

PROFESSIONAL DEVELOPMENT, INSTRUCTIONAL COACHING, AND
DISCOURSE IN THE SECONDARY MATHEMATICS CLASSROOM

by

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Dedication

For my parents. You always said we could do anything we put our minds to, even if it seemed impossible. You instilled a work ethic in me that has been utilized in my life and most certainly in this program. You both have relentless drive that I can only hope to emulate in my life.

To Wally: you always taught me to work hard, and if I wasn't getting results, to change tactics and work harder. You taught me to think through things, to question and challenge my process to determine if I was going to maximize the outcome.

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"Decide what to be, and go be it." The Avett Brothers

Abstract

Background: This study focused on the need for understanding effective, ongoing professional development for teachers as they learn the skill of facilitating discourse into their classrooms. Teachers should engage in ongoing professional development and have support as they implement current best teaching practices. Supplementing professional development, the utilization of an instructional coach can assist teachers in implementing the strategies learned in professional development into their classes. This study focused on supporting teachers as they began to implement the strategy of discourse in the secondary mathematics classrooms. Teachers who work with an instructional coach extend their learning from the initial professional development and have an increased likelihood of using the strategy learned. **Purpose:** The purpose of this study was to determine the impact professional development has on teachers who are including discourse as a practice within their classrooms and to assess how teachers perceive the usefulness of instructional coaching in the secondary mathematics classroom. **Methods:** Utilizing a case study approach, this study began with a three hour professional development on discourse in the mathematics classroom. Fifteen participants attended the initial professional development. Four were selected to participate in the research study and to work with an instructional coach to specifically plan activities and questioning strategies for use in their classroom. The research questions for this study were 1. How does professional development on discourse impact secondary mathematics teachers' perceptions of classroom discourse practices? 2. In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?

Within the case study, data analysis followed a convergent approach. Both qualitative and quantitative data was collected simultaneously and analyzed separately, then the data was merged to show trends in each case. The study used surveys that include qualitative and quantitative questions and semi-structured interviews to measure teacher perceptions of how their practices shifted from the initial professional development to the time spent working with an instructional coach. **Findings:** Participants viewed instructional coaching as an extension of professional development and coaching allowed for participants to implement the learning from professional development into their classrooms. Specific to instructional coaching, generalized findings from the four cases include the participants feeling that the coaching conversations allowed them to plan for student discourse in their lessons, discuss teaching strategies to engage students into the conversations, and reflect on their practices when implementing discourse. **Conclusion:** Each participant engaged in the coaching cycles by setting a goal and worked to facilitate discourse in their classrooms. Participants used the coaching cycles to plan where to facilitate discourse, learn new methods of engaging students, discuss possible student responses, and how to address those responses to further the conversation. The participants felt that coaching allowed for them to engage in discussions about their lessons and reflect on how the discussions were beneficial to students. The increased engagement of their students led the participants to increase the number of times they facilitated discourse in their classrooms.

Keywords: Instructional Coaching, Discourse, Professional Development, Secondary Mathematics Classrooms

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Chapter I

Introduction

This study focused on the need for effective, ongoing professional development for teachers as they implement the instructional strategy, facilitating discourse, into their classrooms. More specifically, the study analyzed how teachers worked with an instructional coach to improve teaching practices with a systematic method to determine perceived growth for the teacher with an emphasis on implementing the facilitation of mathematical discourse as an instructional strategy. Like most professionals, teachers need to engage in professional development to learn and implement new teaching strategies into their classrooms to demonstrate growth in teaching (Darling-Hammond et al., 2017). Professional development can take many forms, however, it should point towards teachers improving their instructional practices in order to impact student learning (Ball & Forzani, 2011).

To reinforce the need for teachers to engage in professional development, the State of Texas changed the teacher appraisal system to the Texas Teacher Evaluation and Support System (T-TESS). The main focus of this new system is to “support teachers in their professional growth” (Texas Education Agency, 2019, section header). The state enlisted the National Institute for Excellence in Teaching (NIET) for assistance in developing the rubric and training of administrators and teachers across the state. Of the four domains and sixteen dimensions within T-TESS, goal setting and professional development (PD) are two of the dimensions, but the learning that teachers will engage in during the professional development may carry over into other dimensions as well. While the state expects teachers to set goals focused on improving classroom practices, there is

little data used to support a teacher's claim that they reached their goal.

Statement of the Problem

With T-TESS as the current evaluation tool in the State of Texas, teachers set a goal for themselves for the year, then actively document how their selected PD supports their learning and implementation of the strategies into their classroom. Teachers and their appraiser meet regularly in a pre-conference, observation, post-conference iterative cycle to discuss how the teacher is working to reach their goal. T-TESS supports the use of a cycle where a teacher is able to set a goal, learn and implement a new strategy, including attending relevant PD, then be observed and receive feedback on how implementation supports a focus on classroom practices (Ritter & Barnett, 2016). The NIET (2017) advocates for an appraisal system that supports educators with an evaluation that includes professional growth and improves the quality of instruction.

In 2018, the sixth iteration of the National Survey of Science and Mathematics Education (NSSME+) was conducted. In 1977, the National Science Foundation first commissioned the study, and the most current study sampled over ten thousand science, mathematics, and computer science teachers nationwide. The results of this survey support the need for ongoing professional development and the use of facilitating discourse in the mathematics classroom. The need for increased content specific professional development is supported by the fact that teachers reported at least 80 percent had attended mathematics focused professional development in the last three years, however only one third of secondary teachers reported a cumulative total of 35 PD hours in the same time period (Banilower et al., 2018). Less than half of the respondents (49%) attended PD that included "deepening their own understanding of how

mathematics is done (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)” (Banilower et al., 2018, p.79). The lack of teachers attending content focused PD could be addressed if districts offer more applicable PD. With continued support at the campus level, teachers will implement their learning from PD into their classrooms.

In the same NSSME+ survey, participants responded that 84% engaged in whole class discussions at least once a week, and 95% explain mathematical ideas to the whole class (2018). While the engagement in whole class discussions is positive, further analysis from the report shows that fewer than 40% of respondents have students justifying their mathematical thinking (36%), pose questions to build on the mathematical thinking of others (27%), and analyze the mathematical reasoning of others (15%) in all or almost all lessons (Banilower et al., 2018). Teachers engage students in justifying their mathematical thinking (76%), pose questions to build on the mathematical thinking of others (63%), and analyze the mathematical reasoning of others (53%) at least once a week (Banilower et al., 2018). The more frequently teachers use these strategies in class, the more students will engage in higher order thinking and problem solving skills. Teachers who use these strategies while engaging students in discussions about the mathematics further student skills in understanding the connections between mathematical concepts.

The National Council of Teachers of Mathematics (NCTM, 2014) has been advocating for a shift in mathematics classroom practices for over twenty five years, specifically increasing the quantity and quality of classroom discourse and encouraging discourse to become a routine practice in classrooms. An effect size is the “magnitude of

the impact that a given approach has” (Hattie et al., 2017, p. 20). The indication that a particular classroom practice is positively impacting student learning has been found to be greater than 0.40. An effect size of 0.82 has been shown for classroom discussions, further supporting that having students engage in discourse is an effective teaching practice. Teachers may choose to increase how frequently students discuss math topics, but may need PD to understand how to facilitate discourse into their classrooms effectively.

Purpose of the Study

As teachers choose their goal and select professional development to attend for the year, it is imperative that PD includes features to make it as impactful as possible. These features include alignment with their content, involvement of an active learning component, the ability to extend beyond the initial learning of the strategy, space for community building during the PD, the ability to provide reflection and feedback, and a means of follow up beyond the PD with a coach or a lead teacher (Darling-Hammond et al., 2017). These elements build the basis for effective PD. In this study, instructional coaching is one tool used to extend the time in which teachers spend engaging in professional development. Because this study focused on secondary mathematics teachers, all PD that teachers chose to attend focused on the secondary mathematics classroom, how to facilitate discourse into the mathematics classroom, and utilized videos of mathematics classrooms to discuss the strategy in action.

Research Questions

The research questions for this study are as follows:

1. How does professional development on discourse impact secondary

mathematics teachers' perceptions of classroom discourse practices?

2. In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?

Context for the Study

The State of Texas released revised standards for secondary mathematics in 2012. Among these updated standards were process standards directed at how students should engage with the learning of mathematics. One aspect of these standards is discussion, justification and explanation students should be using to make connections between mathematical concepts in both oral and written skills. By choosing to focus on facilitating discourse (students engaging in discussion, justification, and explanation) in the classroom, teachers are working on one aspect of the process standards and their personal craft. The National Council of Teachers of Mathematics (NCTM) publication *Principles to Actions* (2014) acts as a guide for teachers to structure classrooms for effective math teaching principles.

Figure 1

Effective Mathematics Teaching Practices

Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.
Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.
Use and connect mathematical representations. Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.

Facilitate meaningful mathematical discourse. Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
Pose purposeful questions. Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.
Build procedural fluency from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.
Support productive struggle in learning mathematics. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.
Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

Note. NCTM's (2014) effective math teaching practices (MTPs). From National Council of Teachers of Mathematics, 2014, *Principles to actions: ensuring mathematical success for all*, p. 10. National Council of Teachers of Mathematics.

This study took place in a suburban school district in Southeast Texas serving over 80,000 students with diverse backgrounds. The district had set goals for teachers to increase professional learning and how frequently teachers are using their learning to shift classroom practices. The district, through several committees of teachers, also set a goal for teachers to engage students in learning which encourages problem solving and communicating (Bates, 2019). Further, starting with the 2019 – 2020 school year, the district math goal focused on one of NCTM's effective math teaching practices, supporting productive struggle in learning of mathematics. Within the last three years, the district goals aligned with NCTM's goal of implementing tasks that promote reasoning and problem solving and elicit and use evidence of student thinking. The effective math teaching practices are the result of research studies on student achievement on

assessments such as the National Assessment of Educational Progress, SAT, ACT, and Advanced Placement Calculus exams. While the data trends indicated increases in student scores, the increases were not overall significant enough to allow for complacency in math teaching practices (NCTM, 2014). The resulting position by NCTM supports effective math instruction in eight strands in order for teachers to understand how to develop mathematical understanding in their students.

All district-level math PD supported productive struggle as the theme and teachers chose aspects of how they can support students with questioning, facilitating discourse, selecting tasks, and allowing students to take ownership of their learning and making connections among mathematical concepts (Bates, 2019). Productive struggle in the math classroom involved students working on a task or problem where the teacher is facilitating rather than direct teaching the problem. Teachers have prepared students with the skills needed for the task, but students must still make decisions about how to approach the task or problem and work on the problem with limited support from their teacher. Facilitating discourse is key to a classroom where students play a central role in making connections within and between mathematical concepts and teachers allowing students to grapple with rich mathematical tasks. In order to facilitate this discourse, teachers needed to plan in order for discussions to become a routine strategy used in the classroom (Bates, 2019). While teachers may understand that this is an effective teaching strategy, teachers spend little time to develop activities or tasks that involved students talking about mathematics in class. Without planning activities or tasks that support the current content in class, teachers attempted to have students discuss in the moment without a clear plan for what the outcome of the discussion needs to be in order to

support students thinking about the mathematics. Professional development helps achieve this goal of increasing the facilitation of discourse by defining what discourse is, how teachers can facilitate discussions in the classroom, and building community within their classes to foster this manner of learning. The PD was continued while the teacher works one-on-one with an instructional coach through a coaching cycle with a goal of improving meaningful discourse among students. The study focused on how continuing professional development through the coaching cycle can impact classroom practice of engaging students in meaningful mathematical discourse.

Instructional coaches are not new to campuses within the district in this study. Coaches have been on campuses full time, providing content-specific support since 2011. The district allows flexibility in how a teacher utilizes an instructional coach. A teacher can choose to work with an instructional coach as it pertains to their goal or they can opt to not work with a coach and still work towards their goals. Delivering PD for the campus and the district has been a practice of coaches for many years. Informally, the secondary mathematics coordinator for the district and coaches have found that when teachers and coaches attend the same PD, the teachers are more willing to use the strategies as the PD continued through the coaching cycle on campus. This has especially been true for teachers of Algebra 1, as the district has implemented a multi-day PD workshop for all teachers of Algebra 1. Results from this workshop strongly suggest that teachers who engaged in the coaching cycle with the campus math coach to assist in implementing the strategies learned at the institute saw improved statewide test scores. The district saw gains in the statewide test scores in 2017 when teachers were working with their coaches in a coaching cycle. In 2018, the surrounding district scores decreased

when this particular districts' scores remained the same from the previous year (Bates, 2019). While the institute is still in effect, this particular study enrolled teachers of any math course who wished to focus on facilitating discourse in the mathematics classroom. Throughout the year, teachers also engaged in PD that continues to focus on productive struggle (the district math focus) and teachers were given an opportunity to focus how discourse in particular contributes to productive struggle.

Significance of the Problem

Studies published on instructional coaching and secondary mathematics are rare, with very few published between 2009 and 2019. Since 2009, researchers have published more studies on discourse with elementary-aged students than secondary students. This study focused on two essential elements. One element is how teachers worked with an instructional coach to improve the practice of discourse in the classroom, and the second was how working with an instructional coach continues PD to keep a focus on improving a classroom strategy after the initial PD has ended. The literature on instructional coaching as a process is available and detailed in the literature review that follows, however, few empirical studies exist for secondary mathematics classrooms. This study aimed to fill a paucity of research on instructional coaching and professional development in the secondary mathematics field.

Definitions

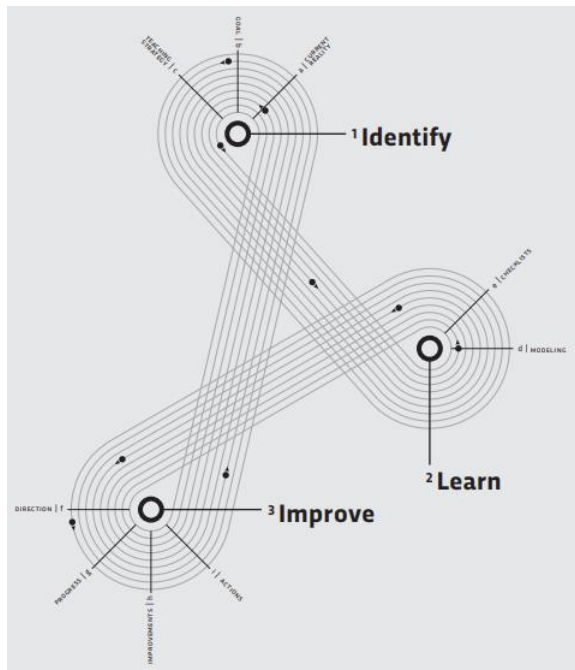
In this study, the following definitions applied.

- **Discourse** refers to students talking about the mathematics, making connections within mathematics concepts, as well as connecting prior knowledge to new learning (NCTM, 2014).

- **Professional development** is learning that teachers engaged in to further their knowledge of pedagogy and implement new strategies into their classrooms (Darling-Hammond et al., 2017).
- An **instructional coach** is a campus based teacher who is an expert in their content and pedagogy (Knight, 2018).
- The term **campus based** describes a person who is supervised by the building principal and does not have a role within central administration of the district.
- A teacher engaged in **instructional coaching** by meeting with a professional development coach who assists the teacher in choosing goals and improving practice.
- The **coaching cycle** was the process through which a teacher and coach worked together in a systematic method of the two people meeting three times. These meetings consist of a pre-conference (goal setting, Identify phase), the coach and teacher meet to plan and strategize how to implement discourse into a lesson (Learn phase), the teacher filming their class, then both the teacher and coach watching the video, then a post-conference (Improve phase) within a day or two of the observation to discuss how the teacher is progressing toward the goal (Knight, 2018). See Figure 2.

Figure 2

The Coaching Cycle



Note. The coaching cycle as a three step process when teachers and instructional coaches work together. From Knight, J. (2018). *The impact cycle*. Corwin. Reprinted with permission.

Preview of the Methodology

This study employed a case study approach. The researcher was a mathematics instructional coach employed in the district where the study takes place and delivers PD to teachers within the district. Within the district, instructional coaches are assigned to work at a specific campus and focused on one subject. For this study, the researcher and the instructional coach are the same person for teachers who teach mathematics at a particular campus. The researcher will consider participants as individual cases where they are able to respond to surveys about their perceptions of instructional coaching and

professional development as they focus on facilitating discourse as the classroom practice. Participants had the opportunity to enroll in a half-day professional development about facilitating discourse during the summer. Prior to the PD starting, participants completed a survey (found in Appendix A) on discourse and how they use discussions in the classroom. In the session, the researcher focused on what facilitating discourse could entail and a discussion of how to build the classroom community for students to be able to engage in discourse. Participants were asked to reflect on current classroom practices and what they would need to work on in order to start the year with these practices in mind. Following the PD, teachers completed a different survey (found in Appendix B). One survey question asked if they would like to work with their campus instructional coach or the researcher to focus on facilitating discourse throughout the year. The survey included questions that were given a numerical score as well as qualitative questions to answer as they pertain to their perceptions of PD and working with a coach to shift instructional practices. As the teacher and researcher engaged in the coaching cycle, the teacher will complete a survey after each cycle that includes quantitative and qualitative questions.

Summary

As an instructional coach, the researcher was seeking to understand how professional development and the coaching cycle impacts secondary mathematics teachers' ability to implement discourse practices in their classrooms. Having informal knowledge that working with an instructional coach does improve specific classroom practices, the researcher was seeking to understand how the coaching cycle impacted specific teaching practices through surveys the participants completed.

