections of algebra and one section of geometry. Her bachelor's degree is in mathematics and her teaching license is for grades sixth through twelve. The other participant from the eighth grade CLT at CPMS was Zach, who was in his fifth year of teaching. While he participated in this study, he taught four sections of algebra to eighth graders. His bachelor's degree is in psychology and he received his teaching certification through a certification/masters program. Along with the special education math teacher, Sarah and Zach had working together on the same CLT for three years. One reason this group of teachers was unique was because they self-facilitated their CLT meetings. Often an administrator would attend the meeting, but the teachers led the meeting, determined the focus and set the agenda.

The other two participants in this study taught at HMS. Two teachers on the eighth grade team volunteered to participate in this study. The two teachers both taught algebra to eighth grade students. Esmeralda was in her nineteenth year as a math teacher. She taught algebra and geometry to eighth grade students. Her teaching experience had been in kindergarten (four years) and eighth grade (15 years) which has always included some sections of algebra. Esmeralda's bachelor's degree is in mathematics/secondary education and has a teaching licensure for mathematics in grades six through twelve. Jon was in his second year of teaching algebra to eighth grade students. Teaching was Jon's second career; prior to teaching at Harris Middle School, he was an electrical engineer. To receive his teaching license, he went through an intensive sixth-month program to receive his teaching certification.

The eighth grade CLT at Harris was unique for several reasons. Last school year, the teachers decided that they would come in before school to meet as they felt that they did not have enough common planning time during the day. Further, this group was facilitated by the principal of the school. Lastly, this group had teachers participate in the meeting that teach at least one of the following subjects: pre-algebra, algebra, and geometry.

The setting and participants were purposefully selected because they can provide insight about their experiences with CLTs. A purposeful sample is used when the researcher wants to understand a current phenomena and needs a sample from which that can be learned (Maxwell, 2005). The participants were members of a CLT and taught middle school math (grades 6-8) at a public school. Each novice participant had more than one year and less than three full years of experience while each experienced participant had more than three full years of experience. All participants were given the informed consent form (see appendix 1). The requirements (three interviews over three months) for being in this study were also expressed in writing and verbally to each participant. Once the study was completed, compensation ($75 gift cards) was given to the participants.

Data Collection Instruments

In order for the researcher to glean as much insight as possible from teachers' experiences and perceptions, a semi-structured interview protocol was used. The initial interview took place in September 2012, right at the beginning of the school year 2012-2013. Two follow-up interviews occurred in October 2012 and November 2012; both

follow-up interviews were scheduled for a time after a CLT meeting. The researcher scheduled the interviews with teachers via email.

Semi-structured interview. The qualitative instrument used in this study was a researcher-developed semi-structured interview protocol. The questions were open-ended and assessed the teachers' perceptions about their experiences within a PLC. (See appendix 1 for *interview protocol*). To ensure that the questions were appropriate for this study and not to lead the interviewee to answer in a specific manner, the interview questions were reviewed by professionals in the field of PLCs and math education. In addition, as a trial, the interview protocol was used with two math teachers not participating in this study. According to Rubin and Rubin (1995), many qualitative interviews have both more structured and less structures parts and vary the balance between both types of questions. Some questions included in the interview are closed questions with specific answers (such as "how often do you meet with your PLC?") while other questions are much more open-ended (such as "how comfortable do you feel contributing to the discussion during the CLT meeting and why?") to elicit the perceptions and experiences of each individual teacher.

Included in Table 1 is the alignment of the research topic to each interview question.

Table 1

Research questions aligned to interview questions and key ideas

Aspect	Interview question #	Key ideas
Research question 1: How do PLCs influence middle school math teachers to explore the nature of the mathematics content and pedagogy?	Questions 8-13 during initial interview; Multiple questions during follow-up interviews	Talking about math topics; doing mathematics together; exploring state and national math standards
Research question 2: What are the perceptions of novice teachers in terms of effective components of their CLT?	Questions 14-20 during initial interview; Multiple questions during follow-up interviews	What makes the PLC effective for the individual teacher; what the teachers leave with—either physically or mentally—what the teacher still has on her mind after the meeting
Research question 3: What are the perceptions of experienced teachers in terms of effective components of their CLT?	Questions 14-20 during initial interview; Multiple questions during follow-up interviews	What makes the PLC effective for the individual teacher; what the teachers leaves with—either physically or mentally—what the teacher still has on her mind after the meeting
Research question 4: How does teaching experience influence perception of the role of and value for PLCs?	Questions 3-7 during initial interview; Multiple questions during follow-up interviews	Structure, routine, value

Procedures

According to Rubin and Rubin (1995), case study interviews are generally designed to be flexible rather than rigid. In-depth interviews, which solicit participant input pertaining to perceptions and attitudes related to professional learning and PLCs will be used as the primary means for gaining the participants' perspective (Yin, 2009). The individual interviews were conducted at the beginning of the 2012-2013 school year. The researcher scheduled follow-up interviews with each of the participants after a CLT meeting; there were two follow up interviews with each participant.

Rigorous qualitative case studies afford researchers opportunities to explore or describe a phenomenon in context using a variety of sources (Baxter & Jack, 2008). A case study involves collecting in-depth observations in a limited number of cases—to focus on fewer participants and more variables within the setting. Through descriptions of their experiences and beliefs, the participants are able to describe their views on reality and this enables the researcher to better understand the participants' actions and situations (Lather, 1992, Maxwell, 2005, Weiss, 1994).

According to Yin (2009) a multiple case study enables the researcher to explore differences within and between cases. Because comparisons were drawn, it was imperative that the cases are chosen carefully so that the researcher could predict either similar results across cases or contrasting results. Thus, the researcher interviewed both novice and experienced teachers from different CLTs. The researcher explored what

similarities and differences there were among the individual CLTs as well as the similarities and differences in perceptions of the novice and experienced teachers.

During the first interview, which lasted 20-40 minutes, the teachers were interviewed about their career experiences as well as experiences with CLTs, CLT meetings and to what extent the team investigates mathematics during those meetings. The interviews were audio taped. The audio files were kept secure and destroyed at the end the study. Pseudonyms have been used for each participant as well as school location and any other potentially identifying information.

For the two follow-up interviews, the researcher and the participant met and interviews lasted 10 to 30 minutes. Again, these interviews were audio taped. All three interviews were open-ended because it was important to learn as much about each teacher's perspective as possible. All interviews were scheduled at a time convenient for each teacher. Prior to each interview, the researcher confirmed the interviews via email. For the first round of interviews, all interviews were done in person except for Esmeralda's interview which was done on the phone due to scheduling conflicts. For the second and third rounds of interviews, they were completed in person except for the third interview with Julia, which was done on the phone also due to scheduling conflicts. The interview protocol for the second and third interviews were similar in nature with specific questions, and time for reflection upon the most recent CLT meeting.

Data Analysis

According to Rubin and Rubin (1995), the researcher listens to the participants to *hear the meaning* of what is being said (p. 7). Researchers develop skills to listen

carefully to each word the participants use. Qualitative interviewing requires listening carefully enough to hear the meanings, interpretations, and understandings of what has shaped the participants' perceptions and experiences (Rubin & Rubin).

In qualitative research, data collection typically coexists with analysis (Yin, 2009). Analysis of transcribed interviews began as soon as the transcripts were available and the analysis of data was ongoing from when the interviews commenced in September. According to Yin (2009), "as you collect case study evidence, you must review the evidence and continually ask yourself why events or facts appear as they do" (p. 69). The transcriptions were read and researcher memos were made during those readings. The transcriptions were read again as a process of open coding to determine initial categories. Rubin and Rubin (1995) explain that coding is the process of grouping participants' responses into categories so the researcher can explore similar ideas, concepts or themes. "You can code for names, evidence, or time sequences. You can also code for hesitations, blocking, signs of emotion, and indications of fear or amusement. In fact, you can code on anything you think may help you analyze the data" (Rubin & Rubin, p. 238).

A systematic procedure was used to code the data: open coding, axial coding, and then selective coding (Strauss & Corbin, 1998). Open coding, as defined by Strauss and Corbin, is the analytic process through which concepts are identified and their properties and dimensions are discovered in data (p. 101). In other words, during open coding, data were broken down into discrete parts, examined closely, and compared for differences and similarities. Strauss and Corbin go on to say that events, happenings, actions and

interactions that are conceptually similar in nature or related are groups in “categories” (p. 102). In this study, the researcher started by open coding for the initial interview as she listened to the transcripts and highlighted quotes and phrases that were evidence of what happens in the CLT. First, she did this for all novice teachers so as to mentally partition the novice teachers from the experienced teachers. After transferring all the highlighted quotes to color-coded sticky notes, the researcher identified five categories to which the “emic” codes could be categorized. These categories were time, math content, purpose, collaboration, and other. Then the researcher reviewed the initial coding and refined the categories to efficiency, math, relevance/value, and community. Through axial coding, the researcher explored the connections among these categories.

On a separate day, the researcher then completed this same process for the experienced teachers. The categories that came out of the initial emic coding were math, purpose, communication, priority, and other. From there the categories were refined to math, people/community, reflection, value, and practice of teaching.

During axial (defined by Strauss and Corbin as the process of relating categories to their subcategories) and selective coding (defined by Strauss and Corbin as the process of integrating and refining the theory), data are reassembled through statements about the nature of relationships among the various categories and their subcategories (Strauss & Corbin). According to Stake (2006) in cross-case analysis, both the similarities and differences should be emphasized. Stake warns researchers to not merge cases too quickly; each case “needs to be heard a while, then put aside a while, then brought out again, and back and forth” (p. 46-47). The researcher listened to and reviewed the

transcripts from each individual interview and reflected on one interview at a time to hear what each individual teacher was sharing in their interviews.

Throughout the ongoing data analysis, the researched used “researcher memos” to reflect upon her thinking in relation to the context of the study and her own potential biases. The use of memos (Strauss & Corbin, 1998, Maxwell, 2005) started immediately as a part of ongoing data analysis. Memos serve a variety of purposes: one is that they can serve as reminders or initial impressions to reflect back on at a later point. Rossman and Rallis (2003) note several questions to reflect upon during the research: (1) What do you observe and why? (2) What questions do you ask and why? (3) What preconceptions and prejudices are shaping your project? and (4) How does your membership in a particular social group shape the research? Memos also capture the researcher’s analytic thinking about the data and facilitate this type of thinking, stimulating analytic insights (Maxwell, 2005). In the next stage, the researcher became immersed in the data and worked to understand the perspective of each participant. Transcripts were read multiple times and notes were made on general themes within the transcripts.

According to Rubin and Rubin (1995), when the coding is complete, the data are grouped in categories that allow comparison of what different participants said, what themes were discussed, and how concepts were understood. The researcher explored similarities and differences as well as parallels among the responses from the group of novice teachers and the group of experienced teachers. Some of the similarities included participation, common assessments, a sense of value, and mathematics. The differences included how a team analyzes data, how teams create common assessments, and what

teams want to do with their time during the CLT meeting. Some of the parallel topics included community versus people/team, efficiency/collaboration versus reflection/communication. After the similarities, differences and parallels were explored from the first round of interviews, the researcher explored how these results addressed the research questions.

After the second interview, the data were coded in a similar way to the initial interview. The data from the novice teachers were analyzed first, and then the data from the experienced teachers were analyzed. The researcher took the emic codes from the novice teachers and explored how they fit into the categories from the first round of interviews. The same process was done for the interviews from the experienced teachers. Again, the researcher explored how the categories connected to the research questions. Then, the researcher focused on research question two and three to explore the similarities and differences among the responses from the group of novice teachers versus the group of experienced teachers.

Before the third and final interview, the researcher met with several peers to discuss the findings as part of a member check; two peers who are experts in mathematics education field and one peer who is an expert in policy and education. As data were collected and analyzed, the researcher integrated member checking, where the researcher's interpretations of the data are shared with the participants and the participants have the opportunity to discuss and clarify the interpretation and contribute new or additional perspectives (Baxter & Jack, 2008).

After the final interview, the data were coded in the same manner as the previous interviews. The researcher continued to review the data analysis previously explored to see how it aligned with the data from the other interviews as well as to explore potential outliers. To explore the similarities and differences between novice teachers and experienced teachers, the researcher used Venn diagrams.

Another tool for both data analysis is a matrix. According the Maxwell (2005) and Miles and Huberman (1994), matrices can serve as a tool for organizing data; matrices will be constructed from the data and used to identify patterns, trends, and comparisons and this was organized by research question. The researcher ensured that all data were accounted for as well as addressing outliers in the data that did not seem to fit into one of the categories.

Further validation is achieved by discussing the analyses and conclusions with other experts in the field of mathematics education and middle school teaching. Spall (1998) notes that peer debriefing is a contributing factor to ensuring that the findings and the interpretations of the researcher are honest, accurate, and believable. To discuss the results and initial findings, the researcher met with several colleagues and professionals in the math education field as well as professionals who are not immersed in mathematics education so as to obtain an outsider's perspective.

Propositions

The focus for this research was to find themes to explain novice teachers' perceptions of professional learning and PLCS and also to determine how the results fit in the context of other research. Propositions, according to Baxter and Jack (2008) and Yin

(2009), may be helpful in a case study but are not always present. When a case study proposal includes specific propositions it increases the likelihood that the researcher will be able to place limits on the scope of the study and thus the more chance the study will stay within reasonable limits (Baxter & Jack, Yin). Further, they note that a researcher can have "several propositions to guide the study, but each must have a distinct focus and purpose" (p. 552). Yin (2009) suggests that propositions are necessary elements in case study research because they lead to the development of a conceptual framework that guides the research.

Table 2

Potential propositions for research

Potential Propositions	Source
Little time during CLT meetings will be spent doing mathematics	**Personal experience and literature** Lampert and Ball (1998) Darling-Hammond (2003)
Novice teachers want resources to use immediately in their classroom.	**Personal experience and literature** Lampert and Ball (1998) Lampert and Blunk (1998)
Novice teachers would benefit from being a part of a community. Novice teachers will	**Personal experience and literature**

seek support determining how to teach standards in a way that exemplifies best practices.	AISR (2004) Dalgarno and Colgan (2007)
Teachers are influenced by professional learning opportunities and interactions with their peers when thinking about and making decisions about teaching	**Personal experience and literature** Dalgarno and Colgan (2007) Darling-Hammond (2003) Park, Oliver, Johnson, Graham, and Oppong, (2007)
Experienced teachers would address connecting multiple standards as well as previous and subsequent mathematic courses.	**Personal experience and literature** Ball (1990) Meier (2002)

Exploring the nature of mathematics. In terms of talking about the content and pedagogy of learning and teaching mathematics during CLT meetings, it was anticipated that novice teachers will find it most beneficial when they can leave a meeting with a resource that can be used in their class immediately. According to DuFour et al. (2006), one aspect that CLT's focus on is exploring specific standards that are taught at a grade level or within a content area. It is anticipated the responses include to what extent discussing standards is supportive for teacher understanding.

Professional learning. It was anticipated that CLTs will serve as one form of job-embedded professional development; for novice teachers, this may be their only form of professional development. Teachers who are able to work in a collaborative setting where there are regularly scheduled meetings will benefit from the support their peers as they learn and grow both individually and as a group.

Perceptions of PLCs. It was anticipated that responses about CLTs will include teachers learning about the process of a CLT and how the structure works at their school. If a teacher has worked in multiple schools and had different experiences with PLCs, responses will likely include comparisons of those experiences. Anticipated responses included what has supported or benefited the teachers' instruction—and conversely, what aspects of PLCs are not useful, confusing, or ineffective. Responses may focus on a "micro" level—what immediately impacts the teacher and his/her work in the classroom.

CHAPTER FOUR

The purpose of this qualitative study was to explore the perceptions of what makes a collaborative learning team and related meetings effective for novice and experienced teachers. Chapter three outlined the methods used to collect and analyze data the research questions that guided this study. This chapter discusses the results of the data gleaned from the data. The four research questions that guided this study were:

1. How do collaborative learning teams (CLTs) influence middle school math teachers to explore the nature of the mathematics content and pedagogy?
2. What are the perceptions of novice teachers' in terms of effective components of their CLT?
3. What are the perceptions of experienced teachers' in terms of effective components of their CLT?
4. How does teaching experience influence perception for effective CLTs?