Through the introduction of T-TESS, teachers now choose an area to grow as professionals. The NSSME+ calls for PD to be content focused and supports the use of engaging students into discourse as a teaching strategy. NCTM further supports teachers who facilitate discourse in the classroom as a strategy to have students think deeply about mathematical content and comparing ideas of how the content connects together. The TEKS have included discussion, justification, and explaining the mathematical connections, furthering support for teachers to engage students into discourse in the classroom.

The school district where the study took place in also supports NCTM's Effective Math Teaching Practices by focusing on productive struggle. Teachers can use facilitating discourse as a tool to have students make connections between mathematical concepts. Instructional coaching was used to support teachers as they plan and implement this strategy into their classrooms. As teachers chose to participate in the initial PD on facilitating discourse as well as the coaching cycle with the coach examining their classroom discourse practices, teachers are engaged in PD that directly impacts their classroom practices. The lack of published studies on instructional coaching in the secondary mathematics classroom indicate that there is a gap in the research. This study aims to add to the body of research on instructional coaching and the secondary mathematics classroom by employing a case study methodology. Each case will be represented by a participant who was currently teaching in a secondary mathematics classroom with a goal to increase how their students are talking about and engaging with mathematics in the classroom.

Chapter II

Literature Review

The purpose of the study is to examine how professional development and the coaching cycle impact secondary mathematics classroom discourse practices. The purpose of this chapter is to review the body of research of professional development, instructional coaching, and discourse practices. The chapter will include the following sections: (1) sociocultural theory of learning; (2) discourse practices; (3) professional development; (4) instructional coaching in the mathematics classroom.

Sociocultural Theory

The purpose of this study is to determine how professional development and the coaching cycle impact secondary mathematics discourse practices. Vygotsky's sociocultural learning theory provides the basis of this study. In this study, the participants were students or learners when they were engaged in PD and the coaching cycle as they learn to facilitate discourse into their classrooms. In PD, participants discussed with peers about discourse in their classrooms as learners and in the coaching cycle, they are situated as co-learners with the researcher. Vygotsky's theory applies to both when the teacher is the learner as well as when the student is the learner.

As participants facilitate discourse into their classroom, the theory applies to the students who are learning through discussion with each other. Vygotsky posed that learning occurs in social settings through the use of language. These social settings become classrooms that transform into learning communities when all the participants engage in learning, and through discourse, build on one another's ideas and contribute to the classroom community of learning. The teacher's role is that of a facilitator,

understanding what students are saying and asking their peers if they agree or disagree (Vygotsky, 1978). The teacher also has a role to supplement the language of the classroom to include appropriate vocabulary and provide context to assist in student learning. When teachers attend PD, they become the student and learn the strategy presented just as a student would learn in the classroom. The PD session becomes the classroom and the learning is supplemented by participants (teachers) discussing the strategy and how to implement the strategy into their classrooms.

Educational theories can be defined as “explanations of the human phenomenon of learning, not truth statements about why we do what we do” (Jaramillo, 1996, p. 134). This definition is central to learning theory because Jaramillo (1996) is constructing his discussion around “how we learn” rather than “why we learn.” Central to Vygotsky’s theory is the idea that students learn in social situations and through self-discovery (Vygotsky, 1978). Students construct their learning through a series of interactions with their peers, their teacher, and the materials used to teach. Defined more accurately as experiential learning, students learn not only the content but also from the experience of learning. It is the teacher’s role is to create learning environments that support experiential learning. The teacher facilitates the learning through activities that include manipulatives. Manipulatives can be concrete models that build on students’ conceptual knowledge before the learning bridges to abstract ideas. Students then can create meaning through their experiences of learning and discussing with each other.

Classroom Structure

Educational reform based on sociocultural theory states learning occurs during discourse about the content that students are working on (Forman, 2013). Reformed

classrooms have been defined to include small group work, working within open-ended questions to shape learning, allowing problems to be open so that students can approach the problem from multiple access points and solve it in several ways, and opportunities for students to explain their processes to each other (Forman, 2013). Connected to the Vygotskian theory of sociocultural learning where social contexts promote learning, learning occurs when teachers model the approach through practice. Students grow as learners when they are in their zones of proximal development and build upon their knowledge by practicing discussions of content (Vygotsky, 1978). Learning mathematics requires discourse and students to make sense of the content through activity (Forman, 2013). Learning takes shape as students participate in communities that practice meaningfully (Lave and Wenger, 1991). Specific to mathematics classrooms, “the ideal conditions for learning mathematics would involve access to meaningful activity within a community of mathematical practice” (Forman, 2013, p. 118). Building on the idea that learning occurs when students engage in practice in a community setting by saying “learning is synonymous with socially situated activity” (Forman, 2013, p. 118). Students are learning in a social setting when they are able to learn content within the context of a mathematical setting where students are posing various methods of thinking and finding solutions.

Teachers utilize sociocultural theory to build students’ mathematical understanding as a central theme within the classroom when learning structures around collaboration, social settings, and the negotiation that the learner does while thinking and learning, the teacher (Hickey, 1997). Learning in which students assist each other to perform beyond their individual level of learning is known as assisted learning. Learners

engage in assisted learning when they learn within their own zone of proximal development (Vygotsky, 1978). An additional definition for sociocultural theory is in terms of students learning through socialization with others as they assist each other in actually learning (Hickey, 1997). Students acquire knowledge through social interaction (Vygotsky, 1978). Students become motivated to learn when presented with a goal based on a learning objective that is met through social interaction and communication with other students (Hickey, 1997). Teachers plan tasks and activities in a way that is meaningful to students in order to increase students' motivations when they become engaged in cooperative learning, decision making, and collaborative situations. As teachers tailor activities and tasks to student interest, individual students may choose to engage more deliberately in the collaborative nature of socio-constructivist centered activities (Hickey, 1997). Students need to have contributed to the creation of the community norms in order for the social interaction and communication to be effective.

Classroom Roles

Sociocultural theory is based on the idea that learning is both social and cultural. The teacher's role in the classroom is a supportive facilitator who helps students construct their knowledge through discussion. The teacher and students hold each other accountable for taking ideas posed to the community, discussing the ideas thoroughly, and reaching a consensus to construct their knowledge. In a seminal study of socioculturally-mediated learning, researchers analyzed the mathematical development of students in the social context of the classroom (Cobb & Yackel, 1995). The study included how social norms develop in mathematics classrooms. They found that students and the teacher had to jointly create the social norms in the classroom. This gave students

a voice in the room as well as understanding their role, their peers' role and how the classroom structure would work with everyone working together as a community. Over time, students assume responsibilities during tasks assigned in class, and this helps to build classroom community. Part of this responsibility was learning when solutions to the task were similar or different to their own; when pieces of solutions to tasks were similar but the thinking to reach that conclusion was different; and when an explanation was sufficient (Cobb & Yackel, 1995). As the classroom norms continue to form by these ideas, students became autonomous in their participation in the community. Student participation in the community can also be described as "students' mathematical activity to be social through and through in that it develops as they participate in classroom mathematical practices" (Cobb & Yackel, 1995, p. 11). Students learning math through social situations within the classroom and through discussion directly connect to sociocultural theory.

Language and Communication

The concept of students and the teacher developing classroom norms and responsibilities during activities hold students accountable for their own learning. Accountability includes students' participation in discussing the activity. Students are held accountable through their communication and the central role communication plays in sociocultural learning (Steele, 2001). Communication (as defined by students sharing ideas with each other or writing down ideas) is how students begin to make connections about what they are learning. "In a sociocultural approach to teaching, communication is central to learning" (Steele, 2001, p. 404). In the concept of sociocultural teaching, communication is a central component as a cultural tool (Vygotsky, 1978). Both teachers

and students define culture in the classroom and students begin to communicate with the language tools of the classroom. The language becomes a part of how students make connections between concepts in the math classroom (Steele, 2001). As students begin to learn to reason, they are making mathematical connections of their own. The students take previously learned material and make connections with the new material through sharing their ideas with others. As the teacher is using communication to help further the activity, they are also encouraging the use of communication as a tool the students can also use. The language that a teacher chooses to use helps to shape the culture of the classroom (Jaramillo, 1996). As students work together, they are constructing knowledge through the activity provided by the teacher as well as through talking with their peers. They hold each other accountable for the learning of the day (Jaramillo, 1996). Students will continue to build their vocabulary and structure of their discussions the more that it is practiced and used in the classroom.

Students need to be able to put the learning in context in order for learning to be meaningful (Forman, 2013). Students have to learn to take what a teacher is telling them and build their vocabulary during discussions. Vocabulary can be defined as words put into a mathematical context as well as symbolic representation. Students need to be able to practice with the new vocabulary as it gives them a chance to apply a new meaning to words they already know in building their mathematical vocabulary and context. Students can imbed these practices into classroom work by presenting their work to the class, presenting multiple solutions, listening to others, learning how to disagree with another student, be able to explain and understand how others arrived at their solution(s). As students practice with mathematical vocabulary, they gain insight on how the new

vocabulary helps build understanding of mathematics, and this process helps to build community within the classroom. Students can hold each other responsible for their mathematical language which also supports the community. As students build their mathematical vocabulary, they build their cognitive skills of reasoning. The communities that form in classrooms support sociocultural theory, when they have students who hold each other responsible for their own learning, use appropriate mathematical vocabulary, and are able to explain and justify solutions (Forman, 2013). Learning requires discourse and student participation in the learning activities according to socio-cultural learning theory.

The teacher facilitates student engagement by motivating students, building their classroom community, and attending to tasks with that community. The teacher has chosen to shift the classroom to hold students responsible for each other's learning and shift their classroom to be more student centered. Instructional shifts that need to occur in the mathematics classroom have been a focus of NCTM since 1991. They include learning math as a community, using logic and mathematical evidence as justification, using mathematical reasoning, using conjecturing and problem solving, and connecting mathematics concepts (Harvey & Charnitski, 1998). These ideas have endured time in that they continue to be supported in *Principles to Action*, NCTM's 2014 publication.

Language, along with the culture and social environment, impacts how students think and process thoughts (Harvey & Charnitski, 1998). Vygotsky's theory is central to the idea of learning through collaboration and the relationship that language has with thinking. Vygotsky described two kinds of learning. Some learning is spontaneous through context in the cultural environment and other learning is scientific and learned in

a structured classroom activity. The two are dependent on each other as students learn in everyday contexts, then can apply that context to the classroom and likewise take classroom learning and apply it to everyday contexts (Harvey & Charnitski, 1998). As students are in their zone of proximal development, the student learns with the support of the teacher and other students through communication. The teacher's role is to support students through their discourse and push students to maximize their learning.

Sociocultural theory supports students at the center of learning in the classroom. The teacher shifts to be a facilitator and the community holds students accountable to complete the task, have a deeper understanding of the mathematics, and to make connections between mathematical concepts. Teachers also become learners when they are learning about a strategy, talking to their peers about facilitating discourse, and learning about their practice through a coaching meeting.

Discourse

Facilitating discourse into the mathematics classroom is one facet of effective teaching. Teachers need to plan for activities which include discourse, when they might fit into a unit of study, what connections students might be able to make, and how students will engage with the mathematics (Walshaw & Anthony, 2008). Part of treating students as mathematicians in classrooms is building a community that allows for students to discuss and make connections within and between mathematical concepts. Teachers need to understand what student discourse will look and sound like in their classrooms as well as understand what their role is during discussions. Student discourse is defined in this study as students discussing not only mathematical procedures but also students making connections between mathematical concepts and ideas and being able to

share these ideas verbally as well as written within their work. The teacher should act as a facilitator of these discussions by building community in their classrooms, value prior knowledge that students arrive in the classroom with, ask questions that support and encourage students to continue to reason, and build academic vocabulary with students as the year progresses (Kersaint, 2017; Nathan & Knuth, 2003; NCTM, 2014; Stein, 2007; Walshaw & Anthony, 2008; White, 2003). Within a classroom, student discourse might sound chaotic or unproductive. Teachers who use and understand the elements of discourse listen carefully to these conversations to determine what connections students build about mathematics.

Classrooms as Communities

For these conversations, teachers must build classrooms that are safe for students to agree and disagree with each other (McGlynn & Kelly, 2018; Walshaw & Anthony, 2008). Teachers need to train and teach their students what they expect of them while discussing and let students know that they will have some responsibility for sharing with the whole group what they discussed. Teachers are responsible for creating classrooms that allow for students to think, share and reflect on others' ideas.

Teachers who are effective have been shown to establish classroom spaces that are truly conducive to sharing. They work at developing interrelationships that create cognitive and physical spaces for students to develop their mathematical and cultural identities. In classroom arrangements, creating such spaces depends a great deal on creating a hospitable environment that makes it possible to reason, communicate, reflect on, and critique ideas. (Walshaw & Anthony, 2008, p. 539)

In addition to building community in the classroom, teachers must also ensure that all students participate in both small and large group discussions and are accountable to their classmates and themselves (White, 2003). The building of a mathematical community gives students a common purpose and responsibility within the community to listen and understand other students' viewpoints and methods (Boaler, 2016a). Routine practices of the classroom support students learning through participation (Yackel & Cobb, 1996). Students understand that a mathematics classroom requires them to participate in the discussions and classroom activities in order to learn while doing mathematics. As teachers build community in their classrooms, the classroom norms are set early in the year. They need to establish what students are doing when they contribute to a discussion and also what their role is as a listener in the classroom (Wood, 2002). Classroom discourse participation includes students who can add to the discussion, listen to other students, tie information together, respect the conversation, and accept other contributions to the discussion (Yackel & Cobb, 1996). As the teacher is responsible for building the community, establishing classroom norms, and facilitating these conversations, the pedagogical skills involved in continuing these discussions develop over the course of the year (Walshaw & Anthony, 2008). As teachers hone their skills engaging students into discourse in the classroom, they validate students' thoughts and help students to realize that they contribute to the community of the mathematics classroom (Cobb et al., 1993).

Classroom Roles

The teacher's role is more than just preparing an activity for students to talk through. Teachers need to plan activities for students to work through on a regular basis,

and support students in various ways such as listening to students, using a revoicing technique to ensure they understand what the student is saying, model a conversation for students using appropriate vocabulary, and question students when the teacher knows students need push their thinking (Walshaw & Anthony, 2008). The analytical nature of this type of scaffolding allows the teacher to use correct vocabulary, if needed (Nathan & Knuth, 2003).

The teacher must give each child an opportunity to work his or her own way through the problem under discussion (whether publicly or privately) while simultaneously encouraging each of them to listen and attend to the solution paths of others, building on each other's thinking. (O'Connor & Michaels, 1996, p. 3)

By serving as a discussion facilitator rather than a discussion leader, the teacher shifts the ownership of the conversation to the students. Teachers can become facilitators by listening to what students are saying and posing questions to students in order to allow them to elaborate their thoughts and create a deeper understanding of the connections within the task (Manouchehri & Enderson, 1999). The teacher is valuing student contributions to the classroom as they listen to student conversations (White, 2003). In addition to building community when students share their conversations with the class, student learning becomes the focal point as they are building on each other's knowledge and creating the connections (Walshaw & Anthony, 2008). Teachers may repeat what students are saying, modeling appropriate vocabulary when necessary to allow for the whole class to hear the contribution to the learning, clarify what a student is saying, extend the class discussion or include new ideas (O'Connor & Michaels, 1996). This strategy allows teachers to use contextually appropriate vocabulary when they repeat the

students' ideas, which gives students practice in hearing the vocabulary in a conversation and in a mathematical context (Walshaw & Anthony, 2008). Teachers may also choose to shape their classroom communities by structuring a discussion around a debate. Students can take sides in an argument and work to prove and defend their side of the argument against the other side (O'Connor & Michaels, 1996). During any classroom discussion, the teacher's role is to facilitate the forward motion of the conversation(s). The teacher needs to be able to listen to what students are saying, understand their reasoning behind it, pose questions for students to be able to clarify their thinking, and move students to a conceptual understanding of the topic (Walshaw & Anthony, 2008).

Further, students have an obligation to listen to their peers in order to make sense of their thinking and reasoning to contribute to their own personal learning (Manouchehri & St. John, 2006). As students listen to each other, they make connections within concepts and are then able agree or disagree with each other's reasoning. Teachers and students listening to each other is critical when discussing discourse (Ihan & Erbas, 2017). Teachers and students have to be aware of their listening style for different parts of a classroom conversation. These styles might include listening for a right or wrong answer, listening to understand one another's thinking, or listening for how one is contributing to the conversation (Davis, 1997).

Vocabulary

Teachers should model these conversations with students along with including the mathematically correct vocabulary (McGlynn & Kelly, 2018). Students will build on their vocabulary as the year progresses and through the study, teachers will take note of student improvement in their discussions. As teachers encourage correct mathematical

language, they should be aware that students are learning not only new vocabulary words, but also symbols, notation, and semantics of vocabulary use (Kersaint, 2017). Students begin to apply mathematical meanings to words they may already have in their vocabulary in order to create critical thinking about the mathematical concepts (Walshaw & Anthony, 2008). Teachers need to support students over time with adapting vocabulary words and their meanings within their mathematical community to maximize student understanding. Teachers can model correct vocabulary and usage within discussions with students to assist in their development of the language and meanings (Khisty & Chval, 2002). The teacher has a large responsibility for teaching mathematical vocabulary and context, as they “profoundly influence the mathematical meanings made by the students” (Walshaw & Anthony, 2008, p. 533). Assisting in implementing appropriate vocabulary within the context of a discussion is essential for English language learner (ELL) classrooms. Repeating students’ contributions to the class, assisting with vocabulary as needed, helps ELL students learn the vocabulary in the mathematical context (Walshaw & Anthony, 2008). As a teacher models a discussion with appropriate vocabulary then shifts the responsibility of the discussion to the students, students take ownership of the learning and are able to mimic what their teacher is doing, then are eventually able to use their own voice to explain and justify their thinking (Wagner, 2007). Teachers assist students in building their mathematical vocabulary within the context of classroom discussions in order to build their classroom community to be a community of support that will foster student knowledge of the content.

Questioning

The way teachers question students is also important to building student capacity in discourse (Aizikovitch-Udi & Star, 2011; Stein, 2007; Stylianou & Blanton, 2011; Truxaw & DeFranco, 2004). In order for students to start thinking critically, the teacher must examine their role in how they question students (Truxaw & DeFranco, 2004). The focus of these question patterns will be to have students use higher order thinking skills to have students be able to clarify their thinking and reasoning (Aizikovitch-Udi & Star, 2011). Students' ability to reason sharpens when teachers respond to questions with additional questions (Stylianou & Blanton, 2011). Student thinking should be probed on why they think what they are saying is true not only by the teacher but also by their peers (Manouchehri & St. John, 2006). The teacher has a role in establishing students questioning each other as part of their discourse community and preparing students on how it is appropriate to question others. The teacher should also model this behavior when asking students questions. Discussions should be reciprocal in nature so students can analyze how other students view and make connections in math classes and determine how they are different than their own (Manouchehri & St. John, 2006). A study on discourse from 1999 focused on a classroom where the teacher shifted discourse away from herself and engaged students to discuss and challenge each other. The teacher facilitated discussions so that students were voicing their ideas, elaborating on their ideas, and questioning each other's contributions. The teacher encouraged her students to make connections among concepts and express their ideas in multiple formats (Maouchehri & Enderson, 1999). The ability to reason and make sense of math is the true study of mathematics (Boaler, 2016b). Discourse in the math classroom should be structured

around tasks and questions that support students in making connections between concepts, making sense of the current material and connecting the new learning to prior knowledge (Kersaint, 2017; Truxaw & DeFranco, 2004; White, 2003). When students connect math to everyday life, they have a chance to practice informally with numbers. When they talk about the math they are learning, students are able to make connections and make sense of what they are learning.

Background Knowledge

Students possess various background knowledge that is valuable to classroom learning (White, 2003). This background knowledge forms from their lived experiences and culture outside of school and discourse in the math classroom builds on this knowledge. Teachers should access this background knowledge and tie it into current content on a recurring basis through discourse practices (Walshaw & Anthony, 2008). Teachers need to value student mistakes during the learning process (Boaler, 2016b; Stein, 2007). As students progress through their classroom tasks using discourse, teachers listen to conversations and begin to find mistakes in their problem solving or flaws in student thinking. These mistakes provide valuable information to the teacher as to what misconceptions a student may have in their background knowledge or their current learning. While not all mistakes can be planned for, teachers should plan for where they think students will have misconceptions and be prepared to guide students through questioning to resolve these issues. Through these questions, students are continuing to build on their knowledge in talking through the answers to the questions with their peers. As students gain skills throughout the year in having academic conversations with each other, they will be able to have back and forth academic conversations where they listen

and analyze other students' thinking and compare it to their own. The reciprocal nature of these discussions is the goal of effective discourse in the classroom (Manouchehri & St. John, 2006).

Professional Development

The National Council of Teachers of Mathematics (NCTM) has stated that the Mathematics Teaching Practices (MTPs) should be used to guide mathematics instruction in schools (2014). The MTPs provide teachers with strategies that are high-leverage practices to engage students in deep understanding and learning of mathematics. These practices are not innate and take time and practice for most teachers to employ as tools in their classrooms. Teachers have a responsibility to support students in “conceptual understanding; the capacity for disciplined reasoning, analysis, argument and critique; and the ability to communicate ideas and interact effectively with others” (Ball & Forzani, 2011, pp. 19-20). Teachers need to be able to learn what students know through questioning, discussions, and written work. Teachers need to know what students truly understand and be able to validate the students' reasoning (Ball & Forzani, 2011). Many professionals need training on these and other strategies to use in their classrooms.

Professional development can be defined as “structured professional learning that results in changes in teacher practices and improvement in student learning outcomes” (Darling-Hammond et al., 2017, p. v). There has been a consensus among researchers about what should be included in the framework for professional development (Darling-Hammond et al., 2017; Desimone, 2009; Garet et al., 2001; Penuel et al., 2007). Effective PD includes: involvement of community, promotion of collaboration, consideration of the PD duration, content focus and applicability to the teachers attending, active learning opportunities,

coaching or mentoring component for assisting teachers in implementing the PD, and time for reflection and feedback for teachers to think about when they might implement new learning into their classroom. The need for PD is even more critical as students need to have the skills necessary to be successful outside of the classroom. Students today need skills such as critical thinking, collaboration, communication, and self-direction (Darling-Hammond, et al., 2017). In the following paragraphs, each of the vital skills gained from PD will be discussed further.

Figure 3

Components of Professional Development



Community and Collaboration

Research has found that when teachers from the same school, grade level, or content area attend the same professional development session and return to their campus and continue to plan together, there is a greater chance of the information gained from the

PD implemented in the classroom (Garet et al., 2001; Darling-Hammond et al., 2017; Easton, 2008; Hill et al., 2013; Penuel et al., 2007; Desimone, 2009; Buczynski & Hansen, 2010; Bates & Morgan, 2018). Collaboration occurs when a collection of teachers from the same grade, content, or team that can take the learning and continue to work together on the common goal of the professional development (Desimone, 2009). In addition to building community, the practice of teaching develops into a collaborative process in which teams of teachers within a particular school work and learn more effectively together and from each other; this collaborative PD has resulted in positive changes not only in the classroom but in terms of the school's culture as well (Darling-Hammond et al., 2017). Continued support for teachers from campus leadership, departments, or grade levels develops trusting relationships that allow teachers to be bold and vulnerable in order to solve problems and improve their own practice.

As teachers build community with their group from PD, they continue their learning from PD and are able to observe, be observed, view and discuss student work, and share issues they are having in their classrooms. Teachers who work together and attend professional development together are more likely to carry the learning into their lesson planning sessions and ultimately take their learning into their classrooms. Hearing from other teachers, receiving feedback on a different way to try teaching strategies, and continuing to be encouraged by the community also helps foster the growth that begins in professional development (Garet et al., 2001). Teachers from the same school or grade level should attend the same PD in order to have people to collaborate with on campus and to support each other as they implement new programs or classroom strategies (Penuel et al., 2007). This collaboration assists in building trust within the teaching

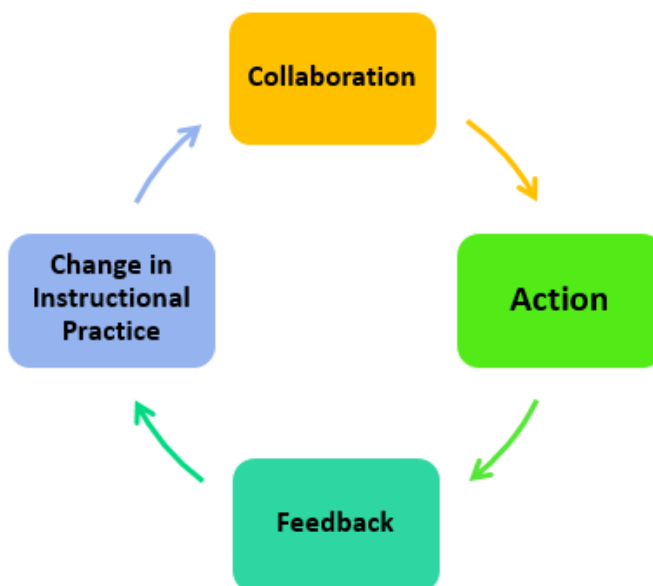
community and will keep teachers accountable for using the program as well as able to troubleshoot when teachers need support (Penuel et al., 2007; Bates & Morgan, 2018).

These communities help form a team that can problem solve in a supportive way.

“Collaboration ultimately allows a group to arrive at solutions through professional, evidence-based conversations” (Baker & Morgan, 2018, p. 624). Further, these conversations begin a cycle of action, feedback, and change in instructional practices (Baker & Morgan, 2018).

Figure 4

Teachers working within community



As teachers work within a community, professional learning communities (PLC) form. PLCs might be formed by campus leadership to indicate that teachers should be working together, but it takes a collaborative nature of the members for PLCs to be effective. PLCs function at their peak when there is trust between each member. This

trust allows for feedback to be given and received in a way that is constructive to the learning process. Within the PLC, teachers should work together on their cycle of improvement by using student work, observing each other, giving and receiving feedback, and reflecting on their current practices to determine what changes need to be made (Stewart, 2014). If the teachers from the same PLC attend a professional development, the cycle of change can be strengthened when the PLC focuses on implementing the strategy learned and supporting each other through the implementation process in the classroom.

In addition to making classroom instruction more effective, the most improvement was seen in schools where multiple teachers engaged in the same professional development (Buczynski & Hansen, 2010). As the research suggests, when teachers from the same school, grade level, or content area attend the same professional development, they begin to build community and a support system to utilize when implementation of the learning strategy needs adjusting. Additionally collaboration in teaching assists to foster community among teachers when they are working to implement the same strategies in their classrooms and have each other to discuss what is working for their classrooms and what isn't.

Duration

The length of time teachers spend in professional development is referred to as duration. While teachers may think of professional development as a one day commitment, research supports a longer duration of PD that may span weeks or months. Duration can include an initial, longer session that can engage teachers into deep content knowledge along with shorter sessions that supplement the initial session (Garet et al.,

2001). The addition of shorter, follow up sessions allows the teacher to have time to try the strategy in their classroom followed by feedback from an expert teacher or a coach.

Teachers working with others from PD will actively extend the duration of the session. Teachers should engage in a sustained amount of time of PD in order to learn the teaching strategy fully and implement it successfully into the classroom (Darling-Hammond et al., 2017). “Professional development that is sustained, offering multiple opportunities for teachers to engage in learning around a single set of concepts or practices, has a greater chance of transforming teaching practices and student learning” (Darling-Hammond et al., 2017, p. 15). Therefore the duration of PD opportunities are important for administrators to consider.

Furthermore, the duration of a professional development extends when teachers engage in observation, feedback, or coaching as they implement the PD into their classrooms (Desimone, 2009). Informal discussions during teacher meetings, reflecting on lessons, looking at student work, and coaching and/or mentoring are times that teachers continue to grow and learn (Borko, 2004; Desimone, 2009). Due to an emphasis on how PD encourages learning, terminology can shift from the professional development to professional learning (Easton, 2008). More importantly, as technology advances and students become more complex in their learning needs, teachers have to shift their thinking about how their own professional growth trajectory should include strategies to meet the changing needs of their students. Learning is ongoing and can occur within the workplace on a regular basis (Easton, 2008). Duration of professional development can be thought of as a long-term and continual process rather than a one day PD where implementation never occurs in the classroom (Baker & Morgan, 2018). As

teachers continue to work on a cycle of implementation, observation, reflection, and enacting changes, they engage in continuous learning. Just as students need time to learn a concept and how to apply it, so do teachers (Baker & Morgan, 2018). Consequently the duration of PD that is longer and more involved than one half-day session is most effective for long term impact.

Content Focused

Professional development can occur in many different settings and is best situated within a teacher's content such as mathematics or social studies. Professional development, when content focused, is more effective than sessions on a generic teaching practice because teachers can use the strategy or strategies in their classrooms; ultimately having more of an impact on student learning. Professional development should mirror the strategies teachers take back to their classroom, but teachers first should learn the strategy within the context of what they are teaching (Buczynski & Hansen, 2010). "The continual deepening of knowledge and skills is an integral part of any profession" (Garet et al., 2001, p. 916). Student growth is partially dependent on how prepared teachers are to help their students grow and that preparedness to teach is an outcome of effective professional development. Therefore, teacher growth is dependent on professional development focused on the content that they teach and how students learn the content (Garet et al., 2001). Professional development sessions should focus on a particular content. When this occurs, the content becomes a "central dimension of high-quality professional development" (Garet et al., 2001, p. 925). Teachers who attend PD to learn new strategies within their content area will be able to visualize how they can implement the strategy into the classroom.

Teachers need to understand what the strategies learned in PD might look like in their classroom as it pertains to the content that they teach (Darling-Hammond et al., 2017; Baker & Morgan, 2018). PD should be designed to incorporate these skills in order to model for teachers what this might look like in the classroom so that they are willing and able to try something new in their instruction method (Darling-Hammond et al., 2017). Teachers need in-depth engagement during the PD and follow-up with an instructional coach to assist in implementing the strategy effectively into their classroom (Penuel et al., 2007). Further, “when teachers are more comfortable with teaching a particular topic, they are more likely to allow for student questioning and discourse, an essential feature of inquiry” (Penuel et al., 2007, p. 930). Deep teacher knowledge of the content allows a teacher to contemplate the best strategy to teach because teachers are able to focus on the strategy rather than learning the content themselves. Teachers need to have deep and flexible content knowledge in order to understand where students have misconceptions and to quickly ascertain if a student’s reasoning is correct (Ball & Forzani, 2011). Not only should PD focus on content, but also it should focus on “how” students best learn the content (Garet et al., 2001). Teachers who have a deep understanding of the content gain content knowledge through repeated iterations of learning, implementing, and improving (Borko, 2004). Focusing PD on how students learn the content and includes an instructional coaching component for continued support for implementation, teachers are more likely to implement the strategies into their classroom successfully.

Active Learning

In addition to needing a strong connection to content, teachers need to be active learners in the professional development they attend. Teachers should be participants in the learning, and they should also understand what components of a training have an impact on student learning by having an active role in the PD (Antoniou & Kyrakides, 2013). As teachers understand what skills they are learning, they can make connections to how it may impact their classroom and consequently, active participation will help the teachers learn and use the strategy in their classroom.

Active learning can be described to include observation (both observing others and being observed) with feedback provided, analyzing student work, and discussing strategies (Desimone, 2009). Active learning should include the facilitator of the PD giving teachers the chance to try the strategy in a small group setting, then allowing time for teachers to receive feedback and reflect on how the practice might look in their classroom. An effective PD facilitator models teaching methods through participation, videos, observation notes, or viewing student work samples. Through these activities, teachers are actively learning as a student would (Darling-Hammond et al., 2017). “The importance of providing professional learning in conjunction with model curriculum and classroom materials should not be underestimated” (Darling-Hammond et. al, 2017, p. 12). Professional development needs to have specific teaching practices modeled during the session in order for teachers to learn and they should be centered on their content as well as including activities that keep the learner engaged (Hill et al., 2013). Teachers should take an active role in learning the content or strategy and should be engaged deeply in the learning. PD which allows teachers time to plan and discuss impacts the

classroom implementation of the strategy learned (Penuel et al., 2007). Professional development has positive effects on teacher self-efficacy when the learning is content-focused; teachers engage in active learning and have goals similar to other learning opportunities they participate in (Garet et al., 2001). Teachers are more likely to try the strategies in their classrooms when they understand that their learning has a direct impact on their students and that the learning is part of a larger, common goal for instruction. Support from their community and having the community also striving to reach the common goal set by their team, school, or district is also an important aspect of successful PD.

Coaching or Mentoring

Much of the literature on professional development supports a coach or expert teacher assisting with classroom implementation and/or follow up from the PD (Citation to back this up). Teachers who engage in a cycle of learning, implementing, and reflecting are more likely to continue to use the strategies they have learned in PD if they have support throughout the process. As teachers immerse themselves in the learning of a new strategy and focus on understanding what the strategy is, they may need support in how to implement the strategy into their classroom.

Teachers bring their own knowledge to the PD in terms of the content that they teach and their knowledge of the teaching pedagogy they have tried in their classrooms. PD should link content to pedagogy in order to best support teachers. As stated previously, content cannot be presented without teachers understanding how it links to classroom practice. Therefore, teachers should engage in the strategy as students would for whatever topic that PD is trying to get teachers to learn, not just learn about the

strategy. Teachers need time to learn the strategy as well as think of how it might work in their classroom, discuss what may occur when students work with the strategy, and problem solve ahead of trying it in their classroom. Participants should have access to either a coach or an expert that can engage in coaching sessions with the participant. The coach could observe in person or the participant can record a class. In either instance, the teacher should reflect with the coach on the observation. (Darling-Hammond et al., 2017). A common support for teachers is a coach who observes within a teacher's classroom to provide individual feedback to the teacher. The teacher and coach choose the practice they will work on together based on the observation of the classroom or a focus that the teacher wants to improve within their practice. Once a teacher establishes a plan, the coach observes and provides feedback to the teacher. Teachers who receive coaching in addition to PD are more likely to implement the strategy than those who just receive PD (Darling-Hammond et al., 2017). There is a higher chance of the strategy being used on a regular basis when teachers have a firm grasp of a teaching strategy situated within their content and support beyond a PD session through coaching,

In addition to having a coach, as teachers begin to take the strategy back to their classroom, they should engage in observing other teachers (preferably those who participated in the initial professional development) as well as being observed by others (Garet et al., 2001). The observation then needs to be followed by a discussion between the observers and the teachers being observed. During that discussion time, student work can be viewed to assess if the strategy was effective and teachers can then plan for future lessons at an appropriate rigor (Garet et al., 2001). This cycle of observation and discussion supports the community of PD where teachers can plan, process, discuss, and

continue to improve their practice. Teachers continue to learn and grow from their peers as they work as a community to improve their practice. When coaching occurs during the school day, there was a positive relationship between the learning from PD and the teacher using it in their classroom (Garet et al., 2001). Learning opportunities such as coaching or mentoring, observations, and looking at student work can occur within the workplace on a regular basis and allow for teachers to continue to improve through a cycle of learning, implementing, and reflecting (Easton, 2008).