This chapter is organized first with comparisons of the three collaborative learning teams (CLTs). Within these comparisons, similarities and differences are explored. This chapter also includes an analysis of the results by the research question which includes comparisons of the novice teachers and the experienced teachers focused on three different themes: (a) how the interpersonal nature and interactions among the members of the CLT influence the collective work and the perceptions of being effective, (b) how the

logistics and structure of meeting influence the collective work and the perceptions of being effective, and (c) how the meeting focus influence the collective work and the perceptions of being effective.

Collaborative Learning Teams

The three CLTs examined in this study were math-focused collaborative teams situated in a middle school (grades 6-8) in the mid-Atlantic. Due to school, specific administrative requirements, experience, and size of the team, there were many differences among the teams. The teams were unique from each other in a variety of ways for reasons that were directly related to the members of the team while other factors were based on the school culture or school schedule. In the following section, the profiles of each time will be described.

CLT Profiles and Organization. In the following section, the three CLTs are described in more detail. Figure 1 shows the on which teams the teachers in this study participated.

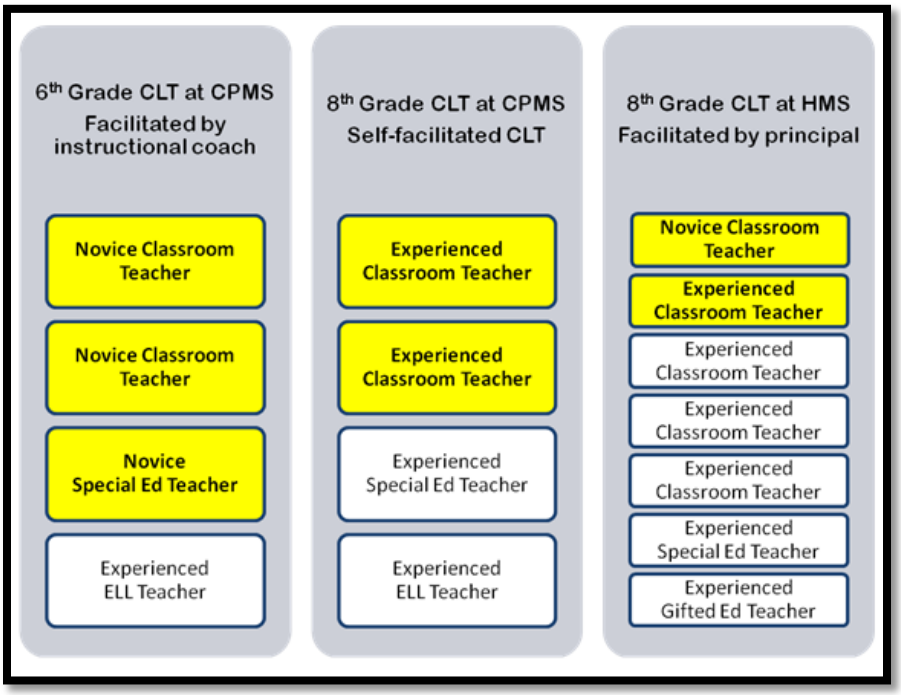

Figure 1.This figure illustrates which CLT teams the teachers in this study participated. The highlighted boxes represent the teachers who participated in this study.

Sixth Grade CLT at Chases Pond Middle School. The sixth grade CLT at Chases Pond Middle School (CPMS) had four teachers on the team: two classroom teachers, a special educator and an English Language Learner (ELL) teacher. This CLT was facilitated by the instruction coach, Ben, whose background was teaching middle school mathematics. Ben taught middle school math for five years and this was his third year as an instructional coach at this school. The principal of this school rarely attended their CLT meetings because the coach attended and facilitated these meetings. Three of the four teachers on the team were interviewed for this study. The fourth teacher, who was an ELL teacher, did not participate in this study. The two classroom teachers interviewed were Beatrice and Heather. The special education teacher on the team, Julia,

was also interviewed for this study. All three teachers interviewed were in their first year of teaching. This team met regularly on Mondays at 1:35pm for approximately 45 minutes. This meeting time was scheduled into their planning period and the group met in Heather's room. Within several choices as determined by the administration, the team selected the specific direction the team wants to go for a given meeting. Beatrice explained that Ben "gives us options of things, and then we can choose what we want to work on." The topics that the participants shared that were discussed during the CLT meetings included unit planning, daily lesson plans, completing IB (International Baccalaureate) planner, exploring or revising the transfer task, and creating common assessments. All three teachers interviewed in this study liked spending time on daily planning, exploring or revising the transfer task.

Eighth Grade CLT at Chases Pond Middle School. Similar to the sixth grade CLT at Chases Pond Middle School, the eighth grade team had four people on the team: two classroom teachers, a special educator and an ELL teacher. Both classroom teachers, Sarah and Zach, participated in this study and both teachers were classified as experienced. This group self-facilitated because the instructional coach was facilitating the sixth grade CLT meeting at the same time (Mondays at 1:35pm). The principal attended some of the meetings and when asked about self-facilitating and having an administrator or the instructional coach attend, Sarah shared, "we kind of feel it more of a hindrance to have somebody direct our meeting when we have come in there with a purpose." This team met regularly on Mondays for approximately 45 minutes. This meeting time was scheduled into their planning period and the group meets in Sarah's

room. Most of the time during CLT meetings was spent time creating and revising common assessments, as well as reviewing data from common assessments. Sarah explained, "We start to make our assessment for the unit and work on our unit plan. The following meetings are looking at our data for common assessments and making common assessments." The third CLT in this study will be described in the following section.

Eighth Grade CLT at Harris Middle School. The CLT at Harrison Middle School (HMS) had seven teachers on the team which included five eighth grade general education classroom teachers, one special education teacher, and one gifted education teacher. The two teachers from this team who participated in the study are classroom teachers. This team was facilitated by the principal of the school (whose background was not in mathematics). This team met regularly on Thursday mornings, before their contract time, from 7:10-7:50am; this was a decision made by the team during the school year 2011-2012. The meetings occurred in Esmeralda's classroom. For these meetings, sometimes there was an agenda ahead of time, and other times, the facilitator asked how things are going in each teacher's classroom. The following section will provide a comparison of the three CLTs.

Comparison of the CLTs. There were many factors that influence how a team functions: the number of teachers on each team, the regularly scheduled meetings and how administration supported each team. First, the similarities among the teams will be provided. In the subsequent section, the differences among the teams will be explored.

Similarities. The similarities among all three CLTs emerged in two themes: (a) how teachers described the extent to which the logistics and routine of the meetings

influenced the work of the CLT and (b) how teachers described how they valued the time spent during the CLT meetings. Logistics included the requirements of meeting as a team, how often the team met formally and informally, what agenda guided the meetings, and how common assessments were used (differently) on each of the teams. Teacher values included what teachers deem as a productive use of their time and to what extent the focus of the meeting was relevant and useful and to what extent the feel they have a voice in the meetings.

Logistics. There were four emergent categories: weekly meetings where attendance in mandatory, meeting formally and informally, CLT meeting agendas, and discussion of common assessments. These four emergent categories were connected within the theme of "logistics" or to what extent the logistics and routine of the meetings influenced the work of the CLT.

Required meetings. First, attendance in CLT meetings was mandated by the principals of each building. At Chases Pond Middle School, CLTs were officially started in school year 2011-2012. At Harris Middle School, CLTs started in school year 2007-2008. All three teams had weekly meetings where attendance was mandatory. All seven teachers interviewed in this study said that they would meet with their colleagues even if the team meetings were not mandatory. When asked if she would still attend the meetings if they were not mandatory, Heather said, "Yea, if we need to, I meet with Beatrice. I would do it anyways. This makes it have a set time, which is good, instead of just doing it whenever we needed to." When asked the same question Zach said,

> The idea is so strange to me, because it's not. They did make it a little bit more flexible, this year. To speak to that slightly, they allowed us to have the freedom to say, okay, this is our designated day. If we're able to do it some other time, we can do that, as long as we're still using that online recording mechanism. It's optional in the sense that it's optional for Monday at sixth period, but I think mostly we just stick to it because it's the structure and makes life a little bit easier having one set time. I think I would still want to meet. Like I said, we meet all the time, not just that Monday.

When asked about participating in the meetings if they were optional, Esmeralda shared, "I would definitely attend them. I think the collaboration and hearing what's going on in other classrooms makes you understand that you're not alone." It is important to note that all seven teachers interviewed in this study said that they would meet with their CLT even if participation was not mandatory.

Meeting formally and informally. Each CLT met at a specific time during the week. Teachers shared how they appreciated having this time each week for meeting. Sarah explained, "We meet formally once a week. That's required by the school, but we meet almost every day as a group for at least fifteen or twenty minutes." Beatrice also described her experiences meeting informally, "we're constantly collaborating and working together anyway." Teachers shared their experiences meeting multiple times throughout the week informally as well as formally as a CLT. It is important to note that the eighth grade CLT at CPMS had the flexibility to meet when it was convenient for the teachers on the team; the sixth grade CLT at CPMS met at a specific time so there was at

least one scheduled time to meet with the instructional coach. It is important to note that a team with the support of an instructional coach may have significant implications for instruction.

CLT meeting agendas. All seven teachers shared their thoughts on how the time during the meeting is spent and how they are able to influence the direction of the meeting, however teachers did not report having a set, outlined agenda ahead of time. When asked if the team has a set agenda, Beatrice explained, "Ben doesn't tell us. He gives us options of things, and then we can choose what we want to work on." During the meetings, Julia explains how the teachers participate and set the direction of the meeting, "We do most of the talking; they're just there to prompt us, especially as all three of us are new. Ben does a lot of talking in the beginning, and then we kind of go off on our own. He just listens." When asked about the routines and structures in place during the CLT meetings, Sarah shared,

> We just decide beforehand what our purpose is. That's just our agenda. We don't formally write out anything like that. The school, this year, has an online form so you decide which type of meeting you're having, whether it's a data meeting or a unit planning meeting. There's a form you have to fill out each time you meet."

Jon described how his CLT meetings were organized in terms of an agenda for the meeting,

> Ms. G had just asked, "Well what's up?" and went around to everybody and talked about things and when it got to Mr. P, he brought up the re-test idea, then it bloomed from there and it kind of just stayed there.

Esmeralda shared similarly,

> Typically there's a plan of some sort. Yesterday it was our big data analysis again. So typically she'll tell us you know this is what we're going to do. Sometimes she comes in with something in mind. Sometimes she'll come in and just say, so does anybody have any concerns kind of thing?

Teachers in this study reported that there was a general understanding of what would happen during a given CLT meeting, but there was no formal agenda.

Common assessments. All three CLTs discussed common assessments in some way. The sixth grade team at Chases Pond Middle School discussed how the common assessment will influence instruction. Heather shared, "We always do backward lesson planning. That's why, today, we started with the assessments, even though we didn't get to the specific day-to-day thing. I'll do that with my co-teacher. It's just so we know what they're going to have to know for our common assessments." In every interview, Sarah talked about the importance of common assessments. In the first interview, Sarah shared, "We start to make our assessment for the unit and work on our unit plan. The following meetings are looking at our data for common assessments and making common assessments." She went on to say, "Today we were adjusting our upcoming unit assessment. So we looked at the data from last year's SOLs for really how we did specifically on that topic and kind of adjusted some of the questions to assess things." When asked about what has been the most beneficial part of CLT meetings Sarah shared, "I think for me, the assessments because we completely tweaked everything and I think it's a lot, so much better this year. Which has then changed the way that I teach." Jon, on

the other hand, shared his dislike for discussing data from assessments, “When we don’t have an administrative thing going on where we have to share data or whatever it is, I hate doing that…It’s just boring." Likewise, Esmeralda shared,

> I feel sometimes at the beginning of the year we wasted too much time doing data. I feel this whole year is going to be that way, actually. It’s important to look at it. I feel that it’s something though we can analyze on our own. Sure then we do get to a point and we need to compare our subject matters though, so we do plan, we use the same tests. We don’t have to use the same quizzes, but we do use the same tests. So sometimes that’s good, not always.

All teams spent time during meeting talking about data from assessments, many of which are common assessments, but their reactions to those discussions were different. It is important to note that how teachers contribute to these discussions about common assessments was framed by the teachers’ perspective on how helpful data was to discuss and how it would impact their work in the classroom.

Teacher values. There were two emergent categories that comprise the theme of teacher values. Teacher values encompassed what teachers deem as a productive use of their time and to what extent the focus of the meeting was relevant and useful. Secondly, this theme included when teachers described how and in what ways they had a voice in the meeting.

Worthwhile and efficient meetings. Teachers from each team in this study wanted the CLT meetings to be productive so that at the end of the meeting, something meaningful had been accomplished. Teachers also shared a desire to do what needed to

be done in as short amount of time as possible. Sarah shared, “If this is our purpose, that’s what we do we sit down that’s what we do, we look at our data. There’s none of this extra fluff to it. This is what it is; it’s all about our teaching.” Sarah’s teammate, Zach shared similar views,

> Here’s what we’re working on, I’m gonna handle this; you handle that, partnership, collaborative work. I’ll do my stuff and we’ll be in the same room maybe, it doesn’t have to be, but sometimes it’s helpful and then hammer some stuff out. Meet back up real quick, let’s look, that looks good, let’s move forward and that’s it. I don’t think it needs to be a long drawn out meeting of how does it make you feel?

When Sarah was asked about what factors she attributes her team’s focus and ability to get work done, she shared, “Because we like efficiency and value our time.” It is important to note that the two teachers interviewed on the eighth grade team at CPMS felt similarly about the focus and productivity of the meetings. Because this team was in its beginning stages compared to the eighth grade CLT at CPMS, the teachers from the sixth grade team at CPMS shared their desire for their meetings to be more efficient—the teachers described what they are striving for in meetings. Beatrice explained, “I would like to get more done in one meeting because I always feel like there’s so much we have to do and there’s just not enough planning time for all of us between meetings and such. I think we’re getting better at using our time more efficiently.” Because there are multiple content areas covered in the CLT meetings at HMS, Esmeralda shared her frustration with not having enough time to be productive during shorter, impromptu meetings, “So,

you feel pressure for time and thus you're not as productive. You're making quick decisions and it's not good."

The teachers on the CLT teams in this study also wanted the meeting to be relevant to their needs. The teachers wanted to find value in the work that was done during the CLT. In regard to making a CLT meeting productive, Sarah's recommendation to a team starting their work as a CLT was "just to have a focus on what you're going in there for because I've also sat in meetings where okay, yeah we're going to plan, but nothing gets done because it's just chaos. So to have a specific purpose, this is what we're doing, let's just get it done." Later in the same interview, she included, "I think it just takes awhile to get the hang of managing your time and really knowing what your purpose needs to be." When Heather was asked about how the CLT meetings impacted her work in her classroom, she shared,

> Yes they are a good structure because I can sit down with someone. Beatrice and I are new and Ben and Ms. P are experienced, we can really sit down with them and just talk. Even my co-teacher is a first year teacher. I don't even really have someone that I'm planning with for our daily stuff that's really experienced.

Jon shared similar experiences that he appreciates learning from his more experienced colleagues, "It's when we share those type of strategies [that is the most beneficial aspect of the meetings]." All teachers reported that they wanted meetings that were productive and relevant to their work in the classroom.

Voice in meeting. All seven teachers from all three CLTs shared their experiences contributing to the meetings, sharing their perspectives and asking questions. All three

novice teachers from Chases Pond Middle School shared about their participation in the meetings. Heather said, "Normally, if I just have any good ideas, I just throw them out there. I try to participate a lot." Julia shared,

> Basically, we all are kind of equal. We split up who makes the common assessments; usually we have three so it's easy…what impacts it is probably how much I've looked over the unit and what I know. For this unit, I was pretty familiar, because I've already started to look at the transfer task, so I think I made more contribution today than the last one. I was just starting to look at the unit then. I think that impacts it the most.