Feedback and Reflection

As teachers engage in the learning as active participants, they will need time to stop and reflect on how to use the strategy in their classrooms, plan for possible student questions or struggles, and start to think about how they might address struggles in their classrooms. Teachers should continue these conversations with their communities or PLCs as they plan to use the strategy as a whole group. Coaches can assist with feedback from observations (either live or video recorded). Teachers should continue their learning of the PD through observations, being observed, sharing student work, discussing the strategy, and identifying what growth they are seeing in their students as a result (Garet et al., (2001). An example of a longer duration of PD can include PLC time where teachers have time to plan, implement strategies, and reflect on their effectiveness (Antoniou & Kyrakides, 2013). They call for reflection and state “that reflection is more effective when the improvement priorities of the teachers are identified and taken into account and teachers are encouraged to develop action plans which address their professional needs” (Antoniou & Kyrakides, 2013, p. 9). During the PD, teachers should be provided time to reflect and receive feedback when given time to practice the strategy (Darling-Hammond

et al., 2017). The PD should provide time for teachers to receive feedback, reflect, and make changes during the PD. As teachers use the PD to enhance their knowledge of content and strategies to help facilitate student learning in the classroom, instructional coaches can support the implementation of the strategies from PD into the classroom and provide teachers with feedback.

Research on professional development calls for learning to be ongoing, connected to the goals of the teacher, campus or district, and collaborative (Antoniou & Kyrakides, 2013; Buczynski & Hansen, 2010; Darling-Hammond et al., 2017; Desimone, 2009; Easton, 2009; Garet et al., 2001; Hill et al., 2013; Penuel et al., 2007). Professional development supports teachers from the same campus when they attend together. Teachers can act as a support to each other as they implement the learned strategy into their classrooms. As these groups of teachers continue to support each other, the PD continues in its duration, engaging teachers in sustained practice of using the strategy. Teachers who teach the same content also support each other when they attend PD by understanding how the strategy can be implemented into their content that they teach. Teachers engage in active learning when PD includes teachers as participants in learning the strategy (as well as embedded within the content they teach). As teachers talk about how the strategy is working (or not working) for their classrooms, they are engaging in reflection of the practice and receive feedback from their peers on another tactic to assist the strategy to be used effectively. Instructional coaching provides an ongoing support, directly related to the teacher, campus, or district's goals, and coaches work with teachers in a collaborative manner. When these elements of PD are present for teachers and teachers engage in a cycle of learning, implementing, reflecting, and making changes to

their teaching practices, teachers grow in their capacity to design lessons with student learning at the heart of teaching.

Instructional Coaching

Traditional professional development is often a one day workshop or session where teachers learn a specific strategy. At the end of the PD, there is little to no follow up with teachers on if the teachers made changes in classes or what a teacher could do differently to help the implementation work for their particular setting. Research has shown that traditional professional development is not effective in that a training without follow up does not foster growth in teachers (Darling-Hammond et al., 2017).

Instructional coaching can support the teachers to take their learning into the classroom. Instructional coaching is a form of PD, however, where PD often occurs in a group setting, coaching is often one-on-one between a teacher and a coach. An instructional coach is described as a person who believes that teachers are able to analyze their teaching and are capable of change (Aguilar, 2013). To refine the definition of coaching, Aguilar (2013) writes,

coaching is a form of professional development that brings out the best in people, uncovers strengths and skills, builds effective teams, cultivates compassion, and builds emotionally resilient educators. Coaching at its essence is the way that human beings, and individuals, have always learned best. (p. 6)

She continues and describes the act of coaching as professional developments that “meets people wherever they are” (Aguilar, 2013, p. 7) and through patience and trying a few strategies, results develop. Coaches should encourage teachers to collaborate and reflect

on their practice, they should assist in promoting cultural change within a school, use data when appropriate to inform practice, use coaching as a way of embedded professional development to continue to support teachers as they implement a new practice, and build a relationship between teachers, coaches and administrators to keep a focus on teaching and learning (Aguilar 2013).

Coaching dives into the emotional side of teaching, defined as the “intellect, behaviors, practices, beliefs, values, and feelings of an educator” (Aguilar, 2013, p. 8). In order to dive into the emotional side, the teacher and coach have to build a relationship and view their working relationship as partners in order for teachers to grow (Knight, 2018). Coaches need to build their relationships with teachers around “equality, choice, voice, dialogue, reflection, praxis and reciprocity” (Knight, 2017, p.5) in order for teachers to feel coached rather than told what to do.

The relationship that the coach builds with the teacher is a key component to the teacher being willing to make changes to their practice when supported by a coach. A coach can assist the teacher in defining what needs work, then planning what it will take to make improvements, culminating in celebrating the successes of the teacher (Aguilar, 2013). Coaches must understand the context in which they work, that administrators and coaches must work together to be change agents in the school. However, coaches must focus on the “how” within their work, as well as how teachers reflect and act on improving their practices (Aguilar, 2013). “Instructional coaches partner with teachers to analyze current reality, set goals, identify and explain teaching strategies to meet goals, and provide support until the goals are met” (Knight, 2017, p. 3). Teachers must be

willing participants as they work with a coach, as working with a coach requires teachers to dive deep into their practice and be reflective as they work to improve their practice.

Coaching and PD

Several researchers have suggested that instructional coaches can extend the learning from a professional development to assist teachers in implementing a strategy learned in the PD into their classrooms (Czajka & McConnell, 2016; DiPrima Bickel et al., 2015; Graves Kretlow & Bartholomew, 2010; Knight et al., 2015; Knight, 2017; Reinke et al., 2012).

Teachers report one reason that they do not use student-centered strategies is that they did not have enough time to learn, implement or be coached through implementation in order to make it successful (Czajka & McConnell, 2016). Effective professional development occurs in a sustained time frame and where the participants take an active role in determining how to best implement the strategies learned in a PD. Participants also may be more successful in implementing PD if they can also observe others and receive feedback on their teaching. Lastly, the participant of the PD must keep a sustained focus on the change they want to make in their classroom (Czajka & McConnell, 2016). Some PD is successful for teachers because they make use of collaboration (such as learning from peers, team teaching or coaching). “Without fostering the continued enactment and reflection across multiple domains, it limits the professional growth of teachers and may not ensure the long-term adoption of effective change” (Czajka & McConnell, 2016, p. 3)

While teachers sometimes think that they continue to use the skills acquired, a study found that they were not actually implementing the learning after time has passed

(Reinke et al., 2012). As the learning from a professional development may not immediately be practiced in the classroom setting, coaching provides teachers a chance to work with a peer or expert to use the tools learned. The coach can be an observer in the classroom to determine what strategies are used and which ones need to be revisited by the teacher (Reinke et al., 2012). “Coaching is one form of systemic support that can help move evidence-based practices into real-world settings” (Reinke et al., 2012, p. 426). Coaching has a positive impact on a teacher’s implementation of strategies following professional development. Professional development also needs to be sustained in duration from initial learning through a coaching process (Graves, Kretlow & Bartholomew, 2010). The authors found that small group instruction followed by classroom observations, feedback and modeling were all strategies that helped to improve teacher’s instruction. More teachers implemented a strategy after at least one individual coaching session.

Coaching Cycles

Coaches must employ many different strategies when working with teachers. Research suggests that coaches and teachers work together in a cycle of learning or pre-conference with goal setting, implementing with observation, then finally debriefing in a post-conference with feedback (Baker & Knapp, 2019; Costa & Garmston, 2015; DiPrima Bickel et al., 2015; Graves Kretlow & Bartholomew, 2010; Knight et al., 2015; Knight, 2017; Reinke et al., 2012). The steps that Costa and Garmston (2015) suggest for the partnership between the teacher and coach are setting a focus, determining where the teacher is currently on a continuum for that focus, setting a goal (where they want to end up), have the teacher determine what success in this area looks and sounds like as it

pertains to the skill they are working on, decide what kind of support the teacher will need to help them grow in the desired area (this could be strategies, coteaching, modeling, etc), and finally reflect on the process and set next steps. Supporting a similar model, Knight uses the terms identify, learn and improve to describe the coaching cycle (Knight, 2015 & 2017).

The first component of the coaching cycle is the identification phase where teachers determine a goal to work on with the instructional coach. One goal of coaching is for teachers to work together with a coach and reach the goal that they have set for themselves (Reinke et al., 2012). The authors note in order for collaboration with a coach to be successful, the coach and teacher must have built a relationship around trust and that the coach uses the teacher's strengths during their time together. As coaches should have a stance that teachers are capable of change in their practice (Aguilar, 2013), Costa and Garmston (2015) support the idea that teachers are lifelong learners who are looking for ways to improve their teaching. They note that the conversations that occur between a teacher and a coach allow teachers to continue to grow and apply new learning to their skill set (Costa & Garmston, 2015). In the identification phase, Knight et al., (2015) states that the teacher and coach establish a goal for the coaching cycle and what teaching strategy they are going to use. Goals should be student-centered and reachable within the coaching cycle. The coach and teacher also establish what successful changes in the classroom the teacher would look for in order to determine that the goal was met. The teacher needs to understand what the classroom looks like from an observer's point of view and could use video to establish that viewpoint. In addition to what the classroom will look like if the goal is met, teachers also need to see what their teaching looks like

from the outside, with videotaping a lesson being one method to use for teachers to view themselves. Without realizing what their classroom truly is like, a teacher may not have a clear view of what they need to work on in their classroom (Knight, 2018).

In the second phase, the learning phase, the teacher learns about the strategy they want to implement in class while the coach is explaining or modeling what the strategy is (Knight et al., 2015). In the learning phase, a teacher should be presented with the strategy, or the strategy should be revisited from the professional development where the teacher learned about the strategy (Graves Kretlow & Bartholomew, 2010). The coach can work one on one or within a team setting to model the strategy for the teacher. Coaching can be used as the follow up collaboration tool from professional development to keep teachers using the skills learned in the professional development after the session has ended (Reinke et al., 2012).

A coach may need to practice modeling the strategy in front of other coaches prior to engaging in the learning phase with teachers (DiPrima Bickel et al., 2015). The coach models the strategy or strategies that the teacher wants to implement while the teacher takes notes on what the coach is doing to engage students in the content. This helps shape the coach/teacher relationship into a partnership rather than a supervisory role for the coach. The authors also discuss using the professional learning community as a place for teachers to share with each other when the meetings focus on pedagogy rather than the individual's performance. The coach may also model the strategy in a teacher's classroom with students while the teacher observes, or co-teaching can be employed in the learning phase (DiPrima Bickel et al., 2015; Knight, et al., 2015).

The third phase of the coaching cycle is the improvement phase. In the improvement phase, the coach and teacher determine if the teaching strategy met the goal. Video could be used as well as an observation tool to track what students are doing. In addition to the observation tool, the teacher and coach could examine student work (Knight, et al., 2015). The use of an observation tool can be used by any observer in the classroom (DiPrima et al., 2015; Knight et al., 2015; Knight, 2017; Melhuish et al., 2019). While the tool might change depending on the goal of the teacher, the observer is able to collect data on what the students and teacher are doing as the strategy is used in the classroom. If a PLC is working on the same strategy, teachers on the team might go and observe each other. If that is the case, the teachers should use an “evidence-based reasoning tool” (DiPrima Bickel et al., 2015, p. 38) as a format for teachers to share their observations in a non-judgmental manner. Observation is a key component to hold the teacher accountable for implementing the strategy more regularly. The coach provides specific feedback to teachers and models the strategy in a classroom setting for teacher (Graves Kretlow & Bartholomew, 2010). Following the observation, the teacher and coach should meet at least once more for a post-conference to determine if the goal has been met or if it is still in progress and what the teacher’s next steps are (Knight, 2018).

Feedback within Coaching

As the ultimate goal of coaching a teacher is an increase in student learning, observers in the classroom need a way of tracking what students are learning. Tied to sociocultural theory that states learning occurs when students discuss the content with each other, the coach can use a student discourse observation tool (SDOT) with teachers to help teachers notice, track, and observe student conversations in mathematics classes

(Melhuish et al., 2019). Discourse is a high leverage practice that promotes student thinking and learning. As students are able to justify and generalize, they are building sense-making of mathematics and are tying concepts together. The authors argue that teachers need a tool to be able to track these conversations to know if their students are able to justify and generalize and understand what students have learned (Melhuish et al., 2019). Using a tool like the SDOT, the coach and observers would have data to discuss in PLC and during the post-conference with an individual teacher. The tool could also be used while watching a video of the class if the observer(s) were not able to watch it in real time.

When a teacher receives feedback from a coach or their peers, the feedback should be objective and constructive. One way of structuring feedback is with notice and wonder language (Roller, 2019). Notice and wonder language is a method of communicating with others. Instead of being an expert, a coach may frame a conversation with “notice” and “wonder.” For instance, a coach may start a sentence with “I notice...” and describe a point of interest from the observation, then give a suggestion with a stem of “I wonder...” with a suggestion of what a teacher could do. In this manner, the coach is making suggestions but allowing the teacher to choose a course of action that is best for their style and classroom. Feedback given in a notice and wondering language allows mentor teachers a construct for providing feedback to new teachers (Roller, 2019). The framework of the mentoring language supported mentor teachers with a structure to “notice” a classroom practice (or lack of a classroom practice as evident of student behavior or other notices about the practice) with a suggestive improvement “wonder.” This frame allows the conversation to engage the teacher in collaboration without an

evaluative component from the person giving feedback. All teachers and coaches involved in this structure should learn and practice it in a learning setting. The setting should include examples of the language of notice and wonder, reading scenarios together to listen to what the language supports, and practicing the language after watching a video to simulate what a conversation might sound like in real time (Roller, 2019).

Coaching Tools

While much of the research presented thus far focuses on what a coach does, it is also important to note that a coach may need training on a strategy prior to presenting it to teachers (DiPrima Bickel et al., 2015). Coaches often serve dual purposes within their coaching role. One purpose is to support teacher learning and the other is to assist in creating classrooms where students are active participants in their learning (Baker & Knapp, 2019). Coaching frameworks utilized by coaches allow for a continual assessment of their methods and goals in a coaching cycle. They call the framework the Decision-Making Protocol for Mathematics Coaching (DMPMC). “The DMPMC provides a framework for planning interactions as coaches develop context-specific opportunities for reflective practice while supporting the individual needs of teachers within these contexts” (Baker & Knapp, 2019, p. 28). They frame their work around NCTM’s Mathematics Teaching Practices (MTPs) “to support mathematics coaches in purposefully planning coaching interactions” (Baker & Knapp, 2019, p. 27). Coaches need training in order to be an effective coach, namely that they participate in a cycle of planning and reflection as they coach teachers. A coach needs to understand what the teacher’s goal is and what strategies they could use in their classroom in order to achieve

that goal (Baker & Knapp, 2019).

There are several types of instructional coaching. Facilitative coaching poses the coach as a person to bounce ideas off of, where the teacher knows what they need to do and the coach poses questions to the teacher to help them focus on themselves. Directive coaching poses the coach as the decision maker with the teacher needing to acquire knowledge in order to improve. The focus of the coaching is the teaching practice in the classroom, specifically on the strategy that they are learning and the coach makes the decisions on what the teacher should try. Dialogical coaching is a mixture of facilitative and directive coaching. This type of coaching poses the coach and teacher as partners where the teacher may need additional learning in order to make improvements in their practice, however the focus is on the student and the impact that the strategy has on the student. The dialogical coach pushes the teacher to make decisions based on the questions that they ask the teacher. In the facilitative and dialogical approaches to coaching, the coach poses questions to the teacher to assist in the teacher making the decision(s) on what to do next (Knight, 2018). During the relationship building phase of a teacher/coach partnership, the coach will have to determine which kind of coaching each teacher needs. The coach needs to enter into a coaching cycle with a teacher prepared to coach in a manner that is appropriate for the teacher and what their goals are.

Summary

Teachers need to engage in ongoing professional development and experience the concept or strategy through the lens of a student. While engaged in PD, the teachers become students as they learn and think about applying the strategy to their classrooms. This directly supports Vygotsky's sociocultural theory in that students (in this case

teachers) learn through discourse in a social (or community) setting. The theory states that when in social settings, learning occurs through conversation. These settings require that both the teacher and the students uphold their roles within the classroom. The teacher should plan for these conversations to take place, model appropriate vocabulary and further the discussion if it becomes stagnant and should facilitate discussions rather than lead as students become comfortable with the strategy of discussing. Teachers also help shape a classroom community with setting norms and a safe place for students to engage in learning. Students help create the classroom norms that foster their participation in the classroom, fully participate in the discussion, and listen to what others are saying in order to build on their own thinking with the thinking of others.

The PD that teachers engage in to learn a new teaching strategy should be content focused, sustained in duration, have the teachers be actively engaged in the learning, occur within the community, and include coaching, feedback and reflection. The learning needs to occur within the context of the teacher's classroom. For instance, PD on facilitating discourse should be focused on how discourse looks in a math classroom with examples that apply directly to content that is taught to students. PD should be an ongoing process and last longer than a single day workshop. Instructional coaching is a way to continue this with teachers engaging by choice with a coach to continue to work on implementing the strategy learned into their classroom. Teachers should practice being engaged in the strategy through modeling and role playing during the PD session in order to be actively engaged in their learning. Participants should be encouraged to build community within the session to have support from each other as they implement the strategy into the classrooms after the PD session. Teachers should also be given time to

reflect on their learning, receive peer feedback after any role playing activities and be given time to plan for the strategy to be implemented into their session.

Discourse in mathematics classrooms supports both NCTM's effective math teaching strategies as well as Vygotsky's theory that students learn through talking through problems, adding to the community's conversation about methods to solve, and building mathematical and community connections as they learn. The teacher's role as facilitator helps to shift the responsibility of the conversation to the student, where they are held accountable for participating and contributing to the conversation. Teachers can also model and encourage appropriate vocabulary use and note when students start to increase their mathematical vocabulary use in their conversations. Teachers have planned these activities in order to further student thinking and deep understanding of topics through accessing background knowledge and questioning students.