Beatrice explained, "We all equally, I feel, do the same thing…we all participate and share our ideas of what we want to do." Jon shared similar experiences about participation in the meetings, "Everybody knows everybody very well and there's no fear of speaking your mind… We've agreed to disagree a number of times." Both teams at CPMS have four teachers on the team and as Sarah noted the size of the team influences the work of the team. One factor that both Zach and Sarah attributed to the efficiency and direction of their meeting is the number of teachers on their team. Sarah shared, "Four people is good. You get any more than that and it starts to get a little too big." There were similarities and differences among the teams – and differences in perceptions about some of the similarities. As noted by Guskey (2002), most professional development programs or innovations will not be implemented uniformly. Because of a variety of factors, the teams, even at the same school, functioned differently and had different

outcomes. In the next section, the differences between teams and among teams will be explored.

Unique characteristics of each team. Characteristics that were distinct to the sixth grade CLT at Chases Pond Middle School included that both classroom teachers were first year teachers, and all three teachers interviewed in this study were first year teachers. This was the only CLT that was facilitated by a person with a mathematics background who was not a classroom teacher at the time. The characteristics that were distinct to eighth grade CLT at CPMS included having the instructional coach as a math resource when the team wanted additional support. This team was the only one that self-facilitated. Also, the two teachers interviewed for this study had both been teaching five years and had been on the same team together for three years. The third CLT is in this study had several characteristics that were unique. First, the eighth grade CLT at Harris Middle School included having the principal as the facilitator. This group had seven teachers who participated in the CLT (Jon taught only algebra, Esmeralda taught algebra and geometry, three teachers who taught pre-algebra, and one special education teacher and one gifted education teacher). The eighth grade CLT at HMS also was the only group who focused on more than one content area during the meetings (pre-algebra and algebra). This CLT also was the only team that met outside of the school day; all of the teachers came in before school on Thursdays to meet (this was a decision made by the team in the previous school year).

There were some similarities between two of the teams in this study. The two CLTs at Chases Pond Middle School included a focus of only one content area (6^{th} grade

honors math for the 6th grade team and algebra for the 8th grade team). Further, there were four teachers (two general education teachers, one special education teacher and one ELL teacher) on the team. Both of these teams have access to an instructional coach who has a background in mathematics. Both of these teams met at the same time every Monday. The commonalities between the two eighth grade CLTs include discussions that are focused on common assessments and/or other assessment data. There are also experienced teachers on both of these teams. The commonalities between the 6th grade CLT at Chases Pond and the 8th grade CLT at Harris included that both teams have novice teachers on their team.

Collaborative learning teams can serve as a form of job-embedded professional development. The subsequent section is organized by research question and there were many themes that overlap among research questions. The following sections present a discussion of results by research questions where the factors that influence perceptions of effective CLTS, by novice and experienced teachers, are presented.

Discussion of Results by Research Questions

The four research questions that guided this study explored to what extent CLTs delved into mathematics during their team meetings and what teachers perceive as effective components of a CLT. For this first research question, *How do CLT meetings influence middle school math teachers to explore the nature of the mathematics content and pedagogy?* the analysis was done by team. For the three remaining research questions, which focused on the differences between novice and experienced teachers, the analysis was separated by these two groups.

Research Question 1

How do CLT meetings influence middle school math teachers to explore the nature of the mathematics content and pedagogy? There were many factors that influenced how the time during CLT meetings was used and to what extent mathematics was explored and discussed. These factors included teacher need and input, administrative initiatives, district requirements and other issues that may come up that need immediate attention. During the interviews, the teachers shared their experiences about exploring mathematics content and pedagogy. There were two themes that emerged to address how teachers in this study talked about mathematics during their CLT meetings. The first theme was how teachers described planning and the role of planning during their meetings. The second theme was how the teachers described the process of creating and using common assessments during their meetings to drive data discussions. The extent to which teams did math during the meeting will be addressed; this was only present in the sixth grade CLT at Chases Pond Middle School.

Teachers in this study explored content of mathematics with the focus on planning which includes "working backwards" and secondly the data discussions generally focused on common assessments. Planning can refer to both day to day planning as well as long-term, unit planning. Working backwards refers to planning with the end of the unit in mind and considering what students will know and be able to do by the end of a given unit. Data discussions occur when teachers reflect on data from assessments (may or may not be common assessments). Common assessments encompassed any sort of formative or summative assessment that was used by different teachers.

Planning. Exploring the mathematics content and pedagogy surfaced in the interviews in the planning aspect of the meetings. To be able to plan, the content focus of the meeting directly impacts if planning can be done during the planning meeting. At Chases Pond Middle School, the sixth grade team and the eighth grade team each had one content focus each; the sixth grade teachers only taught honors math-6 while the eighth grade teachers only taught algebra I. At Harris Middle School, the teachers in the meetings taught different subjects (pre-algebra, algebra I, and geometry). Esmeralda explained one reason that the CLT meetings are not effective, "I feel we need a separate PLC for our subject matter [algebra]." Esmeralda said, "Ideally, we'd use the time to plan." She also explained that

> I really purposefully plan and pick every problem that I do…I think it would help the younger teachers too, or the less experienced teachers. I can be willing to share that to the less experienced teachers, but when do I do that? You know, it's like too late. Oh, I taught that lesson yesterday. Oh, if I'd known I would have.

It is important to note that Esmeralda mentioned, multiple times during each interview, her desire to spend time planning with teachers who teach the same content. Because her CLT addressed multiple content areas, she described this as a barrier to feeling value in the meetings.

During CLT meetings at Chases Pond Middle School, the teachers talked about planning and Sarah explained that their discussions included ideas for "how we can incorporate more manipulative and more hands-on activities…we also make sure that we are showing all representations: graphically, algebraically…" When asked about a

connection between what happened during the meeting and what happens in his classes, Zach shared,

> What's happening in class is the end product of what we've planned out for in the meeting. When I say planning, it's not just the planning of the lesson, but it's planning of a test, looking at the state curriculum guides, looking at the district curriculum guides, finding the commonalities, and finding things that still need to be addressed that may not be in the district curriculum guides. Making sure all of that is included in creating our lessons. I would say here is the end result of all the work we did on the front end.

Another aspect of working backwards was when the sixth grade team at Chases Pond Middle School started looking at the transfer task for a unit before they started teaching the unit. When the teachers reflected upon their team meeting during the second interview, Heather, Beatrice, and Julia all explained how the team decided to redesign the transfer task. As Julia said, the team agreed that the current transfer task, "just didn't make sense and it was hard for us to understand it, let alone the kids." She continued, "We decided we didn't like it and we changed it." The team then decided to create a new transfer task. Beatrice explained that the team "pulled together resources for a new transfer task." She continued that we wanted a "transfer task that was more student-friendly." The team then used books that the facilitator suggested to explore alternative transfer tasks. Heather explained that "Ben had us solve it and [explain] how we would do it." All three teachers described the time recreating the transfer task as valuable and a "good use of time." Heather explained that "we all agreed upon the change [creating a

new transfer task]. Julia shared that the most beneficial part of the meeting was "agreeing to change the transfer task and working together." Heather echoed those same thoughts: "the most beneficial part of the meeting was getting a new transfer task and having everyone agree [on that task]." The discussions about doing mathematics while revising the transfer task were reflected on positively by the team of sixth grade teachers. The teachers on the sixth grade team were the only teachers to talk about doing mathematics during a team meeting.

For Beatrice on the sixth grade team, the planning that occurred was one of the most beneficial aspects of the CLT meeting. She shared,

> I like spending the time on planning how we're going to teach the stuff, so that we're on the same page and that we're following the state standards and the [district] curriculum guides, so that we're not just each figuring it out on our own. We're all collaborating and all on the same page.

Julia shared similar feelings towards how time was spent during CLT meetings,

> Specifically I think just meeting all together as a math team to get on the same page of what exactly what exactly we're supposed to be teaching, how we're going to do it, and what strategies we're going to use to have the kids grasp the concepts.

The day of the final interview at CPMS, the CLT meetings were unexpectedly postponed due to another meeting. When asked about this change, Heather shared,

> I would have rather liked to have the CLT meeting because I feel like I have so much to start planning for the next unit and it's nice when we can sit down and kind of get all of our ideas together, but it didn't happen.

The planning that occurs on the eighth grade team at CPMS was selected by the teachers on that team. Sarah and Zach informally talk periodically throughout the day and week about what they want to do during their formal meeting on Mondays. During the second interview Zach explained how he and Sarah informally determine the meeting's focus, "we had already touched base, so we had an agenda in mind." Sarah explained,

> Now administration and our coaches trust us enough to know that…our team goes in, has a purpose and gets done what we set out to do. I don't think every group's there yet, so they still feel it, but we had to show them that they can trust us and now they do, so we get to do our thing and move on.

During their meetings, Zach and Sarah determined what they want to get accomplished and how they would spend the time during their regularly scheduled Monday meeting. In terms of planning ahead, Zach and Sarah talked about "entry points" for math tasks. Entry points will be defined as the point where a student begins working on a task. Zach explained,

> We discuss the different entry points because even with them, each teacher would have different classes that would have different ones. We both might have those different entry points, but just because of the fact that my co-time class might need one and her ELL class might use a different style. Then a lot of times also it's like bringing back some of those how are we going to get us to higher order?

> This is procedural knowledge, but eventually how could it lead to higher order thinking?

The teachers from CPMS described that they enjoyed the time during the meeting where the teachers could plan together and talk about the data from common assessments.

The teachers on the eighth grade CLT at HMS taught different subjects so there was little opportunity to talk specifically about planning day-to-day lessons or even common assessments. The discussions were focused on general strategies. Jon shared that "Everybody's just generically sharing strategies as opposed to talking specifically about how are we going to be able to get them to subtract negative numbers." During the second interview Esmeralda shared,

> Yesterday and probably last week, it was more about strategies. You know how we can get this student to do this better, and we can get that, you know and so on. One of the things we recently did and it was part of a PLC conversation. The Special Ed teacher in the building just feels she needs some extra support in the classroom…So I said I'm going to send some students over to you. You know, we'll see how it goes. So I think that that was two weeks ago that we had discussed that so helping her and working with those kids. I know another thing came up yesterday and it was more of a strategy, teaching strategy, instructional strategies.

At HMS, the teachers described how there were no opportunities to plan specific lessons because the meetings were structured as a group discussion around general strategies for

planning and classroom management. Planning was one aspect of mathematics that was explored during CLT meetings; the other aspect was discussions around data.

Data Discussions. In addition to planning, the teams reported and described how they created and utilized common assessment to drive their data discussions. Data discussions based on formative and summative assessments were addressed by each teacher in at least one interview. Some teachers found value in discussion the data, while others did not find value in these discussions. Further, the sixth grade team at CPMS has just scratched the surface of data discussions about common assessments.

The teachers on the eighth grade team at CPMS described how they enjoyed talking about data analysis and using data to influence instruction. When asked about what she liked spending her time doing during CLT meetings, Sarah explained, "The data and the assessments. Just making up the new assessments because we really have a different focus this year on making them more, thinking about different ways we can assess things instead of the same old way." Sarah continued,

> We looked at the data from the SOLS from last year. I do the data for the school, so I broke it down by every question. How the school did as a whole and how each teacher did as a whole on that specific question and the descriptions of the question and how they were worded. So if our assessment, if we thought our kids got it, but they bombed it, then maybe we should look just not at our teaching, but the way we assessed it too. So are we really assessing what the state is asking us to teach?

Zach explained that all the major assessments given to the eighth grade students are common assessments, "for every quiz and unit test…we are creating them together. They are common assessments and then we'll come back once everybody in the party has theirs graded, and so then we'll be able to compare them." Both eighth grade teams in this study talked about using data from assessments to determine next steps for instruction.

The eighth grade team at HMS reflected on the data from end-of-quarter assessments. Because the teachers teach different subjects, the data shared was from different assessments. When asked about data discussions, Jon explained that he doesn't enjoy

> Doing that…We have six of us and when one person shares data, the rest of us are just sitting there while she's sharing data until she starts talking about the reasons for the data. Then we can get into it, but while the data's being shared what is there for me to do, except just sit there, which is why I don't like it.

When asked about opportunities to share data, Beatrice, at CPMS, shared, "we have sometimes, but the past few times I feel like we have not. Just because we would have rather focused on the upcoming stuff, so better our teaching for the future rather than focus on the past." When sharing her reflections from the CLT meeting focused on data sharing, Esmeralda said, "when there was two minutes left, I started sharing my data…We get off on tangents now and then" so time was quite limited for her to share her data. Esmeralda explained,

> Ms. G (the facilitator) is aware of other things I think that need to be said there's just only so much time in the day. She's got to use this meeting to get her data gathered, so that she can go to her next meeting. There's a lot of pressure put on her as well at the next level.

The time devoted to discussion of the data from assessments was limited when there were different subjects covered at the same meeting like the CLT at HMS. Likewise the data being shared at this meeting was different for the teachers because the students were enrolled in different classes.

As the next three research questions are explored, the similarities and differences will be discussed regarding the perceptions of the novice teachers and the experienced teachers as teachers described factors that influenced effective CLTs and CLT meetings. The next research question focuses on the perceptions of the novice teachers.

Research Question 2

What are the perceptions of novice teachers' in terms of effective components of their CLT? There were four themes that emerged that influenced novice teachers' perceptions of what makes a CLT effective: (a) to what extent teachers feel a part of a community, (b) how teachers feel a sense of empowerment, (c) how the time during the meeting is used and what makes it "productive" and (d) to what extent that work during a CLT meeting influenced what happens in the teacher's classroom.

Community. A CLT provides a structure for teachers to meet together. This was especially important for novice teachers because they have less experience teaching and collaborating with others than the experienced teachers. The emergent categories

embedded in this theme of to what extent teachers feel a part of a community include "belonging," "working together," "learning together," and "support." All four novice teachers talked about their work as a group of collaborators, as a group of teachers, and as a group of learners. Dalgarno and Colgan (2007) noted that a community of practice can be a powerful means of professional development because it promotes sharing ideas and quality resources, it offers a way of communicating and reflecting with others who teach the same grade/content and it may prevent feelings of isolation. To what extent teachers feel a part of a community impacts their work with students. All four novice teachers shared experiences about working together to improve instruction or make collaborative work more efficient. These teachers worked together and described how they learned from each other. In her first interview, Julia shared,

> I think it's a good idea to know exactly what's working for your students and what's not. Also, like Beatrice, who has totally different kids and sometimes does different kinds of lessons than we do, sometimes we'll be like, this didn't work for us. What worked for you teaching this? I think that's really good to collaborate on. It's also good to make common assessments together…it's easier and takes less time.

Julia also noted, "I like how we're all coming together, discussing each individual student and their progress, and making interventions based on that." When Beatrice was asked if CLT meeting were optional, she explained, "Especially with all of us being new teachers, we're constantly collaborating and working together anyway. It would happen by default." Both classroom teachers at Chases Pond Middle School, Beatrice and Heather,

spoke about experiences with sharing work and collaborating with each other. Heather commented, “Just realizing that if I have to do make up everything on my own then it’s like a million times more work than if I have somebody doing half of it and me doing the other half of it.” When asked about what was on her mind after the meeting was over, Beatrice shared,

> I hope we can all get done our sections of our work quickly because then we always send it back to each other and proofread to make sure it’s okay. So, if we could all get them done quickly then we’ll have everything finalized more quickly.

None of the novice teachers at Chases Pond Middle School made direct comments about their relationships or perceptions of other people on their team. However, in his first and last interview, Jon explained that, “there is a great synergy among the group; there really is.” Through their comments about working together, collaborating and learning from each other, these novice teachers described feeling a sense of comfort being a part of a team where the work could be divided or teachers would collaborate on tasks.

Empowerment. A CLT provides a structure for teachers to discuss what they are teaching, how they are teaching, and why they are teaching what they are teaching. This is especially important for novice teachers to have a forum for learning from others as well as being able to contribute to the team. The emergent categories embedded in this theme of to how teachers feel a sense of empowerment include “contribution”, “agree to disagree”, “different perspectives” and “different strengths.” The novice teachers in this

study shared their experiences in regards to how the work they did during the CLT meetings gave them a sense of feeling empowered.