As teachers engage in the learning in PD and throughout the coaching cycle, they are increasing their knowledge of the strategy while talking through planning, implementing and reflection on a particular lesson. Teachers are learners within the PD setting and the coaching cycle and the use of socio-cultural theory is evident as the teachers are learning through discourse with their peers and the coach. Coaching assists teachers with one on one focused planning time versus a group setting of PD. The teacher and coach build a relationship similar to teachers and students in that there is trust in the relationship and they are working towards a goal the teacher has set. Coaches assist teachers in reaching the goal during the coaching cycle. The coaching cycle consists of an identify phase, a learning phase and an improve phase. In the identify phase, the teacher identifies an area they want to improve and set a specific goal they want to work towards.

In the learning phase, the coach might plan additional PD or learning for the teacher to understand a strategy, plan with the teacher on how to implement the strategy, then observe the strategy in their classroom. During the improve phase, the teacher reflects on the use of the strategy and how they need to move forward with their teaching practices to make the strategy most effective for themselves and students.

As teachers engage in learning through conversations in PD or while working with an instructional coach, they are learning while engaged in Vygotsky's socio-cultural learning theory. They are learning in a social setting and through conversations to build on their own knowledge. As teachers gain knowledge of how to facilitate discourse, put the strategy into practice in their classroom and improve their skill of engaging students, they are working to improve their craft and work towards their goal of improving their practice.

Chapter III

Methodology

The purpose of this chapter is to describe the research methods that were used to determine the effects of professional development and instructional coaching on secondary mathematics teaching practices. This chapter describes research design, participants and setting, instruments, procedures, and data analysis procedures. The research questions for this study were:

1. How does professional development on discourse impact secondary mathematics teachers' perceptions of classroom discourse practices?
2. In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?

Research Design

The methodology used for this study was a case study. A case study is used in order for both qualitative and quantitative data to be collected, analyzed, and provide in-depth evidence for each case (Creswell & Plano Clark, 2018). Each participant was seen as an individual case, where the study focused on their particular situation and gives insight into the happenings (Merriam, 1999). The boundaries of this study were secondary mathematics classrooms and how secondary mathematics teachers view mathematics coaching as the participant and coach work to increase discourse practices in their classrooms. A case study could be described as holistic, empirical, interpretive and empathic where the researcher and participants interpretations are valued even if they are different (Stake, 1995). As the participants engaged in the coaching cycle with the researcher, they set a goal centered on facilitating discourse as a strategy, then reflect on

the strategy after using it in their classroom with the researcher and determine what changes or adjustments needed to be made prior to using the strategy again. The coaching aspect of the study was tracked in the researcher's journal for her interpretation of the participants' facilitation of discourse as a strategy in their classroom, adding a qualitative element to the study.

Qualitative and quantitative data collection was utilized in this study. Qualitative data was gathered from participants through surveys to indicate their feelings about implementing discourse strategies into their classrooms. Quantitative data was collected through surveys to measure the degree to which professional development assisted in their learning of discourse strategies and continuation of the PD through the coaching cycles. Case studies include multiple data sources, including surveys and interviews (O'Learly, 2014). This study focused on the perceived impacts of PD and of the coaching cycle on secondary mathematics classrooms, and the study tracked their ideas about how coaching is affecting their classroom practices. A case study was the best fit in order to measure participant growth or change in their perceptions as teachers engaged in the coaching cycle along with their thoughts on why coaching is changing their practices.

Participants and Setting

The final study sample included any certified secondary mathematics teachers (grades 6 through 12) who were employed in the researcher's school district. There are about 400 secondary math teachers in the district. The participants chose to attend the initial professional development on facilitating discourse in the classroom in the summer when they were off contract. No populations were excluded from attending PD or consideration to be included in the study if they meet the criteria as an employed

secondary mathematics teacher. Participants who were selected for the study were assigned a pseudonym for the purpose of describing their case.

About the District

The research study took place in a suburban school district in Southeast Texas. The participants in the study were employed by the school district as secondary mathematics teachers. Teachers in this district, on average, have 11.3 years of teaching experience and 6.9 years within the district. Specifically, 15% of teachers have more than 20 years of teaching experience, 30% have between 11 and 20 years of teaching experience, 23% have between 6 and 10 years of teaching experience, 28% have between 1 and 5 years of teaching experience, and 5% are first year teachers. The ethnic make-up of the teachers in the district are 74.6% white, 14.4% Hispanic, 6.5% African American, 2.8% Asian and less than 1% combined are teachers who are American Indian or Pacific Islander.

Participants

Of the fifteen participants that attended the initial professional development, five were chosen for the research study. Four participants were on the same campus as the researcher and were selected based on their proximity to the researcher. The fifth participant and the researcher worked together and were on the same teaching team about 13 years ago and had a positive working relationship. The fifth participant dropped out of the study due to lack of response to the researcher. The four participants described in the study teach on the same campus, a large comprehensive high school where there are over 2900 students.

Participants in the study are all white, have on average 11.5 years of teaching

experience, and on average, they have been on their campus for 4.25 years. One of the participants teaches on-level Algebra 1, one participant teaches on-level Geometry, one participant teaches Math Models with Applications (MMA), and one participant teaches on level Algebra 2 and Algebra 2 Pre-Advanced Placement and Gifted and Talented students. Three of the four participants have a bachelor's degree and one participant has a Master's degree in Curriculum and Instruction. One participant earned their teacher's certificate from an undergraduate program and three participants were alternatively certified (meaning their teaching certificate was earned through a program after the bachelor's degree was earned). Of the three alternatively certified participants, two have an undergraduate degree in Mathematics while the third has a degree in Consumer Science.

Table 1

Participant background data.

Participant	Years Teaching	Years on Campus	Course Taught	Highest Degree	Teacher Certification
Julie	8	6	Geometry	Bachelor's Degree in Mathematics	Alternative Certification
Brandi	4	2	Algebra 1	Bachelor's Degree in Consumer Science	Alternative Certification
Kristine	20	5	Math Models with Applications	Bachelor's Degree in Education	Undergraduate Certification
Mia	14	4	Algebra 2 & Algebra 2 Pre-AP/GT	Master's Degree in Education	Alternative Certification

*Note: Summary table for participants' educational background.

Intervention

Teachers chose to attend the initial professional development on facilitating discourse. The scheduled sessions were in the summer and the participants needed to be present for the session in order to participate in the study. Of the 400 secondary math teachers in the district, 15 people chose to attend the initial professional development. The initial professional development was facilitated by the researcher. Part of the researcher's job in the school district was to deliver professional development to all secondary math teachers. An email was sent out advertising the session as it was open to all secondary math teachers in the district to enroll in and the email included a description of the session. The initial PD was made available for secondary math teachers to attend. The PD session was held on a weekday morning and a Saturday morning to accommodate summer schedules.

Participants were involved in the study for approximately 6 months. The initial PD session was 3 hours, then each coaching cycle was approximately 1.5 hours in length delivered in 30 minute segments. The participants each engaged in one Identify cycle which took 30 minutes, then three sets of a shortened cycle of Learn and Improve. Total time for participants in professional development plus coaching time was approximately 7.5 hours (including time when the participant watched the video of their classroom). The Identify phase occurred in September or October, followed by one phase of Learn and Improve by December. The other cycles were completed January through March, set by each participant based on their availability for the coaching meetings.

The coaching cycle involved one Identify meeting followed by three mini-cycles of Learn and Improve. The Learn and Improve phases were repeated three times for each

participant. The first meeting was the Identify stage of the coaching cycle where the participant records a full class period and watches it on their own time to determine what was actually happening in their classrooms. The researcher also watched the entire class period separately from the participant. The participant and researcher used what they each noticed in the classroom to determine if classroom management needed to be addressed before setting a PEERS goal (Knight, 2018). PEERS stands for Powerful, Easy, Emotionally Compelling, Reachable and Student Focused. By writing a PEERS goal, participants chose a strategy to engage their students in their classrooms.

In the second part of the coaching cycle, the Learn phase, the researcher assisted the participant with any learning about the strategy that needed to occur before the participant implemented the strategy in class. The strategy that the participant chose to use may be different from strategies used by other participants in the study. The strategy that the participant employed was determined by the participant and was embedded in lesson plans with the researcher's assistance. The participant had to be comfortable using the strategy within their classroom. If the participant was not comfortable using the strategy, the researcher modeled the strategy for the participant in a class or assisted in planning for possible participant responses to students as students work with the strategy. The participant and researcher determined together what hallmarks of the strategy would indicate that students used the strategy to increase discourse in the math classroom. Because each participant could have chosen a different strategy, successful use of the strategy may have been different in each classroom.

In the last phase of the coaching cycle, the Improve phase, the participant implemented the strategy and video recorded their class. The classroom segments will be

recorded so the participant and the researcher viewed the interactions between the participant and students. The school district had purchased the program that the researcher and participant used to record classrooms for the specific use of the teacher and the coach (with teachers permission). The recordings were used within the scope of the participant and researcher's jobs and the recordings were not used in the study beyond the realm of their jobs. No student information or identification were used in the study. Student responses were limited to indicating if the strategy was successful based on the participants' notes of their conversations in class. The participant and researcher met after each had watched the video to determine if the implementation of the strategy was successful or not and plan next steps for the participant's use of the strategy in their classroom. Next steps might include different cues for the participant to use with students, questions to ask students during the activity, or more planning of possible student responses so the participant can plan responses to those possible responses.

Instruments

Instruments used in this study included surveys, a research journal, and a final interview. Surveys were used before and after the initial PD session to answer the research question, "How does professional development on discourse impact secondary mathematics classroom discourse practices?" by asking participants if the PD met the needs of the participants as it pertained to implementing discourse into their classroom. The survey questions that were asked prior to and during the coaching cycles were used to answer the research question, "In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?" The survey questions asked participants to rate their experience with PD and working with an instructional

coach then provide specific explanations of instances of “strongly agree” and “agree.” The research journal was used to track the researcher’s thoughts on participant growth through the use of coaching conversations. The interview asked participants about PD and how instructional coaching impacted their practice of facilitating discourse as well as questions about how their classroom discourse practices shifted over the course of the study.

Data Sources

Data collection included demographic information of participants, surveys by participants before and after the initial PD session, and surveys during the coaching cycles (full survey questions can be found in Appendix D of this dissertation). Each survey included both quantitative and qualitative questions for participants to respond to and expand on their answers to the quantitative questions. The quantitative questions were asked in a format where participants could rate their response to a statement then were asked to give specific examples related to the question that was responded “strongly agree” or “agree.”

Demographic information that was collected was done so on a voluntary basis (a complete list of the demographic questions can be found in Appendix C of this dissertation). If a participant did not want to answer, they had the option of leaving the information blank. The survey about the initial PD were available to participants at the beginning and end of the PD session through a Google form. The responses were only available to the researcher, secured under her password protected Google account. The other surveys were also given and collected through Google forms, secured under a password protected Google account, and the links were emailed to participants. The

researcher kept a research journal to track her thoughts about meetings with the participants. During the coaching cycle, the researcher kept notes of the conversation using Knight's (2018) questioning strategy of what went well, what did you learn, were there any roadblocks and what's next. These conversations were used for the researcher to reflect on her practice and to help shape future conversations.

Pseudonyms were used in any writing of the case and results of the study. No one outside the research team will know what the pseudonym is for a particular participant. Because this was a case study, each participant was written about separately and no comparisons were made about their attitudes or growth from the coaching cycles. Themes were tracked across cases, but no comparisons of growth were made. Audio recordings of the interviews with the researcher were transcribed and the original files were stored in a password protected file with the researcher. The original videos of the interviews were stored in a password protected Google Drive. The program that was used to record classrooms is password protected by both the researcher and the participant and only they have access to the files.

All data was kept in password protected programs and is only accessible by the researcher. Any audio from the interviews is in a password protected program and transcribed by the researcher. Data was stored in the researcher's personal Dropbox account that is password protected. It will be stored for a minimum of 5 years and only the researcher will have access to the files.

Procedures

In this case study, the researcher worked with participants to examine their classroom practice of discourse about mathematics, and each participant was treated as an

individual throughout the process.

Data was collected through surveys using Google Forms at the initial PD, before the Identify phase for any participant, after each Improve phase of the coaching cycle, and as a final interview after all coaching cycles were completed. At the initial PD, participants filled out a pre-PD survey and a post-PD survey using Google Forms. Participants in the study completed the background information survey through Google Forms and the survey was emailed. For each survey following the coaching cycle, participants filled out a Google Form survey that was emailed to them (the same survey questions were used for each coaching cycle). The interview questions were sent to participants at the time the interviews were scheduled. The full list of interview questions can be found in Appendix E of this dissertation. Participants had approximately 5-7 days to review the questions before the interview was conducted. Once the surveys and interviews were completed, the data was analyzed and one set of codes were used to identify information that related to research question one. A second set of codes were used to identify information that related to research question two.

Participants reflected on how participating in coaching sessions with the researcher had an impact on their classrooms through planning and facilitating discourse within their classrooms after coaching sessions.

Data Analysis Procedures

Both qualitative and quantitative data were collected in this study. Data analysis followed the research paradigm of interpretivist. An interpretivist methodology relies on observation and analysis of texts. Interpretations that result from a qualitative study represent the context and time that the data was collected (Cohen & Crabtree, 2006).

Because the case study was bound and focused on perceptions of how discourse practices are impacted by mathematics coaching, the interpretivist idea supports data analysis in that “research relies upon the (inevitably somewhat subjective) interpretation of a particular human being who will necessarily bring his or her own idiosyncratic experiences and understanding the interpretations made” (Taber, 2013, p. 45). Data analysis was conducted according to a convergent design. The convergent design allows the researcher to analyze the qualitative and quantitative data separately, then examines the results to show (or not show) that both types of data support the same conclusion(s). The merging of the data assisted in comparing the two sets of results and provide a clear picture than producing only one set of data (Creswell & Plano Clark, 2018). Survey data was analyzed in the order that it was collected to look for trends in participant perception as it related to participant perceptions on coaching and discourse practices. Data was analyzed per participant using coding for qualitative data. Open coding was utilized in order for the patterns and themes to emerge. The amount of data collected required the researcher to analyze and find patterns within the data. Before starting any data analysis, a framework was put in place to assist in sorting and looking for patterns and themes (Patton, 2002). For quantitative data, trends were analyzed for perceived growth over the course of the study as it related to how professional development and coaching were impacting discourse practices through the information collected in the surveys. Growth was shown through participants rating themselves as more proficient in incorporating discourse during a coaching cycle or including more discourse into their lessons without the prompting of a coaching cycle.

Following the write up of the findings of each case, the researcher employed

member checks for each case. Member checks allowed each participant to review the case as presented to verify and “confirm the credibility of the information and narrative account” (Creswell & Miller, 2000, p. 127). This confirmed that the data presented was true to the account of what occurred during each coaching cycle. The use of the final case study allowed for the participant to verify themes that emerged during the study (Creswell, 2009). The member check allowed the participant to read their case and indicate to the researcher if their experience was represented correctly.

Summary

The method used in this study was a case study. Each participant was studied as an individual as how they perceived instructional coaching impacted their practices in the classroom. The in-depth nature of a case study allowed for both qualitative and quantitative data to be collected to represent the case. The case study was selected to study individuals as the study represented the case of each individual and not generalized for every teacher (Qi, 2009).

Out of a possible four hundred secondary mathematics teachers in the district, 15 chose to attend the initial PD. Five were selected to participate in the study based on their proximity and previous working relationship with the researcher. One of the five dropped out of the study, leaving four cases represented in this study. Each of the remaining four teachers taught on the researcher’s campus within the school district.

Each participant completed four total coaching cycles. The first coaching cycle included the Identify phase of Knight’s (2018) coaching model. The participants filmed an entire forty-five minute class period and set a goal which framed the work with the researcher. Each participant then completed three coaching cycles of Learn and Improve

focused on their goal. After each cycle, the participant completed a survey. At the conclusion of all coaching cycles, the participant completed an interview with the researcher.

Surveys were utilized to gather both quantitative and qualitative data from participants to measure how they felt working with an instructional coach could impact their practices and how it actually did, if at all, impact their classes. After the researcher analyzed the data and wrote up each case, the case was presented to the participant for a member check to ensure that what was presented was the experience of the participant.

Chapter IV

Findings

The purpose of this chapter is to report the findings of the case study. The two research questions were:

1. How does professional development on discourse impact secondary mathematics teachers' perceptions classroom discourse practices?
2. In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?

Each case was represented a single participant in the study and includes a summary of each coaching cycle and data analysis. Participants engaged in a coaching cycle of sessions that included an Identify phase, a Learn phase and an Improve phase (Knight, 2018).

In the identify phase of the coaching cycle, the participant filmed an entire 45-minute class period. The participant and the coach watched the video independently before initiating the coaching cycle. Using Knight's (2018) Identify Questions, the full list of which can be found in Appendix F, the participant and the researcher discussed the questions and answers based on what the participant saw in their teaching video. This allowed the participant to gain a clear picture of their classroom reality and work towards setting a PEERS goal emphasizing Powerful, Easy, Emotionally Compelling, Reachable and Student Focused teaching (Knight, 2018). The participant and the researcher worked together to craft each goal.

Following the Identify phase, the coaching cycles focused on the Learn and Improve phases for three cycles. The researcher and participant met in the Learn phase to

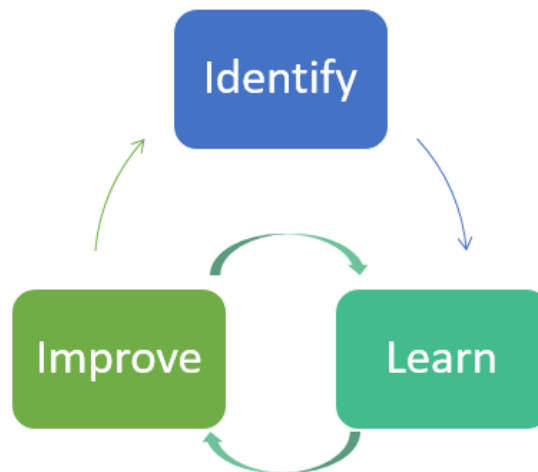
discuss and plan how the participant could work towards their PEERS goal for a specific lesson. In the Identify phase after the participant filmed their class, the following questions were asked to frame the follow up discussion.