The sixth grade CLT at CPMS spent one CLT meeting doing, agreeing to discard, and revising a "transfer task." As described by Beatrice, a transfer task "is basically one giant application problem that incorporates different topics from that unit that students have." All three teachers on this team reflected upon this experience. Heather said, "Basically what we ended up realizing was that we looked at the transfer task that the curriculum people gave us and we decided to scrap it completely, pick a new task for our kids to do, which is a million times better. I just said, "Can we do something different?" and Ben was like, "Yes"." Heather elaborated, "We give him [Ben] our ideas and he's like, yeah we can do that because I didn't realize that we could like completely change the transfer task." Julia shared,

> We decided we wanted to do the transfer task because we had all previously looked at it and were kind of worried about it….we all read it and we all basically said, "Does this make sense to you?" … So, we asked him what he thought of the transfer task and he thought the same thing as us. So, then he gave us the go ahead to change it.

Beatrice echoed similarly after the group had decided to revise the transfer task, "We looked at what the unit was about and then we looked at some other resources to try to pull different questions that were worded differently, more student friendly."

In terms of participating and being able to contribute to the discussion during the CLT meetings, all four novice teachers said that they felt comfortable speaking up in the group and sharing ideas. Jon, who is in his second year of teaching, said,

> Absolutely, I do feel like I have a voice. I do share. However, I'm kind of judicious. Like I said, I'm kind of the quiet one, partly because, well especially last year, I just didn't know enough yet to be able to share too much. This year I feel like I'm sharing more, because I know more. I know things that I can contribute.

On the sixth grade team at CPMS, three out of four of the teachers are in their first year of teaching. All three novice teachers said they were comfortable talking in the group and sharing ideas. Julia, the special education teacher, shared, "Some people are really good at the math part, and some people are really good at the strategies, so it's nice to all come together and collaborate on it." It is important to note that the novice teachers in study described feeling comfortable talking and asking questions during team meetings. The teachers also recognized the insight that different teachers brought to the team.

Productive CLT Meetings. Another theme for the novice teachers' perceptions of effective CLT meeting was how the time during a CLT meeting was spent. The two emergent categories were organization and the focus for a meeting. All four novice teachers shared their experiences about how the meetings were organized and what content was discussed during the CLT meeting.

Organization. At Chases Pond Middle School, all three novice teachers shared their experiences during the CLT meetings and what made the meetings a "good use of

time." Ben facilitated these meetings and all three teachers explained how that impacted the structure, agenda, or direction of the meeting. Beatrice shared

> Ben brings a plan to what we're going to be doing for that meeting time. We don't have to follow exactly what he wants to do, but him coming with that suggestion or offering suggestions to us when we're stuck. Since we're new teachers we're new to how things should look and how they should sound. So he's good at offering suggestions.

During the second interview, Beatrice reiterated this, "I think it's been really good that Ben has been there to direct us." When asked what works well about meetings, Heather shared that she appreciated a plan for the meetings, "Starting with an agenda and knowing exactly what we're going to do for the day helps us figure out what needs to get done quickly." Both Beatrice and Julia echoed similar comments about wanting to increase efficiency during the meeting. During her final interview Beatrice said,

> I feel like we've been more productive. I think we've doing more things like how we're going to teach the material and I think we've been looking further ahead into what concepts we want to emphasize and which ways we want to emphasize those concepts. Like dealing more with the content and also the forms that we have to fill out for our CLT, they were kind of altered a little bit, so that we had less busy work to do and more stuff to get to the point to help us teach.

When she was asked about how things may change later in the year, Julia shared, "I think maybe being more experienced at it, so the meetings would go a lot quicker. We'd know exactly what needed to get done. We'd have a much quicker time and be more efficient

at it." Beatrice echoed similarly, "I think eventually we're going to become more efficient… we did transfer tasks one meeting, planning another meeting, unit plan another meeting. I think eventually we'll be able to get more of that stuff done in one meeting."

In terms of timing of the meetings, Beatrice shared, "I feel like there's not enough time. That's by no one's fault other than the length of the period." Likewise often duties are divided up for teachers to work on outside of the meeting. When asked about how one meeting ended Beatrice explained, "So we decided at the meeting that we would break up the duties, since we didn't get to do everything that we wanted during the CLT." At HMS, Jon also shared about what his experiences with meetings when asked about how meetings come to a close, "Otherwise there's no other real closure. Usually I know I'm trying to run away because the bell, that means the students are coming in the door. The meetings do really run long." Further, at HMS, Jon describes the organization of the meeting as a "round table discussion." He continued, "It's becoming more going from person to person to person." The organization of CLT meetings influenced how novice teachers perceived the effectiveness of the meeting.

Meeting focus. The focus of any meeting varied in both CLTs in which novice teachers attended. The meeting focus/agenda included some or all of the following: planning, creating common assessments, reviewing data, or other directives from the facilitator or administration of the building. For some meetings, teaches reported that there was a clear focus ahead of time for the meeting. Other times, the focus, as determined by the facilitator, was shared with the teachers at the beginning of the meeting. Heather reflected upon one CLT meeting and why she felt it was productive,

> I remember we had this one CLT meeting where all we did was talk about was the transfer task at the end of the unit. We totally restructured it, which was totally productive because we were all there together restructuring the transfer task.

When Heather was asked about she would like to spend the time during the CLT meeting for the remainder of the year, she explained, "I want to keep working on the planning aspect. I would also like us to get better about…common assessments that we're going to do… but we never seem to be all ready to compare data at once." Julia shared "I think Ben does a really good job, because he knows a lot about math. I think he has a lot of good strategies to use and ideas of how to teach the lesson."When asked about what mathematics the teachers do during the CLT meeting, Julia shared,

> We haven't yet, but I think that's a good idea. We're going to start, because we made a common assessment, a quiz, and we didn't actually go through it together. We found out it was pretty long for the students, so it would have been a good idea to actually go through and see how long it would take.

Often novice teachers would benefit from a common understanding in terms of many facets of teaching and the content, and as Hiebert and Morris (2009) noted, the absence of a shared knowledge base for teacher education forces new teacher educators to start from scratch when they begin teaching. The CLT was a structure for teachers, especially the novice teachers, in which they had a built-in forum for collaboration and job-embedded professional development.

The content focus for the CLT at HMS was split between pre-algebra and algebra. In the first interview, Jon shared, "The content focus is definitely a pre-algebra centric.

That's for sure. That really doesn't benefit me." In his second interview, when asked about the focus for the meetings recently Jon shared, "over the past few weeks that the meetings are going to more of a round table discussion. That's beneficial for me because it's not content specific. It's mainly classroom management stuff, the more I think about it." And in his final interview, Jon shared,

> It [the CLT meetings] started out very much pre-algebra centric and it's gradually moved its way over to where everybody's just generically sharing strategies as opposed to talking specifically…I'm really happy with where we're getting to right now. I don't think it would be fair for it to slide more towards algebra. I would like it to stay more generic.

The structure and meeting focus influenced to what extent the teachers felt the meeting was productive. Often times, the facilitator was the person who decided the agenda or meeting focus, however, when the teachers had input in the meeting focus, the teachers reported that they found the meetings more productive. The final theme, connection to the classroom, which emerged from the data addressing this research question will be addressed in the next section.

Connection to the Classroom.

The final theme to emerge out of the data from the novice teachers was to what extent the teachers described a connection of the work during CLT meetings to the teachers' work in the classroom. All four novice teachers shared their experiences demonstrating to what extent there was an impact or connection to what happened in their classroom.

> Heather shared "wanting to get things done during the meeting." She elaborated, Things that I'm going to use in my classroom. Today, we got done with the assessments that I'm going to be using in my classroom. We don't do so much day-to-day stuff, but when we look at data, I guess the point is to figure out how we're going to do interventions. If we create interventions to help our students, then that will feel like I got stuff done. When it's actually being used in my classroom, that's when I feel like it's important.

Heather also shared how the work of the team on assessments directly relates to what happens in her classroom,

> When we create our three assessments that we're going to use throughout the unit that helps me. I have to know what I'm teaching to for these assessments. We always talk about working backwards, or backwards planning. I know I'm going to give my kids this on this day, so I need to make sure they understand such and such so they're ready for it, which helps me a lot.

Beatrice described the relevance of CLT meetings to her work with students,

> Lately more because the stuff that we've been planning during the CLT is exactly pretty much what we do then in class. Whereas before when we were doing more of the busy work type stuff, like the unit planner and such I feel like that was more of a formality, but we weren't talking about the little, nitty gritty details of how we were going to teach it. So lately I feel that it's more directly impacted.

For Julia, she noted the impact in her classroom in relation to how Ben supports the teachers, "He gives us a lot of ideas of how to teach it. Like a lot of manipulatives or

activities. He gives us a lot of higher level thinking questions." Jon shared similar experiences with what he found impacted his work in the classroom, "I've actually tried to use some of the strategies that I've heard from the other teachers." And when asked about how the work in the CLT relates to his work in the classroom, Jon shared in his final interview, "There is now, more now this year than there was last year." Jon also noted in his final interview that, "I like the direction that the PLC is going. It seems to be this year less about county meetings and department meetings and essentially it's more geared discussing what's going on in everybody's classroom. I can pick up things, just by listening."

To conclude, all four novice teachers shared experiences with their CLTs that influenced their work in a positive way, as well as areas that they would like change. All four teachers reported that the meetings were a good use of their time in general. There were aspects of the meeting that they preferred, but, in general, the meetings were a good use of their time and they shared why the felt that their time was valued.

Research Question 3

What are the perceptions of novice teachers in terms of effective components of their CLT? There were three themes that emerged in the data that influenced experienced teachers' perceptions of what makes a CLT effective. The three themes were as follows: (1) how teachers described to what extent they have ownership in the work and how teachers described how much time during the meeting is spent working on specific tasks and (2) how teachers described to what extent that work during a CLT meeting influences

what happens in the teacher's classroom, and (3) how the work of the CLT impacts overall growth in a teacher's practice.

Ownership. The theme of ownership entails teachers being able to determine the direction, agenda, and outcomes for the meeting. The experienced teachers described how and to what extent they influenced the direction and outcomes of the meeting. One clear difference between the two CLTs with experienced teachers was how many subjects that they explored during the meetings; at CPMS, algebra was the only focus while at HMS, both pre-algebra and algebra were explored. Both Sarah and Zach shared examples of being able to determine the agenda and determine how the time was spent during the meeting. In the initial interview, Sarah shared,

> As an eighth grade team, we've always worked well together, so we kind of took charge of our meetings. We get to work, we have a plan, and it's a good experience because we kind of know what we want to get accomplished.

Zach shared his experiences about how he and Sarah determine what will be done during the meeting,

> We set those things [agenda items] and prioritize them amongst ourselves casually, and when we get there [to the meeting], we do them. It's rare that we get there and say, hey, what do you guys want to do? We've talked so many times throughout the day, every day. We usually have an idea of what priority for that meeting leading up to it already.

During the second interview, Zach shared what the team did after they postponed the common assessment data discussion,

> So we decided to use the time to complete our unit test. We already had a unit test made from the beginning when we first started writing our unit plan, but then we wanted to modify it based on things that we'd taught in addition and things that weren't such a focus. So today during the meeting we spent time just sitting there and working and just kind of looking at the questions.

In every interview with Esmeralda, she reflected on her meetings and shared that she wanted more planning time during her meetings. In her first interview, when talking about the general purposes of the CLT meetings, she shared,

> The past five years has been working with PLCs and I think it's very helpful in many ways. I wish everybody did it the way we did it; we are weekly touching base with our grade level partners to discuss any issues we're having with teaching and with students. It allows us to work together to create similar tasks, and the resources that you're getting from your other peers helps your pace and makes sure you're taking at the same pace and the same things.

During the subsequent interviews, Esmeralda elaborated on the idea that this collaboration and planning was not happening in her current CLT meetings although that was what she really wanted to see. During her second interview she explained,

> So, I wish we spent less time doing data analysis and more time doing planning on our specific subject and not just planning what we're going to teach, how to teach it. You know what's the best strategy for this particular objective? And what are you going to do here to review and if this doesn't go well, how could we look at it a different way?

In her final interview she reiterated those ideas, “I’d really rather have my PLC be a planning rather than a discussion group.” The challenge that Esmeralda faced was clear: the meeting focus did not address her needs because she taught a different subject that the majority of the teachers.

Connection to the classroom. The experienced teachers in this study described to what extent the work during a CLT meeting influences what happens in their classroom. Sarah, Zach, and Esmeralda shared the importance of being able to accomplish specific work during their CLT meetings. The work included reflecting on data from a common assessment, sharing data on specific groups of students of interest to the administrator, creating or modifying common assessments, creating or modifying lesson plans, or sharing strategies. Because Sarah and Zach determined the agenda for their meetings, they were able to use that time for work time to revise or create assessments as well as to discuss planning.

One challenge to using the time during the CLT meeting to work is, as Esmeralda shared,

> The only thing I wish we could do that we can’t, just because there’s only so much time in a day, is when we need, as the eighth grade PLC, that’s including my PLC, the algebra, and the pre-algebra. You’re actually covering three different subject matters and you don’t get to talk about all the subject matters in one PLC.

All three experienced teachers discussed and reflected on the importance of having time during the meeting to get work accomplished. This time during meetings to accomplish

work directly impacted the teachers' perceptions of how the work in their CLT influenced work in the classroom. When asked if the work in the CLT meetings impacted their classroom, Sarah and Zach said yes. When asked if there was a connection between what happens in the CLT meetings and what happens in her classroom, Sarah shared, "I say it does, especially with the assessments." Zach shared similar thoughts, "Usually what's happening in class is the end product of what we've planned out for in the meeting….I would say here is the end result of all the work we did on the front end." On the flipside, when asked if the work in the CLT meetings impacted the work in her classroom, Esmeralda shared,

> I don't think as much as we'd want it to be. There can be. One time we were talking about getting the kids to write more. Truly writing and reflecting themselves, so it was like 'oh I'm going to change up my exit slip today'. You know not always directly affecting my classroom, but does have some impact I guess. It's not going to totally change a majority of what I do, probably just bits and pieces I suppose.

To conclude, all teachers wanted to see a connection from the CLT meetings to what happened in their classroom. For the team that only had one content focus, those teachers saw a direct connection from meeting to classroom. For the team where there was more than one subject focus, the connection was not clear.

Developing Teaching Practice. The three experienced teachers described how the work of the CLT impacts overall growth in a teacher's practice. When Sarah reflected on how the meetings impacted her work as a teacher, she shared, "I think for

me, the assessments because we completely tweaked everything and I think it's a lot, so much better this year. Which has then changed the way that I teach." Likewise, Esmeralda, who has been teaching for nineteen years, described how she wanted to continue to improve her practice as a teacher,

> I've been teaching almost 20 years now. Like I said, it's not the perfect world, but it's not terrible because I am the kind of person that will walk away thinking about something that was said…I'm glad we have them, as much as I may have been critical about it. I think it is needed. I think it's important otherwise you're going to have teachers just going off and doing their own thing and never having a clue what's going on within the department, so I think it's important to kind of provide an opportunity for everybody to be together.

The experienced teachers in this study described how the focus and work of the CLT impacted their work as a teacher and to what extent they developed their practice as a result of working with their colleagues. It is important to note that all three teachers wanted to make the most of the meetings and were invested in the work of the group. For Sarah and Zach, their team focused only on one subject so all of their time was devoted to algebra content. Esmeralda described how frustrating it was for her to be in a CLT that did not focus a subject that she taught. In the following section, the differences between novice teachers' perceptions and experiences teachers' perceptions are explored in the next section.

Research Question 4

How does teaching experience influence perception of effective CLTs? There were a variety of factors that influenced a teacher's perceptions of what makes a CLT effective. In this qualitative study, there were elements distinguishable by years of teaching experience. In addition the differences between novice and experienced teachers' perceptions were explored. This section is organized around three comparisons: (a) how teachers described the way the interpersonal nature and interactions among the members of the CLT influenced the collective work and the perceptions of being *effective*, (b) how teachers described the way the logistics and structure of meeting and how these influenced the collective work and the perceptions of being *effective*, and (c) how teachers described the way the focus of the meetings and how this influenced the collective work and the perceptions of being *effective.*

Interpersonal. The interpersonal theme included emergent categories such as peer interaction, talent of the team, and role of facilitator. The various ways in which teachers interacted with each other was explored. Teachers described how they related to each other professionally and personally, what influenced their participation with their peers, and how the facilitator impacted their perceptions of the meeting.

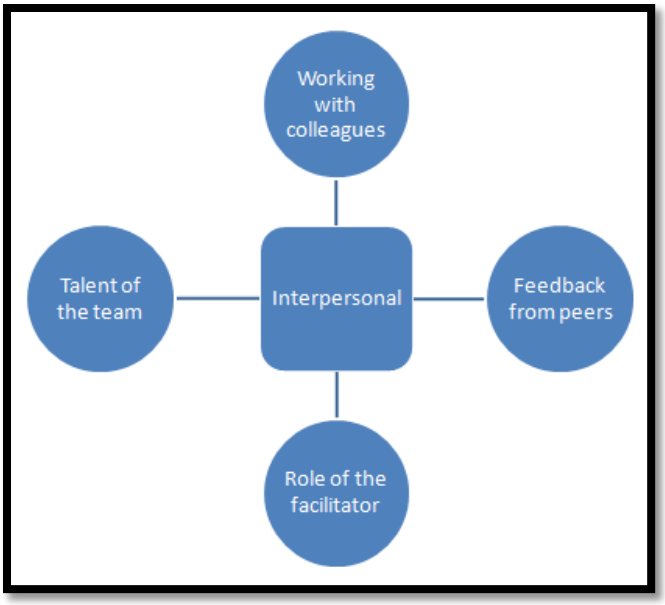

Figure 2. This figure represents how teachers described the ways the interpersonal nature and interactions among the members of the CLT influence the collective work and the perceptions of being effective.

Working with colleagues. Novice and experienced teachers described how they enjoyed working with the other teachers on the team. In his first interview, when asked about his favorite aspect of the meeting, Zach said, "It's people that I work with, and I like them as people." During his second interview, when asked about what else was discussed in the meeting Zach shared, "I mean there's always like just fun banter and chatter, but that's more just 'because we're friends too, you know, but I wouldn't say that it was like a distraction or anything..." When Sarah was asked about her favorite aspect about the meetings, she shared, "The people there. We work well together." Likewise Jon, in his first interview, shared, "There is a great synergy among the group; there really is. I've been to meetings and I've run a lot of meetings where there wasn't that. People would argue and bicker…Here, that's not the case." The similarities of what contributed

to an effective CLT for both novice and experienced teachers included the working with colleagues.

Talent of the team. A second similarity was that both novice and experienced teachers described how they perceived the talent of the team and how that influenced effectiveness of the CLT. Novice teachers looked to the experienced educators for ideas and suggestions, and the experienced teachers recognized the power of collaborating and sharing ideas. The CLT also offered teachers a format to hear what other teachers were doing in their classrooms, as well as the successes and challenges they were having. Julia shared,

> I think it helps a lot in the fact that we can bounce ideas off of each other. For example if Beatrice tried one method and it works and our method doesn't, we often try her method or the other way around, when we talk about that in the meetings.

When Jon described an ideal CLT meeting he shared that teachers would, "bring issues, share with the group, we get ideas from everybody or share ideas with everybody." Similarly, Esmeralda shared,

> I think it's good for new teachers because it's an opportunity for them to hear from other adults what's going on and that my life isn't so terrible in the classroom. There are experienced teachers; they're having the same issues. So I think it's good, it helps give them a peace of mind that we all went through this at some point in time. It forces them to have an opportunity to collaborate with others and I think it's important, I think it's good for new teachers.

Two similarities of what contributed to an effective CLT for both novice and experienced teachers included the opportunity to work with colleagues who teach the same subject and recognizing the talent of team.

Within the emergent category of talent of the team were two different perspectives from the teachers. The novice teachers were looking for direction from their more experienced colleagues while the experienced teachers recognized their ability to problem solve and work together. When asked to describe her ideal CLT meeting, Heather shared, "You would come in, someone has created the agenda, Ben in our case…you just do the agenda. You're happy because you've gotten stuff done." Julia also shared, "Ben gave us a lot of good ideas of stuff he's used in the past. We look through a lot of books. We just bounce ideas off of each other of what we've used in the past." On the other hand, the experienced group noted the collective knowledge within the group and how they contributed to that. Sarah shared how her team talks about data, "if we thought our kids got it, but they bombed it, then maybe we should look just not at our teaching, but the way we assessed it too. So are we really assessing what the state is asking us to teach?" Esmeralda shared, "I always like hearing other's ideas and the way things are done." During a CLT meeting in which teachers discussed ideas for supporting students' understanding of the mathematics, Esmeralda also included, "How can we encourage them to do better the next time? Because that came up too, one of the other teachers had to re-quiz her kids because they just bombed this quiz. So what strategies did she use so that when they took the quiz the next time, their scores improved?" The

experienced teachers recognized their ability to problem solve and share ideas to improve instruction across classrooms.

Role of facilitator. All four novice teachers in this study made note of the importance of having a leader (or facilitator) for their CLT so that they had another person to support them. For the sixth grade team, Heather shared that "We just come in, Ben makes us focus, and we start chugging along with what we need to do. It's great." Beatrice also referred to the impact that Ben has, "Ben started off by saying he wanted us to save time…then, focusing on our unit plan, he decided that we would try to put them together to try to save time." It is important to note that only one team was facilitated by an instructional coach with a background in mathematics.

Feedback from peers. One aspect of how the experienced teachers described how the interpersonal nature and interactions among the members of the CLT influenced the collective work was the feedback that teachers gave each other. Zach shared, "I enjoy the meetings in terms of being about to get that feedback from my peers, touch base with them, see their data, and compare how kids are doing. I think it's useful." Esmeralda also shared that teachers on her team can pose questions to the group, "I'm having this issue, who else is having this issue?" Which is good to hear, you know that others may be having the same problem you are." All seven teachers described their experiences working with their colleagues in a way that positively impacted the effectiveness of the meetings.

Teachers described how they related to and worked with other members of the team and how this influenced their perceptions of an effective CLT. The next theme explored was the logistics of a CLT.

Logistics. The theme of logistics encompassed the extent to which teachers described how the structure and routine impacted the effectiveness of the work of the team. This included emergent categories such as the number of teachers on the team, time allocated for regularly scheduled meetings, how time was allocated for specific tasks within the meetings, and efficiency of the team during the designated meeting time.

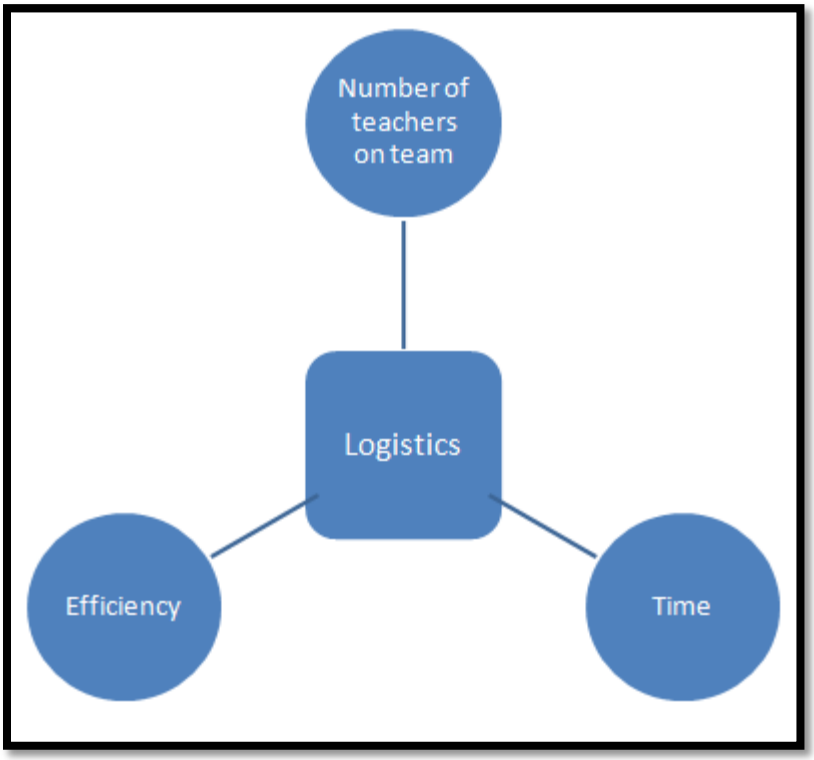

Figure 3. This figure represents how teachers described the logistics and structure of meetings and to what extent that had an influence on the collective work and the perceptions of being effective.

***Number of teachers on team*.** The teachers from CPMS described how they valued the small size of a CLT which focused on one content area. Due to scheduling constraints at HMS, all eighth grade math teachers met together instead of in separate CLTs for algebra and pre-algebra teachers. Both Esmeralda and Jon made comments about how having a specific CLT devoted to their content (algebra) would be ideal. Further, the other algebra teacher at their school is a seventh grade teacher so she did not attend the eighth grade CLT meetings. When Esmeralda talked about her team she commented, "I really feel we need a separate PLC for our subject matters, I really do." In her final interview Esmeralda reiterated this idea,

> I just feel like we could become better teachers by sharing specific strategies, ideas, lesson plans that kind of thing. I find that because one of us is a seventh grade teacher, you know the other two in the hallway, we'll just start sending emails sometimes and that can be a disconnect and or miscommunication and that kind of thing and now we haven't made this as good as it can be.

When asked about the different content areas addressed during their meetings, Jon shared,

> Oftentimes the pre-algebra teachers will be talking with Ms. G. about something and Esmeralda and I will have a side conversation. We're still kind of paying attention, and if something comes up that we need to know or talk about, we'll get into the conversation…. We'll often have our own little side conversations. We kind of have our own algebra PLC.

The number of teachers on the team also influenced perceptions of how balanced or imbalanced the participation was from teachers on the team. Both CLTs from CPMS had four teachers on the team. These teachers shared feelings that participation was balanced. The CLT at Harris had seven teachers on the team and both Jon and Esmeralda shared how the participation from teachers was not equitable. Jon shared, "the meetings do really run long, there are a couple [people] who really like to talk…" However, Jon noted on multiple occasions comments about feeling comfortable to share and participate in the meeting, "Of everybody in my group, I'm probably the quietest and when I want to I can [participate and share ideas]. I just don't normally. I'm just a quiet introvert and a quiet person."When asked how the meeting in November was different from other meetings, Esmeralda offered, "Maybe different because for once we all had to speak…we all had a chance to give a little bit of input whereas usually it's just one or two." The number of people on a CLT influence how and to what extent teachers had the opportunity to share and reflect on what other teachers contributed.

Efficiency. Novice and experienced teachers made reference to a desire to be efficient and productive during the meeting, as well as leave the meeting with something that will be used in their classrooms. All three novice teachers at CPMS made reference to looking forward to improving efficiency of meetings. In her final interview Julia shared, "I think we'll get better and more used to the meetings and how they're run. I think it will get quicker." Heather shared, "Now that we're getting a lot more productive, now that we know what we have to do, we get it done really fast." When Beatrice was asked what she would like to see more of during the CLT, she responded, "As we move

on throughout the year, yeah, I think it would be useful to start doing other things because we'll get used to doing common assessments and we'll be able to do them quicker." The size of the team made a difference for the teachers because more teachers meant more time was needed to focus on a specific subject. In every interview, Esmeralda and Jon shared their preference for a CLT that was focused on one subject.

The structure and routine of meetings can support novice teachers who are new to teaching while also giving the opportunity for novice and experienced teachers to learn about what is going on in other classrooms. When explaining why she thinks CLTs are important for newer teachers, Esmeralda explained,

> I think it's good for new teachers because it's an opportunity for them to hear from other adults what's going on and that my life isn't so terrible in the classroom. There's experienced teachers, they're having the same issues. So I think it's good, it helps give them a peace of mind that we all went through this at some point in time. It forces them to have an opportunity to collaborate with others and I think it's important, I think it's good for new teachers.

Both experienced and novice teachers recognized the benefits of having a structure like CLTs to support novice teachers. The CLT meetings also offered an opportunity for all teachers to reflect on their practice.

Time. The final emergent category explored within logistics was time. For the purpose of this section, time was explored in terms of how time was used during the CLT meeting and to what extent there was enough time for teachers to complete all their work. The issue of time was addressed by all seven participants; however the perception of not

having enough time was a perception of the novice teachers different from that of the experienced teachers. All four novice teachers in this study shared their experiences with meetings where there was not enough time for everything they wanted to accomplish. The novice teachers talked about their experiences breaking up duties outside of their meeting. If there was not enough time during a meeting, then the work was divided up among the teachers. Beatrice shared, "We'll each kind of split up the assignment and take part of it home, and email whatever we don't finish to each other. If we need a twelve question quiz, we'll each make up four questions." When explaining how tasks are divided among the group, Heather said, "We talk about what's going to be in it, and then we say, you're going to make this one up, you're going to make this one up, you're going to make this one up."

There was great variation among both novice and experienced teachers as to what might be the ideal length of a CLT meeting. The novice teachers would prefer 25-90 minutes to meet where the experienced teachers would prefer 20-45 minutes. Zach shared that an ideal CLT meeting would be about 20 minutes for discussing what was on the agenda. When describing his ideal CLT meeting, Zach shared how he would like tasks to be assigned to the teachers on the team, "[we] assign those tasks, go ahead and work on those tasks, and then come back." In her first interview, Julia shared that an ideal CLT meeting would last 60 minutes. In her final interview, when Julia was asked to describe her ideal CLT, she shared that it would be 25 minutes and

> Probably come in have an agenda ready, each person discusses each part of the agenda. Make a plan for the unit, what you're going to teach and how you're

going to teach it. Then, at the end making a list of things that still need to be done and who's going to do them. Then an agenda for the next meeting.

When asked how long she would like CLT meetings to be, Beatrice shared, "Maybe they would be an hour and a half, or two hours. Maybe not during the planning period." As previously stated, across the board, there was great variation in what would be considered the ideal length of time for a CLT meeting.

Novice and experienced teachers described factors related to the theme of how teachers described the logistics (structure and routine) of meetings and how this influenced the collective work and the perceptions of being effective. The next theme explored was the focus of a CLT meeting.

Meeting focus. The meeting focus theme included emergent categories such as relevance, the level of teacher input, and mathematics. Teachers described the focus of the meetings and what was discussed or completed during the meeting and how this influenced the collective work and the perceptions of being effective.

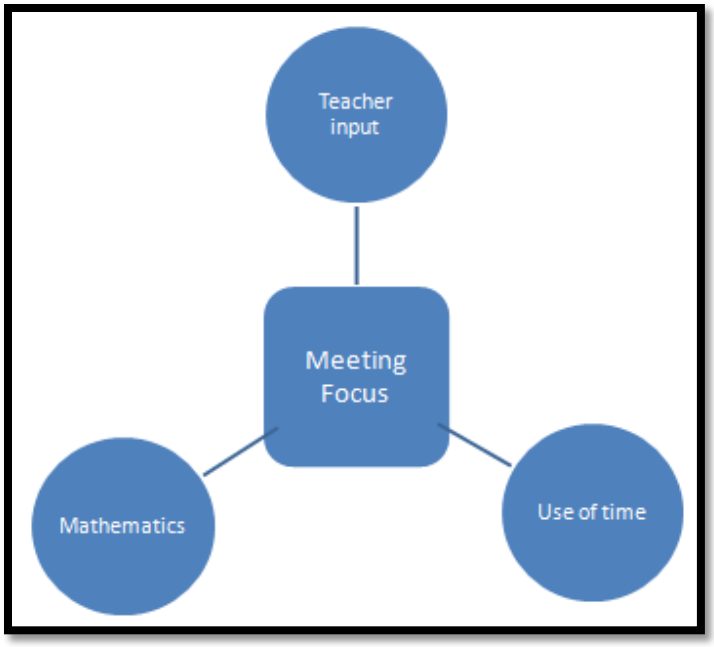

Figure 4. This figure represents how teachers described to what extent the focus of the meeting influenced the collective work and the perceptions of being effective.