- 1) What went well?
- 2) What did you learn?
- 3) Were there any roadblocks?
- 4) What's next?

The participants used the same Identify phase for three cycles of Learn and Improve. The Learn and Improve phases were repeated as an iterative process for the participant to continue to focus on the PEERS goal that was set.

Figure 5

The Coaching Cycle



Note: A visual of the coaching cycle as it was used in this study. The Learn and Improve phase were cycled through three times using the same Identify elements.

Case 1

Background

Julie is a white, forty-five year old female with eight years of teaching experience. The last six of the eight years have occurred on the researcher's campus. Julie earned her bachelor's degree in mathematics and was alternatively certified to earn her teaching certificate. Julie has never been coached prior to this study.

Julie teaches academic (on-level) geometry to tenth grade students. Geometry is a required course for students to graduate with a high school diploma in Texas. The students are on-level meaning they completed Algebra 1 in the ninth grade and were not on an accelerated learning path in junior high. The school is structured into seven classes per day, each class period varying between 45 minutes and 52 minutes, depending on the day of the week.

Identify

In the identify phase of the coaching cycle, Julie filmed an entire 45-minute class period. The class Julie chose to use for her coaching cycles was an on-level class with no students identified who needed additional in class support with another teacher present. After recording the class period and both Julie and the researcher watched the video, they began the coaching cycle. Using Knight's (2018) identify questions (found in Appendix F), Julie and the researcher discussed the questions and answers based on what Julie saw in the videotaped lesson.

Julie felt that the lesson was a 6 (on a scale of 1 to 10) based on evidence of students working both independently and in small groups. In order to move the lesson towards a 10, Julie felt that the students should be engaged in more exploration on their

own and sharing their findings with each other. She felt that if students were truly engaged in exploration, they would be sharing their findings from the activity and discussing if what they found works in all instances. Julie felt that measuring the change would be difficult in knowing if students were really understanding the content, but that she could record the number of student responses, the types of questions they were asking each other and the teacher and to what level of questioning the students were asking (whether students were asking if they completed something correctly or if the students in the group used the same strategy or not).

Julie's PEERS goal for her coaching cycle was "students will engage in exploration of tasks to dive deep into critical thinking and connect mathematical concepts." Julie felt that in order to do so, she would need to shift into a facilitator role while students were engaged in the exploration or task. As a facilitator, she would use questions to guide students.

Cycle 1: Learn. In the first coaching cycle, Julie selected an activity with questions embedded for students to discuss together. In the activity, students used a geometric construction of angle bisectors, medians, and perpendicular bisectors on various triangles. The construction method for this particular activity was paper folding using a translucent wax paper. The goal of the activity was for students to identify the construction marks and create each construction. Earlier in the semester, students had completed constructions with traditional methods of paper, compass and straightedge. Paper folding constructions were new to students and were asked to connect paper folding to the constructions they had previously completed and what constructions marks might look like using various methods of completing a construction. The researcher

asked Julie what kind of answers she was expecting from students, then together they crafted questions that would assist students in producing the answers Julie wanted without telling students what to do. Julie decided to use a recording sheet to track what students were saying with respect to their seats.

The questions that the researcher and Julie planned in the Learn cycle for this activity were:

- How do you know that you found a midpoint?
- How can you verify the midpoint? Can you verify it in another way?
- What might markings look like in a picture to tell you a point is a midpoint?
- How do you know that you folded to find an angle bisector?
- How can you verify the angle bisector? Can you verify it in another way?
- What might markings look like in a picture to tell you a segment is an angle bisector?
- How do you know that you folded an altitude?
- How can you verify that you folded an altitude?
- What might markings look like in a picture to tell you a segment is an altitude?

Cycle 1: Improve. During each improve phase, the researcher asked the same four questions:

1. What went well?
2. What did you learn?
3. Were there any roadblocks?
4. What's next?

What went well? Julie felt that students were working independently working

through the activity, following directions and determining what folds to make as they created the constructions. She noted that students were connecting the folding to the construction marks on the instruction page to the effect the fold had on the triangle. She felt that students were sharing with each other and verifying their findings as well as using the definitions and instructions to guide their progress and selecting their tools in order to work through the activity.

What did you learn? Julie focused on what changes she needed to make to the activity. She felt that some of the questions should be changed to require the students to have to explain their process and how they reached their conclusion. She also felt that the activity could have included points of concurrency as an extension component of the activity and that it could extend to two class periods rather than just one. Julie was surprised that students figured out the folds quickly, the connections students were making about right angles and midpoints within the activity, and that they were making connections about the activity to previous learning (traditional compass and straightedge constructions).

Were there any roadblocks? Julie noticed that some students were just following their group and were not engaged in thinking about the activity. She felt that they needed to be pushed by questions posed by her. She also noticed that she needed to be aware at how much time she spent at each group. She considered altering her recording sheet by adding a column for teacher behavior in that she could track how many questions she was asking to the group before moving on. She felt that some students were not engaged in the activity at all.

What's next? As it was near the end of the semester, Julie decided to wait until the spring semester for another coaching cycle.

Cycle 2: Learn. The activity that Julie used for this cycle was a discovery lesson for students to understand the trigonometric functions of sine, cosine, and tangent. Students were discovering the relationship between the function and the ratio of specific sides of right triangles. Students had to measure lengths of sides of triangles and angles, set up the ratio, approximate decimal values for the ratio and the trigonometric function, then compare the approximations.

Julie wanted students to make connections that the function of the angle equals the ratio of the specific pair of sides. More specifically, she wanted students to realize that the lengths of the sides of the triangle didn't matter, the ratio of the pair of sides is the same for the given angle. She also wanted students to be able to determine the difference between adjacent and opposite sides of a triangle given a non-right angle of the triangle. Students were working on the activity in small groups. The activity was set up so each student was responsible for measuring and finding the approximations for one triangle, then they were to share their data with their group in order to make comparisons and connections. Julie then wanted the students to discuss the comparisons between two sets of tables and define opposite and adjacent in their own words. She planned on using a recording sheet to write questions at the bottom that students were asking and record student thinking.

The questions that the researcher and Julie planned together to encourage student thinking were:

- Can you find any patterns?

- What do you notice about the value of the ratio and the value of the trigonometric function of the angle?
- What is the relationship you see in the table for everyone's sine, cosine, or tangent ratio?
- Did all the ratios for sine/cosine/tangent produce the same value in your triangle?
What about the triangles of your group's findings?
- Can you find a pattern for which ratios produced the same value as the trigonometric function?

Cycle 2: Improve. *What went well?* Julie felt that students were focused on the activity and were engaged. She felt that students understood that the function of the angle equaled the specific ratio of sides and could define the function as the specific ratio.

What did you learn? Julie felt that students needed her to prompt the groups to direct students what to talk about in their small groups. She did not feel that students were looking at the tables of data to make comparisons on their own, rather she had to prompt students to look and discuss. She acknowledged that she needed some pre-planned questions to ask students and have them written down on her recording sheet. She stated that she could do an activity earlier in the unit with similar triangles and have students make connections about similar triangles so when they are talking about trigonometric functions and ratios of sides, students could make connections between ratios.

Were there any roadblocks? Julie felt that she needs to plan more questions in order to prompt students to assist in starting conversations, guiding them on where to look on the activity sheet without telling students exactly what they need to be

discussing. She felt that students realized they were being filmed and were more cautious with their conversations.

What's next? Julie wants to edit the activity to embed questions for students to discuss as well as pre-plan questions she would ask students. She wanted to include questions such as, “What do you notice about the relationship in the value of the sine of angle A and the ratio of the two sides” and repeat that question for each trigonometric function and the related ratio for the triangle the student worked on. Then, she would ask the students to compare their answers about the relationship students noticed. Julie wanted students to talk about this naturally, but she didn't observe students discussing this without being prompted during the activity.

Cycle 3: Learn. The activity that Julie used for this cycle was a two-part activity. The first part was an online Desmos activity which was asking students to determine what fraction of a circle was shaded (central angle compared to whole circle). Students had to estimate what fraction of the circle was shaded, then they were able to check their work. The second part was related to the area of a sector (the area of a part of a circle that is bounded by the curve of the circle and two radii) through an activity that framed the math around a real world scenario of different diameter sized pizzas and what purchase would maximize value to the consumer. Julie wanted students to understand that a sector is a fraction of the whole circle (the fraction is the ratio of the central angle to 360 degrees) in the Desmos activity; then build on that knowledge to connect that the area of a sector of a circle is the same as the ratio of the central angle to 360 degrees. By the end of the activity, Julie wanted the students to connect the proportional relationship in an equation form for the area of the sector.

Julie and the researcher continued to pre-plan questions to ask students in order to engage them in conversations in their small groups. These included:

- Make a guess on the better deal for the pizza and why.
- When you find the area of the shaded region (the sector), how does that relate to the Desmos activity?
- Explain what it means to be proportional.
- What does it mean to be equal?
- What does it mean for two fractions to be equal to each other?

Cycle 3: Improve. *What went well?* Julie felt that the combination of the activities went well. Students learned about the area of circles in junior high and the Desmos activity discussed area of a circle in terms of pi (leaving the area with the symbol for pi rather than multiplying and having an approximation for the area of the circle). The area of a circle was used in the second activity as students were finding areas of sectors. She thought the two activities tied the concepts together because students had visuals to aid their learning. Julie felt that when she asked students to describe the meaning of proportionality, half of the groups were able to give good ideas and one student responded “they have to be equal.” Julie kept asking students “why” to encourage students to justify their responses and dig deep for understanding of the relationship between the central angle to the whole circle and the area of the sector to the area of the whole circle.

What did you learn? Julie stated that some students take more risks than others and some students are more dependent on their groups. She felt that students were making sense of the activity, but she would like them to think more independently. Julie

also was thinking about how to change the activity for future use, including having students define arc measure through examples and non-examples prior to starting the Desmos activity. She would like students to create their own definition first, then their group can refine and produce a final definition before starting the activities.

Were there any roadblocks? Technology was an issue that affected Julie's feelings about the lesson. Julie reported Desmos was taking a long time to process as the students entered answers and waited for the program to check it. She wasn't sure if that was a WiFi issue or the devices the students were using. She also reported being frustrated with students who just wanted to be told the information rather than discovering the lesson. She wanted more time with the activity.

What's next? Finished with the three coaching cycles, Julie would continue to plan activities that students need to discover mathematical ideas and discuss with each other. Full survey responses for each coaching cycle can be found in Appendix G in this dissertation.

Findings Correlated to Professional Development

Addressing the first research question of how does professional development on discourse impact secondary mathematics classroom discourse practices, the findings appear to show that Julie felt that PD allowed her to think about her planning process, including planning questions to ask students, what their possible responses might be, and how she might respond to students. The findings suggest that PD focused her planning and facilitating of the lesson.

Julie felt that the initial PD focused on what discourse is and that coaching assisted in implementing the strategy of discourse into her classroom. Julie appeared to

use the learning from PD and the coaching cycle to change how to she approached facilitating discourse in the classroom. Instead of providing students with the activity then having to talk students through how to complete the activity, she posed pre-planned questions to the students that required students to think about the mathematics and tie concepts together. Julie found value in the coaching cycles in planning the questions to ask students as well as when she was reflecting on the lesson. She appeared to become more comfortable in planning questions on her own and from notes in the researcher's journal, arrived at the second and third Learn meetings with questions in mind on how to engage her students in discussing the topic. At the conclusion of each coaching cycle, Julie answered a survey ranking herself on planning for discourse and implementing discourse.

Julie reported her planning for discourse to be a 2 out of 5 before PD that she was not planning frequently to implement discourse into her classroom. Julie reported that before coaching, she was only planning for discourse in her classroom once per unit. As the coaching cycles progressed, she increased the frequency of planning for discourse to 3 to 5 days per week. Julie also reported after coaching, she felt her ability to use discourse as a strategy in her classroom increased as well (from a 5 to an 8 on a scale of 1-10).

Qualitative Data Findings to Professional Development

The full transcript of the researcher's interview with Julie can be found in Appendix H of this dissertation. This section highlights some of the salient findings using quotes from the participant.

Julie stated

I felt like we talked a lot about what discourse was and what it looked like in that PD. And then like the coaching cycle is like taking it and then putting it into practice and, and kind of working through it and figuring out what it, what it looks like when you're planning and how it looks like in the classroom.

Further, in answering if coaching was an extension of PD, Julie responded

And I felt like a lot of, a lot of the PD in general that we do is about content and how we deliver content. But this is kind of an extra piece that adds into that and kind of lets you plan, helps me plan the discourse within the content because it's kind of there all the time and it's a piece that now I'm more thoughtful about.

Julie understood that coaching, as form of extending PD sessions, allowed her to focus on how to implement the strategy of discourse in her classroom with the outcomes that she wanted to see in her students. She increased the number of times that she planned for discourse in her classroom from once a unit to several times per week.

Findings Correlated to Instructional Coaching

Addressing the second research question of in what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices, the findings appear to show that Julie felt that coaching gave her a chance to talk through her lesson goal, planning questions to ask students, and think about her responses to students. These conversations strengthened her ability to how she might respond to the students and during the Improve phase of the coaching cycle, allowed for her to reflect on how the lesson went and what she learned from it.

Julie responded that it allowed her to “have her own discussion about what I want to have happen in my classroom for each activity.” By the end of the third coaching

cycle, she said “I could really see how this could benefit teachers by giving us a sounding board and helping us learn what works best for us in our content.”

In the surveys following each coaching cycle, Julie reflected that coaching allowed for her to talk through the lesson with the researcher and think about what she wanted her students to be discussing about the math in the activity she had planned. Julie reflected after the third coaching cycle “I think the conversation in planning for discourse and the reflection after are very valuable in determining how the lesson/discourse worked in the classroom and what I can do to continue to improve.”

When she pre-planned questions for her students and prompts to guide their thinking, she felt that the students started to increase the number of times they asked each other questions as well as the types of questions that they were asking (not just a method of how to do a problem, but answering the questions in the lesson that is leading them to make connections).

Julie also felt that in participating in the coaching cycle, she was given a chance to talk through her lessons and plan the questions she could ask students. She felt during the coaching process, planning for discourse and reflecting on the lesson after the lesson was delivered was the most beneficial to her.

Julie’s goal of having the students be engaged in making connections about mathematical concepts led the coaching conversations in the Learn phase to focus on how she was going to keep students thinking about the concept. During planning, Julie felt that “we talked a lot about anticipating what students would talk about and if they’re not talking about it, how to sort of steer the conversation. I think that was one of the most valuable things to me.” She felt that without coaching, she might have asked questions

but not thought about how to further the conversation with more questions to engage her students in making the connections she wanted them to have by the end of the activity.

While Julie responded to several interview questions on how the planning helped the lesson go smoother, she felt that she learned more about her own practice during the Improve phase of the coaching cycle. When asked which part of the coaching cycle she found most useful, she replied

I think the Improve, which, you know, I've, I feel like I learned a lot from each lesson that we did, you know, in, within the lesson. And then after, in that reflection piece, I think I learned more afterwards than I did before. I'm, the planning is important, but I felt like I really kind of learned about it by being able to watch that video of my own kids and see what they're really doing.

She clarified that in addition to reviewing the video of her class, the researcher and Julie were able to discuss what changes needed to be made to the activity that students were working on in order to guide students to tie concepts together better.

Yes, I think, um, I think we will a couple of times where we had some questions that I had used. So we decided we needed to change them a little bit and maybe something a little different, um, in the future or, um, just kind of seeing how things work and, and coming up with ideas for maybe how to tweak it a little bit better. Um, and then also even with the materials we talked earlier about like tweaking our lesson materials to help that what's on the paper actually steer them more towards the discourse piece rather than just, you know, give them the things that they need to find answers on their own.

Julie noticed that during reflection, she was looking at what her students' produced in her classroom with each activity and continued to think about what she might need to change for the following year for the actual activity, but also what misconceptions they might have developed and needed to address immediately.

So, um, for reflection I felt like it gave me an opportunity to improve. So I know like if I'm going to do the same things next year, um, it gave me an opportunity to kind of analyze whether those things that I was using, my questions or my prompts for kids were working, whether I needed to word things differently. Um, and it gave me an opportunity to see how kids react to things, um, in, in reality versus what we think they're going to do, uh, so that I can sort of adjust it. And I know that in some cases we even changed kind of how the lesson was written or how the activity was written to try to make it fit better, um, and support the discourse better.

In answering the second research question, Julie seemed to gain confidence during the coaching cycles as it related to her classroom practices. She appeared to start thinking about where in her lessons she could incorporate more discourse, planned questions to ask students to prompt their thinking, and by the third cycle, started to think about how a student would respond and prepare questions based on potential responses. Julie said that she saw the benefit in talking through a lesson with a coach as it let her focus on what discourse might look like in her classroom and not in a generic math classroom.

Summary

Julie found the most use of the coaching cycle from both the planning and the reflection that she and the researcher did together. She found it helpful to talk through the lesson with someone to help plan the questions she wanted to ask students. While planning the questions, she was thinking about how to engage her students in making the connections about the math concepts rather than just having students talk about a procedural method. She found her students becoming more comfortable talking to their peers about the activity, even a few students who never asked questions in class begin to talk to their table mates about the concepts. Julie found that in giving her students questions to think about, or answering a student question with a question, she was prompting students to think more deeply about what they are learning. Julie felt

the classroom has become more student-centered as we have implemented discourse more. It allows students to share ideas and ask questions in smaller groups which is lower-risk for them. They become more confident in their thinking in the small group, which makes them more likely to share to the class.

She believed her students became more comfortable with talking to each other about mathematics through the activities and helped her reach her goal.

Case 2

Background

Brandi is a twenty-six year old white female who has been teaching for four years, two of which were at the campus where the research took place. She earned her bachelor's degree in Consumer Science and was alternately certified to teach mathematics. Brandi had previously participated in a coaching cycle similar to the Learn

and Improve cycle that was conducted in this study. Her previous campus' instructional coach had coached Brandi in her first and second year of teaching.

Brandi teaches on-level Algebra 1. On-level Algebra 1 students have not completed any high school credit math classes in junior high school. Algebra 1 is required for all students to take and pass in the State of Texas, including passing an End of Course exam to earn their high school diploma. Students enrolled in on-level Algebra 1 are on track to graduate high school in four years and typically take Algebra one their first year of high school. Algebra 1 consists of a study of linear functions including graphing and analyzing the graph, solving multistep linear equations, writing and solving systems of linear equations, graphing and solving linear inequalities and systems of linear inequalities, graphing and analyzing exponential functions, graphing, analyzing and solving quadratic functions, and writing arithmetic and geometric sequences.

Identify

The class Brandi chose to use for her coaching cycles was an on-level class with no students identified as needing additional in-class support with another teacher present. After video recording the class period and both Brandi and the researcher watching the video, they began the coaching cycle. Using Knight's (2018) identify questions (Appendix F), Brandi and the researcher discussed the questions and answers based on what Brandi saw in their classroom.

After watching the forty-five minute video, Brandi gave her lesson a 5 or 6. She chose a class to film that she felt was not as engaged as her other classes with helping each other to learn math. She was pleased that the students were making connections about the math rather than her telling students the connections, and she was pleased to see

that she gave students enough “wait time” for students to process the question she was asking in order to answer it. To move the lesson higher on a scale of 1 to 10, Brandi wanted students to explore more and she would ask more questions to have students think more deeply and begin to be able to answer “what if” questions about the math topic. She would measure the change in the lessons based on an increase in student actions of talking about the math rather than the teacher talking or delivering traditional notes to the students. She felt that if she took the time to make lessons more student-centered and discovery-based, that through questioning her students she would be able to achieve a goal of students talking more.

Brandi’s PEERS goal for the coaching cycle was “students will make connections about and between math concepts through student discourse and student centered activities.”

Cycle 1: Learn. Due to scheduling difficulties in setting up a face-to-face meeting, the initial learn phase in cycle one occurred through email. Brandi sent the lesson to the researcher through email and the researcher responded with stages of the lesson she felt Brandi could ask questions to probe thinking. The activity Brandi planned was set for a review day before a test on systems of equations. She gave students time to work in small groups on the test review. The students were given specific problems to work out together to ensure that the whole group could solve the system using any method. The groups would then present their solutions to the class. The group was responsible for each member understanding how to solve the problem as Brandi did not tell the group which group member would be responsible for explaining to the class. Brandi floated in the classroom, stopping by groups that had questions, and answered

their questions with probing questions rather than just answering directly.

Cycle 1: Improve. During each improve phase, the researcher asked the same four questions (what went well, what did you learn, were there any roadblocks and what's next).

What went well? Brandi felt that students were communicating with each other, asking their group mates for help, and clarifying their thinking to each other. At one point, a student was in tears because she claimed to not understand the math, but within a few minutes was helping her group formulate a method to solve the problem. She didn't feel that she gave students too much assistance, but the questions that she posed sparked knowledge in one student in the group who could then explain what was going on.

What did you learn? In watching the video, the student who Brandi viewed as off-task was one of the most willing students to help his group mates. (He was initially helping the crying student.) She also learned that students were making connections between domain and range and infinite solutions.

Were there any roadblocks? Brandi felt that the biggest roadblock was time. She would have liked this style of review to occur over two days, where the first day would have been what she had them do, and the second day would have been presenting solutions to the class. She could have used an exit ticket for closure on the first day, then look over the closures before the second day, hand the closures back to students and have them discuss it as the warm up leading into the poster presentations. She also didn't think that the students were using precise vocabulary and would encourage students to use the vocabulary as she walked around listening to them solve the problems on day 1. She hoped that this would carry over into the presentations of the problems.

What's next? The researcher and participant agreed that another coaching cycle would happen after the second semester started. She would continue to model precise vocabulary for her students and encourage them to use it as they discussed math in class. Brandi started to think about how to use the same review strategy (work in a group on some problems to recall how to solve, then be given specific problems to present to the class) for several topics. These topics include attributes of graphs (intercepts, domain, range, and features that might be unique to a function like asymptotes or axis of symmetry) and tying geometric and arithmetic sequences to exponential and linear functions, respectively.

Cycle 2: Learn. The focus of the lesson for the second coaching cycle for Brandi was a lesson on dividing polynomial expressions. The students were given a choice of two methods of division, using a traditional long-division algorithm or using an open array model. Students were in small groups of two or three and were asked to complete a specific problem on their own before they were asked to share their work with a partner. Brandi wanted students to understand the relationship during division of a quadratic expression (where the highest exponent of a variable is a 2) by a linear expression (where the highest exponent of a variable is a 1). The relationship is that the resulting expression is linear (the highest exponent of a variable is 1). She also wanted students to understand how to set up an open array for division and to connect the concept of multiplication of polynomials as the opposite operation of division of polynomials. Specifically for Algebra 1, if two linear binomials were multiplied together, the result is a quadratic trinomial. When a quadratic trinomial is divided by a linear binomial, the result will be a linear binomial (with or without a remainder).

Figure 6**Example of division.**

A. $(x+2)(x-5) = x^2 - 3x - 10$	B. $\frac{x^2 - 3x - 10}{x - 5} = x + 2$
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Brandi and the researcher planned for Brandi to ask students questions to probe thinking. Brandi would ask students to count how many terms were in the numerator and denominator of the expression and to state what they noticed. Brandi also gave students the expressions in Figure 6 to discuss what they noticed about the exponents.

Figure 7**Sample expressions given in class.**

A. $\frac{x^2}{x^2}$	B. $\frac{x}{x}$	C. $\frac{x^2}{x}$	D. $\frac{x^2 + 2x - 8}{x - 2}$
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Cycle 2: Improve. *What went well?* Brandi felt that students were engaged in the lesson and their effort in thinking about her questions was high. Students were participating in talking to each other regarding what they noticed about the expressions Brandi gave them to think about. In comparing the four expressions in Figure 7, Brandi had to prompt students which result would have the highest degree as the students were confused as to what she was asking them to compare.

What did you learn? Brandi felt that vocabulary was still a struggle for students, specifically using “coefficient” and “constant” within describing what they understand about polynomial division. Brandi then started to use the vocabulary and point to the number that she was describing to model the correct usage of each term. A few students

started to pick up on the correct vocabulary as the lesson went on. Students were able to tell the difference between when the division answer would be a constant (A and B in Figure 5) versus an expression (C and D in Figure 5), which was one of the goals of the lesson.

Were there any roadblocks? Brandi felt her timing was not quite right in the planning of this activity. She felt that this activity would have fit better on day two of division rather than when she did this task, which was on the review day. She wanted her students to have a day to absorb the activity and put the knowledge into practice before they were tested on the content.

What's next? Brandi said she would continue to plan to ask students questions about the connections she wants students to make within each lesson. Brandi started to think about quadratic functions and how the graph relates to the equation and what connections she wants students to make.

Cycle 3: Learn. For this activity, Brandi wanted her students to solidify vocabulary of the parts of a quadratic function and the attributes of the functions (domain, range, x - and y - intercepts, vertex, maximum or minimum, axis of symmetry, zero or solution when $y = 0$). The day before Brandi filmed the class, students took notes using a recording sheet and went to specific posters around the classroom to identify parts of the graph of a quadratic function. For homework, students were given new quadratic functions as well as linear and exponential functions and the sentence stem “I know _____ because _____.” Using the sentence stem, the students had to use the vocabulary from their notes and answer specific questions about each problem based on attributes. Students also had to correctly identify if a given real world application, whether it was

modeled based on a linear, exponential or quadratic function.

The next day in class, students started with an individual activity for 10 minutes. They were given a table, equation, or graph and had to identify everything they knew about the function based on the attributes they had done the day and night before. While the homework included all three functions, the in class discussion focused just on the quadratic function. After the 10 minutes was up, students were allowed to compare their answers with a partner. Brandi then put one table, equation or graph of a quadratic function on the board and asked one student to share what they knew about it and how they knew it. Students could use the sentence stem from the previous night's homework if they wished. After the student had answered what they knew, Brandi continued to question the student about what they said to further the discussion and to tie back in the other functions (linear and exponential). The student then selected the next student to answer questions until every student had a turn sharing with the class what they knew and how they knew it.

Cycle 3: Improve. *What went well?* Brandi felt that the students made many connections between functions with the attributes that the functions share (domain of all three functions, range of two pairs of functions, one y -intercept, x -intercepts (if present depending on the function) and what was unique to a quadratic function). Students were able to refer back to their homework from the previous night and make connections with similarities in the function from the previous night to the new function. Brandi also heard her students using academic appropriate language for all functions.

What did you learn? Brandi felt that the students who were prepared for the discussion were eager to share with the class what they knew. Students who weren't

prepared or may not have completed their homework from the night before were not as eager to share. Students knew that the activity from the previous day was going to be used during the second day of discussion, and she felt that they put time into it knowing the information was going to be used the next day. She felt that students had a better understanding of attributes and that the functions were related based on some of the attributes, but they also understood that a few functions have attributes unique to them (axis of symmetry for a quadratic function and an asymptote for an exponential function).

Were there any roadblocks? Brandi felt that she didn't have enough time to give the activity justice. The class did not get to review all of the functions she had prepared for the discussion and would have liked to have more time to unearth student misconceptions through the activity.

What's next? Brandi felt that she could repeat this activity during End of Course review, add in more questions about functions and ask students if a statement was always true, sometimes true, or never true for a particular function or family of functions. She would also add in function notation and ask students to find a dependent value based on a given independent value. Full survey responses for each coaching cycle can be found in Appendix I in this dissertation.

Findings Correlated to Professional Development

Regarding the first research question of how does professional development on discourse impact secondary mathematics classroom discourse practices, Brandi responded that she understood going into the coaching process that coaching is an extension of PD. The findings appear to show that Brandi felt that PD helped her grow

faster as a facilitator, she was able to focus on her facilitation skills, and that PD assisted her in including more discourse into her lessons more frequently.

She didn't frequently plan for her students to discuss math concepts, but she understood that coaching, as an extension of PD, could assist her in implementing a new strategy into her classroom. Brandi also grew in her ability to implement discourse after coaching, as noted in Table 8. Brandi self-reported that she ranked herself as a 3 to implement discourse before coaching and an 8 on implementing discourse after coaching. Brandi did not answer the interview questions specific to the initial PD if it changed her perceptions on impacting her discourse, she seemed to focus more on how coaching impacted her practice of facilitating discourse.

Brandi reported her planning for discourse was lacking (2 on a scale of 1-5) before PD that she was not planning frequently to implement discourse into her classroom. Before coaching cycles, she was planning for discourse once per unit. As the coaching cycles progressed, she increased the frequency she planned for discourse to once per week instead of once per unit. Brandi also reported after coaching, she felt her ability to use discourse as a strategy in her classroom increased as well (from a 6 to an 8 on a scale of 1-10).

Qualitative Data Findings to Professional Development

The full transcript of the researcher's interview with Brandi can be found in Appendix J of this dissertation. This section highlights some of the salient findings using quotes from the participant.

Brandi learned from the initial PD on discourse what discourse is and she wanted to improve on her skill of facilitating the use of discourse.

It's definitely made me reflect and change how often I was giving the students genuine and authentic opportunities for discourse. And it made me a better facilitator for student discourse and, um, it helped me just to, you know, find my own misconceptions and mistakes and just get better at being a facilitator.

Brandi wanted her students to engage into deep learning of mathematics and she wanted the activities to lead to conversations among students to assist in making connections.

Viewing the coaching cycle as an extension of PD, Brandi felt that coaching kept her aware of what was really occurring in her classroom and held her accountable for keeping to her goal. She states that she has ideas of what she would like to try in her classroom, but those ideas sometimes don't become a reality.

Having our like coaching cycles, it's, it helps on the follow through. Like there's a lot of things as teachers where we were very creative and like we have a lot of ideas like, Oh I want to try this and I want to do this and then it never comes to fruition. And having a coach there to assist with planning help me to make sure that I was following through on implementing ideas and planning these ideas for my classroom 'cause I didn't just, it wasn't something I forgot to do.

Findings Correlated to Instructional Coaching

In addressing the second research question of in what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices, the findings appear to show that coaching assisted Brandi in keeping focused on her goal by keeping her accountable, the video of her classroom kept her focused on her students, the coaching conversations gave her valuable feedback on the planning and design of activities she wanted to incorporate into her classroom and facilitating the lessons.

Brandi felt that coaching was helping her grow as a teacher. From the first coaching cycle survey, she said

Feedback from the coach is really helpful. It helps me build confidence and helps me evaluate myself as a teacher more accurately. It is also helping me to improve the activities that we are using to help students make more connections and understand the concepts better next time.

From the last coaching cycle survey, she said “I am gaining insight into how to better facilitate discourse and creating new ideas for future units.” She had begun to look at her own practice of facilitating discourse and implement strategies learned from planning with the researcher.

Brandi felt that using filming her classroom as a tool helped not only in the Identify phase, but also during each coaching cycle. She liked to see what her students were really engaged in during the activities and how they were talking and assisting each other through conversation. “But I really also did enjoy the identify because it's, I mean it's really eye opening to like see that reality first and compare it to what you thought was happening before you do start to learn.” She continued to compare her coaching cycles back to the first filming of her classroom as she continued to work on her goal.

Each time we both watched the video and then we had our meetings and that was where we really like reflected on like, was what I doing actually still aligned with the goal? Was it still working towards that goal? And so I definitely think we did that.

Brandi plans to continue to film her class as she works towards her goal next year.

I think honestly like to maintain like recording my classroom because it's just such an honest way of looking at what you're doing and what you're getting out of it. I'm definitely going to keep setting a date for myself like once a month or each six weeks to record and watch again and like go through my own mini cycle with it continuously.

During the coaching cycle, Brandi felt the tool of video was an honest picture of the reality of her classroom and what students were engaged in.

In the final interview, Brandi reflected on what parts of the coaching cycle she enjoyed the most. She stated that the conversations that she and the researcher engaged in as part of coaching helped her reflect on what went well and allowed her to use that information to guide her next planned activities.

So from our conversations I always reflected on, I enjoyed the part where it was like, what went well? Because I think a lot of times we focus on maybe what didn't go well and then you spend so much effort just trying to fix that part instead of when we looked at the pieces that did go well and how to just maybe expand that. And I liked doing the “what went well,” what didn't because I just, I didn't spend so much time on the negative and like killing myself being like, well I ran out of time. How do I fix this? I spent more time saying this went well so I can do that more often type thing. So I used that, uh, the “what went well” was when I would plan the next one and implement more of that and see how could I build off what went well from the previous one.

Brandi did reflect on what didn't go well in her lessons as well, she just didn't focus on that during our meetings. She thought about what didn't go well and during the

next time she had students working together, she focused on her facilitating to help her class stay on track with what had been going well for her students.

While I was facilitating that was probably when I thought more about the what didn't go well from, um, our conversations to avoid making like those teacher miscues happen again where either didn't question enough or I didn't leave something open ended enough or I didn't give a kid enough time. That was I think during the facilitating where I had the, I used the, what didn't go well in my mindset to fix.

Brandi was able to identify the parts of the coaching cycle that she used to improve her practice of facilitating discourse in her classroom.

Brandi felt that working with the researcher improved her practice by having conversations about what she had planned, how it might work with students, and would the activity and questions she had planned help her reach her goal.

Like I said, like having another person to help you look at what you're doing. It's just like having someone like peer edit a paper. You're because you're doing it, you're missing things that are common to you or things that you see every day or bad habits you have 'cause they're habits. So having a coach is just a fresh set of eyes on what you're doing and they bring new perspective and new ideas that you're just not, that you're just missing, even though it's there, you're just missing it sometimes.

In reflecting on how the researcher and Brandi worked together to plan and troubleshoot possible roadblocks during the lesson, Brandi responded

When we talked about roadblocks that helped me in like brainstorming and planning for the next time I was going to be working on discourse with my kids. And even then like whenever we'd be planning we would talk about do you have time for this or how can you make this better? Like trying to troubleshoot it before I did it. And that helps a lot. Like having the sheet of the sentence stems go home with the kids the night before. Like that was a lot of troubleshooting that helped for it to go well.

Summary

Brandi used the coaching cycles to focus her planning on activities that would foster a student centered classroom and how she would shape her responses to students to have them become reflective about their understanding of the concepts in class. Coaching held her accountable to her goal, assisted in planning activities to reach that goal, and allowed her to reflect on how to keep her students discussing math concepts and making connections every day. She found filming her class was a tool she could use to help keep herself accountable for these actions, and it also allows her to reflect on how to engage her students into the conversation.

Brandi felt that she met her goal with the last activity that the researcher assisted her in planning.

I mean I am probably jumping ahead and like my thoughts but whenever I hear my PEERS goal and I think about the final activity I did, like I feel like I finally got as close as I could to really meeting that goal. Cause that last activity I did was all about like it was completely student centered and completely about their own discourse and like feeding off what someone else had said to then bring their

own information. So once I like hear my goal again and think about that last activity, I mean I think we definitely got to the goal or at least got close.