Use of time. The first factor identified within the theme of meeting focus was how the time is spent and on what specific topic or area of discussion. All teachers shared their experiences within their CLT in regard to their time being valued and what makes the time spent in the CLT a "good use of time." By the third interview, all the teachers described the meetings as a good use of their time to some extent. When asked if the CLT meetings were a good use of her time, in her first interview Beatrice responded,

> I think so. As far as the value, I think that everyone's opinion is valuable because we all have different ideas. I think it just lessens our work to be able to share ideas. As far as being worth my time, again, I feel like we'd be doing it anyway. Sometimes the time that we have planned isn't necessarily the most convenient

time for all of us, but since we're going to do it anyway, we might as well get it done then.

In his first interview Jon did not consider the time during the CLT meeting a good use of his time. When asked about this he shared, "Oftentimes no. But, that's because it's pre-algebra centric. If I taught pre-algebra, I think it would be a good use of my time." During the third interview, Jon shared a different perspective, "Yes [it was a good use of time]…For one, Ms. G. allowed the round table discussion to go on." When Sarah was asked if the meetings were a good use of her time, she responded, "Yes, because we kind of take charge of our time. It's not wasted." When describing an ideal CLT meeting, Sarah also shared, "Where we get to decide our purpose. I think they trust our group enough now, because they saw us work last year together, that they kind of just let us do our thing. It doesn't feel like something we're doing because someone says we have to. It's something we're doing because this is how we function as a team."

Esmeralda shared various perspectives about the value of the meeting and the extent to which she thought it was a good use of her time. In her first interview, when she explained how she felt in general about CLT meetings, Esmeralda shared, "I know many other teachers will feel it's just another meeting, but this is one of the more productive meetings I can have, because it can directly affect my classroom." During the second interview, when she was reflecting on a specific meeting, she shared, "There are times, I mean you hate to say it, but there are times I feel like it is a waste of my time." In her final interview when asked about what part of the meeting was not relevant to her work, Esmeralda explained,

> It's so hard. I mean you're always going to get something out of whatever meeting you go to, whether you want to sit there or not. I feel it does make you look at things differently and maybe next time I will analyze mine differently or will I think about you know somebody said. Maybe I'm not trying hard enough to reach my low-performing kids. Maybe I could do something else. So you're constantly thinking of other ways just to go about your teaching. There really never is a meeting that's that terrible. Like I said it might be boring, but you at least get to think and I always like hearing other's ideas and the way things are done and whether I do it that way or not, it allows me again to just reflect and say maybe I should change this or what I'm doing is good.

Esmeralda and Jon both shared their frustrations with meetings where the focus was not related to algebra, the subject they both teach.

Mathematics. Teachers, both novice and experienced, did not report doing mathematics regularly during the meeting. Both teams from CPMS mentioned working on the mathematics of a transfer task. In her first interview, when asked if they do math during the meeting, Sarah shared, "It depends on the meeting. If we're doing a transfer task meeting, to get ready for our unit, we do.**"** All three teachers on the sixth grade team at CPMS shared their experiences with doing a transfer task during one CLT. Heather explained,

> We start with the transfer task to figure out how we should teach in order for our students to be successful in that. But basically what we ended up realizing was that we looked at the transfer task that the curriculum people gave us and we

> decided to scrap it completely, pick a new task for our kids to do, which is a million times better. And we pretty much just spent most of the day creating the transfer task.

Julia shared,

> So, the transfer task was asking about how much mulch, like a fraction of mulch and it just didn't make sense and it was hard for us to understand it, let alone the kids. So then we changed it to one that we found in a book about mixed nuts and they wanted to have a party or something. So, what fraction of peanuts would there be?

Beatrice shared how the group moved forward to determine a new transfer task, "We looked at what the unit was about and then we looked at some other resources to try to pull different questions that were worded differently, like more student friendly."

Teachers did not report doing mathematics or working through mathematical problems during CLT meetings at HMS. For the two eighth grade teams, teachers did not report doing specific mathematics problems together as CLT. When asked about what discussions there were about the mathematics during the meeting, Sarah shared that the team discussed "what the important skills are, what are the different ways we can teach them, what are the different ways they can be assessed, the mistakes we've seen in the past, and how we can correct for those."

Teacher Input. Novice and experienced teachers reported that they liked having input into the direction of the meeting. The novice sixth grade teachers from CPMS explained on multiple occasions, the importance of having the instructional coach at the

meeting to “focus” them and give them guidance. Jon shared that he enjoyed the meetings when all the teachers had an opportunity to share. Sarah and Zach reported that they enjoyed being able to determine the meeting agenda and adjust it to meet their needs. Teacher input was connected to teachers’ sense of ownership of the meeting and feelings of empowerment.

There were similarities among the teachers on a CLT based on the teachers on the team and the subject focus for the CLT. The CLT at HMS incorporated two different subjects during the weekly meeting whereas the CLTs at CPMS focused on only one subject. This impacted the teachers’ experiences as to how they interacted with the other members of the CLT, how the logistics and structure of meeting influenced perceptions of being effective, and how teachers described the focus of the meetings influencing the collective work and the perceptions of being effective.

Summary

The findings of this study suggest that while there were general ideas that the seven teachers in study found as contributing factors to effective CLT meetings, there were distinctions within those perspectives about those ideas. Also, the results from this study suggest there were differences in the perceptions of novice middle school math teachers with three or less years of experience compared to the perceptions of experienced middle school math teachers with four or more years of experience. Because the composition of the teachers on each of the CLTs in this study was different, there were many distinctions among each of the CLTs

The seven teachers who participated in CLT meetings described components of the CLT meetings as effective when there was structure and routine in place for meeting formally, as well as the flexibility within teachers' schedules to meet informally. Teachers stressed the importance of meetings that were productive and efficient. Secondly, teachers in this study also reported that they appreciated the flexibility of the meeting to address their needs. Next, the teachers, both novice and experienced, recognized the talent of the team, or the collective expertise, with the teachers who participated and collaborated. Next, both novice and experienced teachers described how a sense of belonging and community made their work more enjoyable. Lastly, the teachers described the importance of a clear connection from what happened in CLT meetings to what goes on in the classroom.

These five factors will be explored further in chapter five. Additionally, chapter five presents a discussion of the findings, implications and recommendations, future research and limitations.

CHAPTER FIVE

This study explored the perceptions of novice and experienced middle school mathematics teachers in relation to their experiences with collaborative learning teams (CLTs). The goal of this research was to explore what components of a CLT do teachers deem as effective. The four research questions that guided this study were:

1. How do CLTs influence middle school math teachers to explore the nature of the mathematics content and pedagogy?
2. What are the perceptions of novice teachers' in terms of effective components of their CLT?
3. What are the perceptions of experienced teachers' in terms of effective components of their CLT?
4. How does years of teaching experience influence perception for effective CLTs?

To answer these questions, data collection included face-to-face interviews (and two phone interviews) with middle school mathematics teachers in the mid-Atlantic at two different schools. A total of 21 interviews were conducted. This chapter presents the discussions of the findings followed by the implications and recommendations, future research, and limitations.

Discussion of Findings

Research suggests that if educators in a school are serious about enabling teachers to really change the way they work, then teachers must have opportunities to discuss, think about, try out and hone new practices (Lieberman, 1995). Collaborative learning teams (CLTs) embedded within Professional Learning Communities (PLCs) are one option for sustained professional development for teachers. Further, research indicates that PLCs should focus on the content and be based on a cycle of gathering evidence of current levels of student learning, developing strategies and ideas to build on strengths and address weaknesses in that learning, implementing those strategies and ideas, analyzing the impact of the change to discover what was effective and what was not, and applying new knowledge in the next cycle of continuous improvement (DuFour et al., 2006). Within a PLC at the school level, CLTs can be a structure to build community and capacity, and ultimately increase student achievement. Based on this study, there are five factors that contribute to a successful and effective CLT: 1) the logistics and structure of the meeting must match teacher's schedules, 2) there is flexibility within the meeting agenda to support the needs of the teachers on the team, 3) there is shared responsibility and shared learning which is a part of the collective expertise among the participants on the CLT team, 4) there is a sense of belonging and community made their work more enjoyable, and 5) the meeting content directly relates to what is happening in teachers' classrooms. These five factors represented what participants in this study attributed to effective components of their CLT. When these features were present and

incorporated the work of a CLT, the team had better opportunities for teaching and learning mathematics.

Factors Contributing to Effective CLTs

Research indicates that there are factors which may contribute to effective professional development (Desimone 2009, Guskey, 2002, Louis, Marks, and Kruse 199, Kagan 1992), specifically PLCs and CLTs (Baynard, 2011). As evidenced in the findings in chapter four, there are similarities to what both novice and experienced deem as effective components of a CLT. Based on number of years in the classroom, there are also differences to what teachers find meaningful or effective as components of a CLT. As Guskey (2002) noted professional development that does not address teachers' needs is unlikely to succeed. For a CLT to have a meaningful impact on teaching and learning there are several components that make a CLT effective. For teachers to view CLT meetings as effective there are five factors contributing to successful CLTs. Figure 5 illustrates the factors that influence better opportunities for teaching and learning within CLTs. The factors are: 1) the logistics and structure of the meeting must match teacher's schedules, 2) there is flexibility within the meeting agenda to support the needs of the teachers on the team and 3) there is a sense of belonging and community within the team, 4) there is shared responsibility and shared learning which is a part of the collective expertise among the participants on the CLT team and 5) the meeting content directly relates to what is happening in the teachers' classrooms. Within each of these components are elements that differ between novice teachers and experienced teachers,

and, distinctions in novice and experienced teachers' perceptions are discussed later in this chapter.

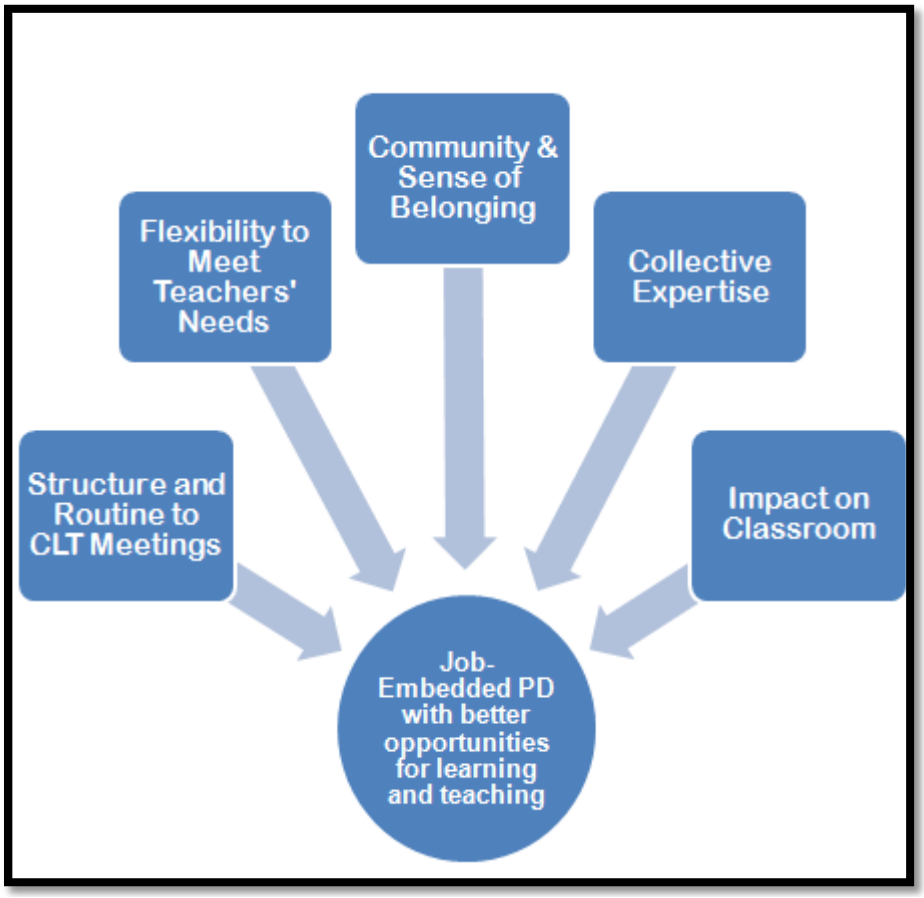

Figure 5. This diagram illustrates the factors that influence better opportunities for teaching and learning within CLTs. Within each of these categories, there are elements from both the perspective of novice teachers and the perspective of experienced teachers.

Each of the components presented in Figure 5 are described in the following sections.

Structure and routine. The structure and routines of CLT meetings are dependent on a variety of factors. Embedded within this factor were the following themes: how the logistics of meeting influence the collective work and the perceptions of

being effective and how the teachers described CLT meetings where multiple subjects areas were discussed. A school's schedule and the priority with which the principal and professional development leaders place on the importance of the CLT meetings will directly impact the potential success of a CLT. The teachers on a team need to be able to meet together at a routinely scheduled, designated time that works for all teachers who teach that content area. All seven teachers in this study participated in a CLT meeting that was built into the schedule where all teachers could attend at the same time. To have a CLT meeting, the team needs uninterrupted time to meet as a team. After the routine of meeting location and time is set, a much more complex element emerges. The structure evolves into something in which teachers are empowered and passionate about and excited their own professional growth as a teacher and learner. The discussions and subsequent actions can positively impact student achievement.

The structures and routines include a regularly scheduled time for the CLT meeting, the efficiency in which the team can accomplish tasks, the number of teachers on the team as well as how the time during the meeting is utilized. The first factor that supports effective CLT meetings is how the logistics and structure of the meeting match teachers' schedule. The logistics and structure of the CLT meetings are generally, at least to some extent, dictated by the master schedule of the school. In all three cases, the teams had flexibility with their meeting schedule. Both teams at Chases Pond Middle School (CPMS) met on Mondays, but were permitted to meet a different day if it worked with their schedules. The team at Harris Middle School (HMS) chose to meet prior to school

on Thursday mornings due to the limited time of the common planning during the school day. Teachers enjoyed this flexibility of structuring their meetings in their own way.

Ideally, the CLT meetings would only have one subject area focus. The teachers on each CLT at CPMS teach the same subject content (sixth grade team focused on sixth grade math and eighth grade team focused on algebra). The eighth grade team at HMS had teachers who teach different subject areas on the team so the discussions were not focused on only one content area. Both teachers in this study from that team expressed their desire to have a CLT focused solely on the content they teach: algebra.

The seven teachers interviewed all shared their experiences with meeting at other times throughout the week in addition to the regularly scheduled meeting. Teachers opted to meet at different times to discuss curriculum, instruction, and assessment and this demonstrated a desire to collaborate with each other. Within their individual schedules, they found time to meet and "touch base" about their work. At HMS, making time to meet appeared more challenging because of the schedules of the two algebra teachers. The teachers shared their experiences in trying to meet during the day but it proved to be challenging. Scheduling is a critical aspect of the organization of a CLT that must be considered with great care because teachers need common planning time in order to schedule CLT meetings.

Teacher Needs. The extent to which teachers' needs are addressed and met during CLT meetings is dependent on a variety of factors. Embedded within this factor are the following themes: how teachers described as a productive use of their time, to what extent the focus of the CLT meeting is relevant and useful, how teachers describe

planning and the role of planning during their meeting and how the work of the CLT impacts overall growth in a teacher's practice. Teachers in this study wanted to be able to use the time during meetings to be able to plan lessons, create and reflect on common assessments, share ideas, ask questions of their colleagues as well as revise tasks for students. Teachers also described different levels of support they wanted from others.

Novice teachers have different, and fewer, experiences than experienced teachers and thus it is imperative that the CLT meetings are designed and structured to meet the various needs of the teachers. The structure of a how a CLT operates may need to be flexible from meeting to meeting to address the needs of each teacher. Flexible groups or small breakout groups may be appropriate to meet these needs. In the case of the eighth grade CLT at HMS, the team's focus was two different subjects: pre-algebra and algebra. To support the teachers, breakout groups to focus on each subject area could meet the needs of the teachers.

At CPMS, the sixth grade CLT was facilitated by the instructional coach and the eighth grade CLT was facilitated by the teachers of that team. This is an example of being flexible to meet the needs of the teachers. The teachers on the eighth grade team embraced the opportunity to run their own meetings. It is important to note that the facilitator of the sixth grade CLT at CPMS, was a math specialist. The sixth grade team at CPMS had this support which was especially helpful to this group because three out of the four teachers on this team were first-year teachers. Although the novice teachers noted classroom management as one area that they wanted more support with, the

instructional coach, with a background in mathematics, was able to support their thinking about the mathematics.

For both novice and experienced teachers on these CLT teams, the teachers all described wanting to maximize the time during the CLT in a meaningful and productive way. For the novice teachers, they enjoyed the support of other teachers and/or the instructional coach to direct the meeting. The novice teachers did enjoy having input in the direction of the meeting. The sixth grade teachers from CPMS noted on multiple occasions, the importance of having the instructional coach at the meeting to "focus" them and give them guidance.

Because the variation in the number of years the teachers have been in the classroom, there were differences with what was the most pressing issue to address during the CLT meeting. The experienced teachers already have lesson plans, projects, and common assessments from previous years from which they modify and tweak. The novice teachers spoke about starting from scratch and having to learn about everything – classroom management strategies as well as multiple models for teaching a new skill. On the eighth grade team at HMS, the one team in this study where there were both novice and experienced classroom teachers, there was some discussion about how the experienced teachers could support and share ideas with the novice teachers. The novice teacher also shared occasions where he was able to share his knowledge with the team. In addition to having more years of teaching experience, the three experienced teachers in this study also had more years of experiences with a CLT. From the initial interview in September, the experienced teachers knew what they wanted out of the CLT meetings.

The novice teachers' perceptions have shifted somewhat from the interviews likely because, for three of them, they were in the first few months of their teaching career as well as the fact that they were still experiencing and learning what a CLT does and how it functions. This aligns with Simmons et al. (1999) who noted that as teachers gained experience in the classroom, they were less likely to wobble in their beliefs systems about their content understanding. The novice teachers in this study shared how individually they were learning from their peers and others in the group. All four novice teachers wanted to contribute to meetings in some way.

Community. The sense of belonging that teachers feel within their CLT is dependent upon a variety of factors. Embedded within this factor are the following themes: to what extent teachers described feeling part of a community and to what extent teachers described feeling part of a community as well as to what extent they felt they had ownership in the work of the team.

When a novice teacher is part of a CLT, the team is a built-in structure for community; however, that structure is only the beginning of building community. In addition to having a common purpose and goal for the work of the team, when teachers enjoy working with the other people on the CLT, that makes the experience that much more *enjoyable*. Four teachers specifically made comments about enjoying working with the other people on their team. It was evidenced indirectly by comments of the other three teachers that they enjoyed working on the team. When teams meet, more than just content is discussed. Even though teachers work together and share ideas, it is important that teachers know that they do not need to agree on everything. It is important for

teachers to share their opinions and keep their identity. As Baynard (2011) noted, "[CLTs] are a mix of the personal and the interpersonal among teaching professionals. Those teachers who participate in PLCs need to be encouraged to maintain their identity when collaborating with other teachers" (p. 168).

After those structures and routines are set, then a sense of community can develop, even flourish, where the team of teachers is meeting to develop and hone the craft of teaching and impacts how that influences students to learn. The team may be able to propel itself to a high-functioning entity where teacher growth and student achievement is woven together so that opportunities for teaching and learning are enhanced.

Collective Expertise. The teachers who participate in a CLT can share their knowledge and learn from others. The extent to which teachers' expertise and experience is utilized during CLT meetings are dependent on a variety of factors. Embedded within this factor are the following themes: to what extent teachers feel a part of a community, how teachers feel a sense of empowerment; how teachers described to what extent they have ownership in the work; and how teachers described how much time during the meeting was spent working on specific tasks.

Teachers have different experiences and perspectives based on a variety of factors. Colunga (2011) noted that it is important to identify what their own individual needs and expertise are and what type of professional development will best support the goals of enhancing instruction. The individual need of any teacher may be influenced by the number of years of experience in the classroom and years of experience working with

a CLT. Colunga's research findings were confirmed in this study. Teachers in this study wanted to be able to contribute to the meeting as well as gain a better understanding or more information about teaching and learning mathematics.

Teachers in this study described how they wanted to be able to contribute to the work of the team. All seven teachers described that they were able to have a voice in the meetings. The novice teachers shared their experiences of learning from other teachers on the team. Ideally, each teacher is valued for the contributions that she brings to the table and is able to share those ideas, thoughts, and questions. At the core of a CLT is interacting, reflecting, and discussing ideas with other people who teach the same content. The teams worked together with their collective expertise on the teaching and learning of mathematics. Teachers in this study consistently shared their experiences about working with their colleagues in their CLT. The teachers in this study reflected upon their experiences of "shared responsibility and shared learning" among the team members. In her final interview, when asked about CLTs in general, Julia said,

> I enjoy them. I think it's a good idea. I think it's a good opportunity for the team, the math team to sit down and get together because we don't have much opportunity for that during the day. So I think it's nice to get together and save a lot of planning like I said and just bouncing ideas off of each other. Some people are really good at the math part, and some people are really good at the strategies, so it's nice to all come together and collaborate on it.

Likewise, Jon likes the direction his CLT is going as he shared in his final interview, "Yes, the meetings are a good use of my time." Jon also included his thoughts about his

participation in the meetings, “I have more experience than last year. As a first year teacher, I was lost. As much as I knew the curriculum, I didn’t know as much. I didn’t know the tricks of the trade I guess you could say. This year I’m changing things based on that and I’m finding things based on that that are working for me that sometimes.” In the final interview, when asked about the CLT meetings that had taken place up to that point in the year, Heather shared, “They’re all positive as long as they’re productive…They’ve been really helpful.” In the final interview, Esmeralda shared, “I mean you’re always going to get something out of whatever meeting you go to…it does make you look at things differently.”

Impact on Classroom. Teachers teach students. At the heart of any professional development opportunity, teachers want to see an impact on student achievement. Therefore it is imperative that the work done within the CLT meetings directly impacts the work in the classroom with students. Embedded within this factor are the following themes: how teachers described to what extent that work during a CLT meeting influences what happens in their classroom, and how the work of the CLT impacts overall growth in a teacher’s practice.

Teachers spoke of finding value in the meetings when the work completed during the meeting directly related to the work in their classroom with students. The content focus is mathematics and the teachers addressed the importance of focusing on work that would impact their teaching in the classroom. Teachers want to accomplish something productive during the meeting—teachers want to feel that the meeting is a good use of their time. This may include creating common assessments, reflecting on data, sharing

strategies or other work mandated by their administrators. Ultimately in the end—at the end of a meeting, during quarter-end reflection, or at the end of a school year—teachers want better opportunities for teaching and learning mathematics. Loucks-Horsley, Love, Stiles, Mundry, & Hewson (2003) note that teacher professional development programs seek to increase teachers' professional knowledge, improve classroom practices, and ultimately foster student learning and achievement gains. This study aligns with the work of Loucks-Horsley et al because teachers in CLTs sought to gain a better understanding of how to develop their work as a teacher through improved classroom practices.

There are five contributing factors that influenced teachers in this study to describe CLT meetings as effective. These five factors are connected to each other. With these factors in mind, the work of the teachers within the CLT can have powerful and meaningful implications for the teaching and learning of mathematics.

Impeding Factors

There were factors that did not support teachers' perceptions of effective components of a CLT. Each school and each CLT is unique and has requirements, structures, and routines that vary for a number of reasons. In this study there were factors that impeded the work within the CLTs. The factors that impede opportunities for creating and sustaining an effective CLT include: addressing more than one content area (pre-algebra and algebra) in one meeting, limited time for meetings, and an agenda or items to discuss that were not "relevant" to the teachers. Impeding factors should be considered by school leaders because if they are not addressed the effectiveness of a CLT may be impacted.

Multiple subject areas covered. The first impeding factor was when the team addressed more than one content area. As noted in the previous section, both teachers at HMS wanted a CLT devoted exclusively to their own subject (algebra). Time for collaboration is often limited enough without trying to discuss two different subjects. To discuss the mathematics deeply and have time to plan, it is important that the teachers who teach a specific subject area have time devoted solely for that subject.

Limited time to accomplish work. The second factor was reported by the teachers as something that was not under their control. Due to the master schedule of the school, there was limited time for teachers to meet. In the case of the eighth grade team at HMS, the team met before school. The priorities of the principal are evidenced with how the master schedule is designed and to what extent there is uninterrupted time for teachers to meet.

Overwhelming amount of tasks. Finally, as noted by four teachers in the study, there were items on the agenda which the team was mandated to discuss as directed by the administration. In addition of the newness of the structure of a CLT, how teachers collaborated and shared resources, how administrative tasks were dealt with, how common assessments were created and how that data were analyzed were also new experiences. Based on the findings in this study, novice teachers need support from their colleagues, the CLT facilitator, and their principal to prioritize the work to focus the team.

Other Factors to Consider

Finally, there are also factors which could be classified as either supporting or impeding factors depending upon the situation. These types of factors include: the number of teachers on the team, the levels of experiences in years of teaching for the teachers on the team, the years of experience on a CLT, and the role of a non-teacher facilitator. These are factors that could also be explored in further research.

To conclude, there are both supporting and impeding factors that influence the work, level of collaboration, and productivity of a CLT. Teachers have some control over these factors. A powerful discussion among teachers on a CLT can elicit members' priorities and the direction the CLT wants to pursue.

Exploring Propositions

In this study, five of the six propositions were confirmed. One proposition was not confirmed but could be further explored in different settings to see if there may be different results. First, it was speculated that there would be little time during CLT meetings spent doing mathematics. This proposition was confirmed throughout the 21 interviews. For all three CLTs, the teachers on the teams did not report doing mathematics consistently as a team. The sixth grade team at CPMS shared their experiences of working, and ultimately revising, a transfer task during one CLT meeting. All three teachers noted that this was beneficial during the meeting. The other two teams did not report specifically about working out mathematics problems during their meetings. The sixth grade team at CPMS is the only team that is regularly facilitated by a facilitator with a math background and this could influence why this group actually

worked out mathematics during a meeting. As noted by Ball (1990) pre-college and college math experiences and understandings tended to be rule-bound and thin and therefore the research sought to learn how much math is being discussed in a conceptual way rather than a procedural way. As indicated by this research, teachers should have more opportunities to talk about mathematics in a meaningful way. In addition, there should be time for teachers to do mathematics and explore multiple representations, various ways to solve math problems, as well as explore potential student misconceptions.

It was speculated that novice teachers want something that they can take away with them to use in the classroom. This proposition was confirmed in both school settings. Even though the proposition was confirmed, teachers described leaving meetings with different tools or activities to use in their class. In one school, the teachers shared generic strategies. In another school, teacher shared ideas for how to modify common assessments and what strategies may work for teaching certain content in mathematics. Novice teachers in this study wanted to use the time during their CLT meetings to be productive and leave with something that could be used in their classroom. Due to the limits on time, the novice teachers felt like they needed more time to get everything that they wanted to accomplish. As indicated by the research, it is important for novice teachers to have experiences where they learn from their more experienced colleagues.

It was speculated that the novice teachers would benefit from being a part of a community and that novice teachers would seek support from colleagues about best practices. This proposition was confirmed in both school settings. The four novice

teachers in this study described how they enjoyed working with and learning from their colleagues. All four teachers described that they shared ideas and asked questions during the team meetings. Two of the three novice teachers at CPMS described how the facilitator, Ben, supported their work. Heather shared, "that experienced person will help guide you…at the beginning of the school year we sat down and tried to plan together, but got sidetracked and I don't think we got anything done. So you kind of need someone there." Beatrice also described how Ben supported and focused the team. For the novice teachers, the CLT is a community of support for them as well as a community of practice which aligns with the work of Dalgarno and Colgan. These researchers (2007) noted that novice elementary mathematics teachers want and actively seek alternative forms of professional development that are on-going and long-term, are connected to their own teaching experiences, provide control over their own learning experiences, and include both online and face-to-face opportunities. A structure that builds community can be viewed as a powerful means of professional development because it promotes sharing ideas and quality resources, it offers a way of communicating and reflecting with others who teach the same grade/content and it may prevent feelings of isolation. The current study aligns with those results that the CLT meeting was more than just a forum for teachers to share ideas and collaborate; the CLT was a structure to support colleagues. As indicated by the research, it is important for novice teachers to feel part of a community and supported by their colleagues. It is also important for novice teachers to be able to contribute to CLT meetings in a meaningful way. To be able to contribute in a

meaningful way, as Baynard (2011) wrote, team members should be encouraged to form relationships built on mutual trust and respect.

It was speculated that teachers would be influenced by interactions and opportunities within their CLT when thinking about and making decisions regarding teachers. This proposition was confirmed in both school settings. Because there were different number of novice and experienced teachers on every team in this study, further research could explore teams with similar dynamics. Teachers in this study shared their experiences learning from their colleagues during the CLT meetings. During the interviews, teachers reflected on how the discussions and interactions during the meetings influenced their thinking about teaching. All seven teachers described their experiences where their thinking was influenced by discussions during the team meetings. Esmeralda specifically noted that she considered what was being shared but that it would not necessarily change her teaching practices. As indicated by the research, it is important that there is time for teachers to have time to share and learn from their colleagues. In addition, it is important that there are opportunities for both novice and experienced teachers to reflect on their practice. This proposition could be explored further in different settings to learn more about what influences or changes perceptions of novice and experienced teachers.

It was speculated that experienced teachers would address connecting multiple standards as well as previous and subsequent mathematic courses. This proposition was not confirmed at either school setting. The teachers on the eighth grade team at CPMS focused on creating and/or modifying resources from previous years, and reflecting on

data from common assessments. This team also looked at the results from the algebra students from the previous years to explore trends and plan for the current students. The teachers on this team did not talk about the connections to previous or subsequent math classes. At HMS, the experienced teacher described that there was little benefit to her to hear about the work in pre-algebra classes. She shared, "my students are at a different level of maturity." She wanted time to plan during her CLT, but because she was on a team that focused on two different subjects (algebra and pre-algebra), the opportunities for collaborating on planning were limited. As evidenced by this research, teachers need opportunities to talk about what they are currently teaching as well as what learning opportunities or mathematics courses students have had previously and what experiences they will have in subsequent math classes.

Finally, it was proposed that teachers would contribute and learn from experiences and discussions during CLT meetings. This proposition was confirmed in both school settings. All seven teachers described feeling comfortable sharing and contributing to discussions during CLT meetings. In some cases, there was consensus about how something should be taught, but ultimately it was up to teachers' discretion. Heather shared how she and Beatrice had different ideas of how to teach multiplying fractions. Heather shared, "if we teach it differently and then someone's kids do better than you know that the way they taught it was probably a better way to teach it." Heather also shared how she would like to talk about the content they are teaching to understand it better, "…because there's so many different models for multiplying and dividing fractions. I wish I kind of knew, like which ones should be the ones I emphasize more,

just because I know that they'll give them on the [test]." As evidenced by the research, teachers need to feel comfortable working with the people on their team. Baynard (2011) noted teachers want to work on teams that focus on sharing instructional practices and common assessments. Each teacher brings a unique perspective to the group and it is important those perspectives and experiences are considered.

Expanding Previous Research with PLCs

Findings from Dalgarno and Colgan (2007) indicate the need for alternative professional development for teachers. Those results suggest that teachers actively seek both formal and informal professional development opportunities for sharing and communicating ideas surrounding pedagogy as well as accessing quality resources. The teachers on CLTs in this study shared their experiences that the CLTs were flexible enough to meet their needs. All seven teachers acknowledged that they would meet together even if the CLT meetings were not mandatory.

Meyer (2004) investigated the concept of prior knowledge in a comparative study of novice teachers and expert teachers. Novice teachers in her study had few strategies for finding out student prior knowledge and if they did, Meyer, noted that it was through unintended interactions. Meyer's study aligns with the current study because the novice teachers are trying everything out for the first time in their classroom. They have no experience from which to make predictions. With more experience in the classroom, novice teachers will be exposed and learn about how their ideas about instructional fit together with what others know and do in the classroom.

Desimone (2009) identified characteristics of professional development that are critical to increasing teacher knowledge and skills and improving their practice: (a) content focus, (b) active learning, (c) coherence, (d) duration, and (e) collective participation. This study confirmed the work of Desimone and Baynard (2011) by the findings that for effective implementation it is essential that 1) teachers get along on a personal level with their PLC members, 2) PLC meetings should be formatted in a manner convenient for the members, 3) PLCs need time to become comfortable sharing data, and 4) PLCs still need to allow for instructional approaches individualized to each teacher.

For teachers to maximize their experiences within a CLT, efforts should be made to provide as much consistency to the CLT meetings. Further, teachers should talk about the mathematics in a way that influences them to think deeply about the mathematics and then plan lessons based on those discussions and experiences. Teachers should also have the opportunities to both analyze the student data and then also determine next steps for instruction. Finally the facilitators of CLTs should encourage all teachers to contribute to meetings with an end goal of improving learning opportunities for students and ultimately increasing student achievement.

Implications and Recommendations

Implications for practice from this study include four recommendations to enhance the effectiveness of CLTs for novice and experienced teachers. These recommendations include structures and actions that move CLT beyond a meeting of professionals; these recommendations guide teams to meaningful work that develops the

art of teaching with a focus always on increasing student achievement. The four recommendations include: (1) provide a structure for CLT meetings to enhance consistency, (2) focus on common understanding of the mathematics, (3) determine next steps after data discussions, and (4) foster opportunities for teachers to contribute to CLT meetings.

Provide a Structure for CLT Meetings to Enhance Consistency

The structure and routine of CLT meetings impact the productivity and overall perceptions of effectiveness of the team. To provide a structure for CLT meetings there are several aspects of structure to be considered. First, there must be a regularly scheduled time for teachers to meet. This time should be uninterrupted and devoted solely to work that relates to the goals of the CLT. Further, the CLT should be focused on a subject that all teachers teach. All teachers on the team (including special education teachers and English language learner (ELL) teachers) should attend and participate in the meetings. Three teachers in this study shared their experiences where their co-teacher (who was either a special education teacher or ELL teacher) was not able to attend regularly CLT meetings. As a result, another time needed to be scheduled to meet separately with those colleagues. Next it is important that leaders attend the meetings. If a school is fortunate enough to have a math resource specialist or math coach, it is crucial for that person to attend the meeting and support the team. Finally, it is important that both teachers and facilitators know what the goals for the work of the team—both short term and long term. The principal must be clear with teachers and staff about the purpose of CLTs and the expectations for meetings. From week to week it is important teachers

understand what the outcomes for a given meeting are as well as what the team is working towards in the long run. One way to make this clearer is to have a set agenda before the meeting begins. When the agenda is set ahead of time, teachers can prepare for the meetings and make better use of the time. As evidenced in the interviews, teachers appreciated the opportunity to plan ahead and have input on the agenda. Julia shared that she wanted "a plan for each meeting on what you're going to focus on, like making an agenda, so you know how much you need to get done in that amount of time." With an agenda set in place, teachers and facilitators plan and prepare for meetings and increase efficiency and productivity. Efforts should be made to secure a regularly schedule time for teams to meet and, ideally, facilitated by an instructional coach. Equally important is the clear direction by the school administration as to the purpose and goals of CLTs.

Focus on Common Understanding of the Mathematics

Teachers, especially novice teachers, described how they wanted a common understanding of the mathematics they were teaching. Teachers need to understand the subject matter they teach in ways that are different from those they learned as students (Ball & Cohen, 1999). Teachers need to know the meanings and connections, not just the procedures and information; explaining, for example, why an algorithm works is different from being able to execute it correctly (Ball & Cohen). The novice teachers described their desire to talk about mathematics and three of the novice teachers reported that one of the most positive experiences was working out the mathematics for an assessment and then revising that assessment. Further, Esmeralda, who was an experienced teacher on a team with novice teachers, explained her interest in collaborating with newer teachers, "I

really purposefully plan and pick every problem that I do…I think it would help…the less experienced teachers. I can be willing to share that." Ma (2010) points out that even though elementary and middle school mathematics may be categorized as "basic" mathematics, teachers need more than just an awareness of mathematics. It is important that teachers have the pedagogical knowledge of how to support students' thinking to engage them with questions and support them in a way where students take ownership of the mathematics. Further, team meetings also are an opportunity to explore student thinking. This can be done prior to a unit of study and also after a common assessment, but it is important that these experiences are authentic and directly related to what students will be learning. Teachers can work together to consider misconceptions and ways to uncover those misconceptions through experiences for the students. To have meaningful discussion about the mathematics, efforts should be made to plan lessons while exploring various strategies, different entry points and multiple representations.. While considering how to design learning experiences where students discover why math works.

Determine Next Steps after Data Discussions

All seven teachers described their experiences collecting student data on assessments. The ways in which this data was shared varied from team to team. First, it is important that teachers are discussing the results from common assessments in order to have a discussion that is meaningful to all teachers. Likewise, efforts should be made so that data are addressed in a timely manner. Heather noted that the teachers on her team, "never seem to be all ready to compare data" at the same time. In addition to analyzing

the data, it is important that there are opportunities for teachers to collaborate on how to address next steps based on the data. Research (DuFour et al., 2006) indicates that PLCs should focus on the content and be based on a cycle of gathering evidence of current levels of student learning, developing strategies and ideas to build on strengths and address weaknesses in that learning, implementing those strategies and ideas, analyzing the impact of the change to discover what was effective and what was not, and applying new knowledge in the next cycle of continuous improvement. Efforts should be made during team meetings to discuss data in a timely way and then to determine next steps for meeting students' needs based on that data.

Foster Opportunities for Teachers to Contribute to CLT Meetings

Teachers want to contribute to a group (Wong, Britton, & Ganser, 2005). With shared responsibility and shared learning, teachers have a voice and contribute to the work of the CLT which influences the perceptions of effectiveness. The teachers on the team have the obligation to participate in the meeting. Participation includes teachers sharing data and determining ways to address student needs based on that data. Therefore it is necessary that teachers have data discussions in a timely manner and subsequently make actions plans to address needs of the students. With an end goal of increased student achievement, teachers contribute to and reflect upon what goes on during the CLT meetings in order to enhance their teaching practices, but ultimately the work should impact student achievement. Baynard (2011) noted it is important for teachers to contribute to a collaborative meeting while also maintaining their own identity. As supported by her response, Heather shared, "It's hard because we have such different

styles I feel like… It would be good to be in sync, but also it could be good to not be in sync." Heather described how there were benefits to teaching and planning both similar to and different from the other sixth grade math teacher. Teachers in this study appreciated "being able to speak freely with one another and valuing each other's opinions." Efforts should be made to encourage all teachers to actively participate in meetings. As supported by research completed by Baynard (2011), leaders should capitalize on each member's strengths and enable them to contribute based on those strengths.

Ultimately, the work of the team should be reflected in the work with students. Significant change in teachers' attitudes and beliefs occurs primarily after they see evidence of increased student outcomes (Guskey, 2002). These four recommendations confirm other research (Louis and Marks 1998, Baynard 2011, Rutherford 2012) which found that when a school is organized into a professional community, teachers set higher expectations for student achievement, students can count on the help of their teachers and peers in achieving ambitious learning goals, the quality of classroom pedagogy is considerably higher, and achievement levels are significantly higher.

Future research

This study focused on the perspective of a small group of teachers in two middle schools in the mid-Atlantic region. More research is needed to understand what role teachers, facilitators and instructional leader have in influencing productive, meaningful, effective CLTs.

This study focused on novice teachers who had less than three years of experience. Three out of the four novice teachers were in their first year of teaching. Further research could explore how the perceptions and beliefs of first year teachers evolved over several years until they become *experienced* teachers (with four or more years of experience). Further research could explore teachers with a variety of years of teaching experience.

This study explored the perceptions of seven middle school mathematics teachers over the course of one semester. Interviews were conducted in the fall semester with interviews in September, October, and November. Further research could be done exploring those perceptions over an entire school year, or over several years. Especially for teachers in their first year of teaching, the progression of their perceptions of the effectiveness of CLT meeting would be of interest to explore.

This study focused on three teams that were different in terms of the team members. One team had three first-year teachers on the team. One team had four teachers with all five or more years of experience. One team had teachers with years of experience that ranged from two to nineteen. Further research could explore teams with similar demographics.

The teams interviewed for this study were structured differently in terms of the role of facilitator; one team was facilitated by the principal, one team was facilitated by an instructional coach with a strong math background, and one team was self-facilitated. Hence, future research could explore how the role and influence a facilitator with a math background influences the work of the group.

To conclude, there are many avenues where future research can be done to learn more about CLTs and PLCs. Depending on where a school or school division is implementing CLTs and/or PLCs would determine next steps for exploration.

Limitations

This qualitative research study had limitations that include threats to internal validity through researcher bias and also to generalizability. Because this study was completed with only seven teacher participants, it is not possible to predict that the experiences described by these teachers would translate to other settings. Although other school districts may gain insight into novice and experienced math teachers' perceptions of PLCs, there was limited generalizability because CLTs and PLCs function differently from school to school and district to district.

Ideally, the researcher would have access to all math teachers in a given school district for the study. However, this was not feasible for the scope of this study. This represented another limitation of this study. The seven teachers in this study volunteered to participate and therefore that was a limitation of the study; teachers may have responded in a way that they think the researcher wanted them to answer. Further, previous to the start of this study, the lead researcher previously worked in the same district with the facilitator in one school—a connection which the teachers at that school were aware of, and which may have influenced how the teachers responded.

Another limitation of this study is the duration of the study. The focus was for the fall semester of the school year. To keep the study within a reasonable scope, the researcher interviewed seven teachers three times. Again, ideally, more math teachers

within a school would have been interviewed, however that was beyond the scope of this study. The implication of these limitations is that the findings of this study may not be generalizable to other middle school mathematics teachers at these two schools—or other middle schools.

Summary

From this study, three themes emerged between novice and experienced middle school mathematics teachers regarding what contributes to their perception of effective CLTs. These themes included: (a) how the interpersonal nature and interactions among the members of the CLT influence the collective work and the perceptions of being effective, (b) how the logistics and structure of the meeting influence the collective work and the perceptions of being effective, and (c) how the focus (of the meeting) influences the collective work and the perceptions of being effective. Five factors were identified that contributed to an effective CLT: (1) the logistics and structure of the meeting must matched teachers' schedules (with only one content focus), (2) there was flexibility within the meeting to support the needs of the teachers on the team, (3) there was shared responsibility and shared learning which is a part of the collective expertise among the participants on the CLT team, (4) there was a sense of belonging and community that influenced their work to be more enjoyable, and (5) the meeting content directly related to what is happening in teachers' classrooms. When these factors were present, participants described a greater sense of effectiveness within their CLT.

APPENDICES

APPENDIX A: INTERVIEW PROTOCOL – FIRST INTERVIEW

General demographic questions

1. Can you explain your teaching experiences (number of years and grade levels) up to this point?
2. What types of certifications and licensure do you hold? And what degrees have you earned?
3. Can you explain how your PLC functions?
    a. Who facilitates the meeting?
    b. How often you meet?
    c. What is the structure of the meeting?
    d. What are the outcomes and how are they measured?
4. Can you tell me about the agenda and routines that are in place for the PLCs?
5. Why do you participate in PLC meetings?
6. To what extent do you participate in the meetings and what impacts your level of participation?
7. If PLCs were optional, would you attend? Why or why not?
8. What discussion occurs during PLC meetings about mathematics? In what ways do you contribute to those discussions?
9. Are all members of the PLC encouraged to participate in those discussions? If so, how? If not, please elaborate.

10. Does everyone contribute to discussions about mathematics?
11. In regards to **doing mathematics**, what would you like to see more of during your PLC?
12. In regards to teaching math and exploring what to teach, what would you like to see more of during your PLC?
13. To what extent do you personally share ideas about teaching mathematics within your PLC?
14. Do you feel your time is valued by your PLC? Why or why not?
15. What works well about how PLC meetings are organized and structured?
16. What do you like best about your meetings?
17. What doesn‘t work well with how PLC meetings are organized and structured?
18. What do you like least about the meetings?
19. If you could change three things about the meetings, what would they be?
20. Is there anything else you would like to include so that I understand what goes on during PLCs at your school?

APPENDIX B: INTERVIEW PROTOCOL – SECOND AND THIRD INTERVIEW

I. To begin 2nd and 3rd interview, summarize notes from their responses from initial interview that address structure/role/purpose (RQ2) and ask the teacher "has any of that changed"?

II. Interview Questions:

1. How was that meeting similar to other meetings or different from other meetings?
2. During that meeting, what was most beneficial to you?
3. During that meeting, what was not beneficial to you?
4. During that meeting, do you feel like your time was valued? Why or why not?
5. With a focus on (teaching) mathematics, would you have liked to spend more or less time discussing teaching mathematics? Why?
6. What questions or ideas do you have on your mind after that meeting?

APPENDIX C: INFORMED CONSENTFORM FOR TEACHERS

AN INVESTIGATION INTO THE PERCEPTIONS OF MIDDLE SCHOOL MATHEMATICS TEACHERS ABOUT COLLABORATION AND CONTENT FOCUS WITHIN A PROFESSIONAL LEARNING COMMUNITY

INFORMED CONSENT FORM - Teachers

RESEARCH PROCEDURES
This research is being conducted to explore the perceptions of middle school mathematics teachers about collaboration within a professional learning community (PLC) and to examine the nature of the mathematics content and pedagogy explored within this collaborative context and the impact on teachers' perception of mathematics teaching. If you agree to participate, you will be asked to participate in three interviews. The first interview will be approximately 45-60 minutes in length. The two other interviews will be approximately 15-30 minutes in length. The interviews will take place during the fall semester. The interviews will be audio recorded and the recordings will be destroyed after all the research is completed.

RISKS
There are no foreseeable risks for participating in this research.

BENEFITS
There are no benefits to you as a participant other than to further research in PLCs.

CONFIDENTIALITY
The data in this study will be confidential. All names and other identifiers will be changed. The audio files will be forwarded to a stenographer for transcription. Files will be identified with a code so that the stenographer has no way to identify the participants. The researchers will be the only people with access to the audio recording and transcriptions.

PARTICIPATION
Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party. Participants will receive a $75 gift card after all three interviews are complete.

CONTACT
This research is being conducted Dr. Jennifer Suh (Mathematics Education) and Molly Rawding (PhD student) at George Mason University. Dr. Suh can be reached at 703.993.9119 and Molly Rawding can be reached at 207.450.9375for questions or to report a research-related problem. You may contact the George Mason University Office of Research Integrity & Assurance at 703-993-4121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research.

CONSENT

I have read this form and agree to participate in this study.

_____

Name

_____

Date of Signature

Version date: August 17, 2012

APPENDIX D: RECRUITMENT EMAIL TO PRINCIPALS AND MATH COACHES

Subject: Research about Math CLTs

From: Molly Rawding, mollyrawding@gmail.com

Date: August 2012

Dear _____,

This fall, as the focus for my dissertation, I will be exploring novice and experienced middle school math teachers' perceptions towards professional learning communities. I am interested in learning the ways that teachers value PLCs and what they deem as "effective" components of a PLC.

I will be interviewing two teachers (one with fewer than three years of experience and one with three or more years of experience) from the same PLC. I would also like to interview the facilitator or lead teacher from that PLC one time.

For the teachers, the study will involve three interviews over the fall semester. The first interview will last approximately 45-60 minutes and the two subsequent interviews will last 15-30 minutes.

If you are interested in participating in this study, please contact me at mollyrawding@gmail.com or 207.450.9375.

Warmest Regards,

Molly Rawding

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CURRICULUM VITAE

Molly Rothermel Rawding loves learning and teaching! Molly Rawding graduated from York High School in York, Maine. She received her Bachelor of Science degree in Elementary Education from the State University of New York-Geneseo in 2001. She began her career as a middle school math teacher in New Hampshire. In 2006, Molly earned her Master's degree in School Leadership from University of Southern Maine in Gorham. From there, she moved to Virginia where she taught middle school mathematics as well as became an instructional math coach. After ten years at the middle school level, she started teaching elementary school and works as a math resource teacher. Molly loves learning and teaching!