She felt that her students also grew through engaging in discourse and the student centered activities she had planned.

I really think for all of them like confidence grew because feeling like, you know, what you're talking about and having something to add to the conversation and not feeling left out or lost helps. Um, with the activities that we did, there was an entry point for all the kids and I did see them start to make connections between, you know, attributes of different, like multiple functions we had talked about. And so they definitely grew in confidence I think definitely grew in being able to connect key attributes across all functions. So that's why I can't wait to do it again next year. I'm so excited.

Case 3

Background

Kristine is a forty-four year old white female. She has been teaching for 20 years, the last 5 at the campus where the research took place. She has a bachelor's degree in education, concentration of mathematics, and was certified through her undergraduate program. Kristine had worked with the researcher in a coaching cycle previously when she taught Algebra 1 and was familiar with the process of coaching.

Kristine teaches a math course called Mathematical Models with Applications (MMA). The course is designated by the State of Texas to be a third-year math course, where students may only enroll in one third year math course for graduation credit as a high school student. Students in MMA typically complete their three math requirements

with this course, while others go onto a fourth credit of math for high school graduation. The curriculum covers graphing functions (linear and quadratic), solving equations with both algebraic and graphing methods (linear, quadratic, and exponential), solve systems of linear equations, geometry concepts such as right triangle trigonometry, surface area and volume, and a personal finance unit.

Identify

The class that Kristine chose to film is supported in class with an additional paraprofessional adult. The paraprofessional assists students with staying on task, monitoring students to ensure that they are taking notes, assisting with small group tutorials, and record keeping. The paraprofessional was not included in the lesson planning or the coaching cycle, but students in the class did receive additional support all year from the paraprofessional.

After Kristine filmed a full 45-minute class, she and the researcher met to discuss the identify questions. Kristine rated the class a 5 on a scale of one to ten; she felt that students understood the content and were on task until they finished the assignment. Kristine likened the class to an average class for that particular group of students on any given day. She admitted to not really knowing what a perfect class might look like. The researcher asked question four (what would your students be doing differently if your class were a 10?) and Kristine thought about it before indicating that students would be more engaged and asking more thoughtful questions about the math. She thought that if she asked more intentional and focused questions, students would be focused on making connections between concepts. She would be able to measure through tracking how many questions students asked and how she responded to their question. Kristine thought that if

she engaged students in critical thinking through the questions that she asked, it would keep students more engaged in class.

Kristine's PEERS goal for the coaching cycle was "students will engage in critical thinking about the math concepts to be engaged in learning."

Cycle 1: Learn. Kristine's first lesson for the coaching cycle was on using tables to model linear data. Kristine and researcher thought it would be a good idea to frame the lesson for students with a lesson goal. Prior lessons focused on the graphs of linear models; this lesson focused on data presented in a table. Kristine wanted students to understand not only how a table can be graphed, but also how to find the linear model that would best fit the data. In setting a lesson goal and sharing with students, she was setting students up for connecting information from prior days together.

At the start of the lesson, she planned to ask students to graph the given data, chose the scales to use on each axis and which quantity was the independent and dependent variable. She planned to ask the following questions:

- Define decreasing as it pertains to a function (any function).
- How do we know this situation describes a decreasing function?
- What kinds of functions can decrease?
- What function best fits the data?
- What are the attributes of that particular function?
- How do you know those attributes belong to this situation?
- How can you verify that information?

Cycle 1: Improve. During each improve phase, the researcher asked the same four questions (what went well, what did you learn, were there any roadblocks and what's

next).

What went well? Kristine felt that the lesson went better than the lesson she filmed for the Identify phase. She felt that the students were engaged and able to answer other student's questions.

What did you learn? Kristine felt that she was moving too fast in the lesson for students to be able to process the questions she was asking. She also thought she needed to prepare more open-ended questions for students to answer and embed them in the presentation so she didn't forget to ask the questions.

Were there any roadblocks? She felt that students were answering the questions before really thinking about the answers and that the same students were answering all of the questions.

What's next? Kristine felt that she needs to plan the open-ended questions in advance, embed them into the presentation and not forget to ask students. She was also going to work on her timing and make sure that students had time to think about the question before she moved onto the next question or topic in the lesson.

Cycle 2: Learn. In this activity, the students were engaged in solving real-world problems involving right triangles as well as angle of elevation and angle of depression problems. Students were introduced to the vocabulary of angle of elevation and angle of depression in Geometry (the previous course for most students). Kristine wanted students to be able to create and draw a picture based on the verbal description of the problem and solve using trigonometry and/or the Pythagorean Theorem. Kristine started the conversation stating that students struggle to draw the appropriate picture. The researcher and Kristine discussed a teaching strategy that utilizes anchor charts (a poster that is

created with students to provide essential background of the concept, including a picture, without describing the process of how to use the concept in a problem) as well as drawing pictures of common right triangle problems and leaving the drawings posted around the room. This suggestion was based on Kristine's comment of students putting the real-world scenarios in context of a right triangle.

Kristine and researcher worked to create questions to frame a process of how to start thinking about a real world problem. The questions were

- What does the problem give me?
- Where does that go in the picture?
- What do I need to find?
- Is my labeling correct?

Kristine would be able to refer back to the anchor charts or the pictures in the room to assist students in visualizing the scenario. Because Kristine stated that students misplace where the angle of elevation or angle of depression belongs in the picture, the researcher and Kristine discussed adding into the notes a section about alternate interior angles formed by a line (called a transversal) intersecting two parallel lines (another Geometry concept). To increase students' thinking about a problem, it was discussed to include a real-world problem where students had to add the height of a person (from the ground to eye level) in the final answer for a vertical distance, where solving using the right triangle would not include this initial height. This particular problem also gave some units in yards and other units in feet.

Cycle 2: Improve. *What went well?* Kristine reported that the challenge of adding the eye-height of a person went better than she thought it would. Kristine asked students

initially what was different about the problem and stated that a few students could complete the problem on their own. When she started talking to the class, they identified needing to convert yards to feet and some were able to complete the problem on their own.

What did you learn? Kristine stated that some students were able to complete more multistep problems and answer more challenging questions on their own. She thought she needed to start planning more challenging questions to ask students in class. Kristine also learned that when the students were talking as a class, more students understood the concept as they were building on other's ideas and it helped their self-confidence in math.

Were there any roadblocks? Kristine felt that some students struggled when left to work the problem on their own. She felt that she might try grouping her students differently and scaffold questions based on the students' needs.

What's next? Kristine thought she could plan more questions ahead of time and scaffold the questions for students who needed it without diminishing the quality of the question for the student.

Cycle 3: Learn. For the third coaching cycle, Kristine was in the process of teaching how to solve a quadratic function through graphing, completing the square, factoring and using the quadratic formula. The lesson that the researcher and Kristine focused on was solving using the quadratic formula. Because using the quadratic formula was the last method for solving in the sequence of lessons, students learned previously how to solve by graphing (when the equation was set equal to zero) and looking for x-

intercepts. Kristine wanted students to connect the graph to the solutions using the quadratic formula. Specifically, she wanted students to understand that the value under the square root symbol determines how many real or imaginary solutions the function will have.

The researcher and Kristine looked at the notes that had been planned for students. The discussion needed to tie the graph of the function to the solutions found using the quadratic function. The researcher suggested working three examples using just the quadratic formula, then returning to the problems and graphing each one. The first problem has two real solutions (the graph crosses the x -axis twice). Kristine could ask students what would change in the solving process for the graph to only cross the x -axis once, or not at all. Specifically, the questions to be asked could be:

- What do you think this graph will look like?
- What are the x -intercepts?
- After completing the first two graphs together, Kristine could ask what no solutions would look like.
- What would the graph of a function with decimal x -intercepts look like?
- When given a standard form of a quadratic function $(f(x) = ax^2 + bx + c)$, ask students to predict what kind of solutions a graph would have just based on the “ a ” and “ c ” values.

Cycle 3: Improve. *What went well?* Kristine changed the sequence to review the graph of each equation after solving algebraically with the quadratic formula. She wanted the students to see right away that the zeros and solutions when $y = 0$ on the graph were

the numbers produced from solving algebraically. From starting the lesson with that structure, when students found a negative under the radical symbol (indicating imaginary solutions and the graph will not cross the x -axis), a student responded “uh-oh,” indicating they were making a connection between the graph and the algebraic solution. Kristine also heard students say “oooh” when they found a decimal solution when comparing the decimal solution to the graph and using a graphing calculator to assist in finding the decimal solution on the graph.

What did you learn? Kristine learned that while she expects that students were proficient in using the graphing calculator, she needs to have the graphing calculator projected in order for students to follow along. She found that several students struggled to use the technology efficiently to find x -intercepts. Kristine also learned that her students knew more than she thought that they did and made the connections that impressed her.

Were there any roadblocks? Kristine found that the same students answered her questions and talked every time she asked a question. The researcher and Kristine discussed strategies to try including call on a specific student at first, give wait time to allow the student to think about the question and prepare an answer, tell students to think about the question first before giving an answer and also telling students she would call on someone to answer.

What's next? Kristine said that she would continue to look at her lessons in order to include more discussion questions within the lessons and plan for the connections she wanted students to make. Full survey responses for each coaching cycle can be found in Appendix K in this dissertation.

Findings Correlated to Professional Development

Addressing the first research question of how does professional development on discourse impact secondary mathematics classroom discourse practices, Kristine felt that an instructional coach continues PD in a personalized manner to help her implement the strategy of facilitating discourse in her classroom. PD appeared to assist her in increasing the number of times she asked students to talk about mathematics and make connections. Kristine's responses to the surveys after coaching could be attributed to her feelings about how instructional coaching assisted her discourse practices, as coaching was an extended form of PD. Table 13 summarizes her responses to part of the survey questions.

Kristine reported that before PD or coaching, she never planned for discourse (1 on a scale of 1 to 5). After PD and coaching, she began to plan for discourse once per unit (2 on a scale of 1 to 5). While Kristine reported her ability to implement discourse before discourse to be between a 2 and 4 on a scale of 1 to 10, after PD and coaching, she ranked herself higher, between an 8 and 6 on a scale of 1 to 10. PD and coaching appeared to assist Kristine in facilitating discourse into her classroom.

Qualitative Data Findings to Professional Development

The full transcript of the researcher's interview with Kristine can be found in Appendix L of this dissertation. This section highlights some of the salient findings using quotes from the participant.

Kristine had previously experienced a coaching cycle with the researcher and viewed coaching as a form of extended professional development. She stated in her interview "I had an instructional coach before I did the professional development session, but I do feel like the, the instructional coaching that you gave me pertaining to that

session, it would be an extension of that session.” Kristine continued, “I think the instructional coach helps me implement some things that I’ve learned in professional development better.”

Kristine felt that the researcher assisted in focusing her lessons on embedding questions to ask her students to assist them in making connections about the mathematics.

I have found places in my lessons to be more intentional about the questions that I ask the kids rather than just telling them something. So, um, maybe different ways to phrase something, different ways to ask questions, having them do things like that.

Kristine felt that she learned about student discourse from the initial PD and without coaching support, she may not have used the strategy with the same focus as she had after the PD.

I would have, um, probably thought that I was implementing discourse practices without the PD and I maybe have done some of it, but I’m not to the extent that I did after the PD nor, um, correctly knowing what discourse actually really was intended for. I just don’t know that I would have done it the right way. Ask the right questions, really understood the definition of what the intention of discourse in the classroom was.

Findings Correlated to Instructional Coaching

Addressing the second research question of in what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices, Kristine seemed to find that coaching assisted her in planning for embedding questions into her

lessons in order to engage students in thinking about the concepts, and to talk through facilitating student discourse using the questions and engaging all of her students.

Kristine felt that planning in the coaching cycles helped her embed questions for students into her lessons. In a survey after the first coaching cycle, she said “it has helped me purposely plan questions and lessons for discourse. My coach has helped me find places in my existing lessons where discourse can help.” In a later survey, she reflected “it helped me find places in my lessons to have to kids have meaningful discussions and discovery.” In the final interview, Kristine reflected

When I'm doing a lesson to intentionally make sure that I am, um, embedding questions for them to talk amongst themselves and have a little discourse and be able to come up with an answer. So for me it was probably more in the planning phases that helped me.

During the coaching meetings, she wanted her students to have the opportunity to talk about the math concepts and needed assistance from the researcher on what kinds of questions to ask and where to put them within her lessons.

Kristine did not feel that she needed to re-write her lessons, rather just needed to plan more effectively for her students to engage more in the learning. When asked in the interview what she found to be the most useful, she replied

the planning piece and, and, and not having to reinvent the wheel with everything, which I think is stressful as a teacher is when somebody is trying to tell you to change something and um, you know, the time involved and if it's not broke, don't fix it. Doesn't mean it can't get better and just tweaking something, um, a little bit,

taking what you have and tweaking it to make it better fit the kids and the stuff like that. So that helped.

Kristine was cognizant of the students in her class and wanted to make sure that the questions she was posing to students were within their reach of answering.

Any of my classes are probably different than the reality of somebody else's class. And I think when we were planning, um, we took into the consideration the students that were sitting into my classroom and what, what the, what the best idea in my class would be.

I mean you helped me, you know, find places in my lesson, especially because I teach kids that, um, probably don't think a lot for themselves. Um, do basically menial tasks when asked they, um, they're not typically your critical thinkers, I would think. And so, you know, finding places to ask questions in my lesson that I think that they would respond to was very helpful.

Through the coaching cycles and Kristine's continued attempts at engaging her students, she did find that students were engaging in the learning.

So I don't know that if it was growth in my students or me understanding that my students did have the ability to make connections that I didn't think that they would make on their own.

I think was it when we were doing quadratics and finding the X, and I remember a couple of my kids having this like aha moment or like when we got a negative underneath the radical sign just to solve them algebraically and they're like, Oh, that means it doesn't cross the X axis. Right? So there are no X intercepts. So them just being able to see what's coming ahead based on what they

already knew and what we'd already talked about and making some connections between graphically and algebraically that I didn't have to tell them. Mmm. And again, my students are really low, so I get excited that those connections happen.

During the coaching meetings, Kristine was thoughtful about the question she and the researcher were planning together, and how to facilitate best with her classes. The class period that she filmed did include students who required additional support in their education and she wanted to be sure that all students in her class had an opportunity to answer. Kristine wanted to be sure that her students were thinking about the questions she was asking, but brought up during the coaching cycle as well as in her surveys that “my students are pretty low, so finding problems and questions for them in order to think for themselves but be successful at it has been a challenge, ”sometimes they students don't want to participate and just want to be told the answer,” and “it seems that the same students are always engaged and tell the other students the answers. Some students just wait for the other students to discuss and figure it out.”

The researcher and Kristine discussed strategies to use in the classroom to engage those particular students, including asking students to not shout out the answer, letting each table group of students know that they were going to contribute to the discussion that day and giving them an order of tables which they would be answering, and giving students a strategy of saying “my neighbor said this...” which allowed the pressure of not having the correct answer be on the shoulders of the speaker.

Kristine did state that planning with the researcher was helping all of her students, saying “it is helping me help the students make connections in math.” Over the course of the coaching cycles, she felt that her students were beginning to think about the answers

to the questions and that process was “making them deeper thinkers and better problem solvers,” and “it is making them more confident learners.”

Summary

Kristine felt that instructional coaching allowed her to plan more intentionally in order to assist her students in making connections among the math topics. She didn't necessarily feel that her lessons needed to be re-written, rather that her lessons should allow time for her students to discuss math topics and she could facilitate additional questions to guide her students to the conclusions she wanted them to make.

Kristine and the researcher also took time to discuss how Kristine might facilitate more effectively in her classroom to allow all students the chance to build on their knowledge before the conclusion was made by another student. She felt that facilitating discourse allowed for her students to become more confident in their mathematical knowledge and problem solving skills.

Case 4

Background

Mia is a forty-nine year old white female. She has fourteen years of experience teaching mathematics and has been on the campus where the research was conducted for the last four years. She has an undergraduate degree in mathematics, was alternatively certified after her bachelor's degree and has a Master's degree in Curriculum and Instruction, Secondary Education. Mia has been coached by the researcher in the past when she was teaching Algebra 1.

Mia currently teaches Algebra 2 and Pre-AP Algebra 2 to sophomores and juniors. The Pre-AP course prepares students to take an Advanced Placement (AP)

mathematics course before graduating from high school. While AP courses are open enrollment and do not require students to have taken any Pre-AP courses before the AP course, the Pre-AP Algebra 2 course challenges students in the depth of learning required for success in an AP course. Algebra 2 is not a required math course for students to take, but many students who wish to enroll in a two or four year college or university typically take the course to prepare them for continuing education beyond high school. The focus of Algebra 2 is a study of various functions (quadratic, square root, cubic, polynomial, rational, absolute value, exponential, and logarithmic function) including solving functions, solving inequalities related to the functions, graphing and analyzing the graphs, data regression and models of best fit, and problem solving real world situations that can be modeled by the above functions. Pre-AP Algebra 2 is differentiated from the on-level Algebra 2 by the pace and higher ordered thinking problems that are posed to students and the rigor at which students are assessed.

Identify

Mia filmed a full class period of forty-five minutes and rated the lesson at a 7 or 8 on a scale of 1 to 10, where 10 is the highest. After reviewing the lesson filmed, Mia felt that her students discovered that the square root of x is the absolute value of x , the definition of the principal square root of a number is a positive number, and understood that solving for a variable (such as $x^2 = 25$) generates two possible answers, where $\sqrt{25}$ would generate the principal root of 5. The concept of a principal root was important to Mia for when students learn to simplify radical expressions and solve radical equations with variables as well as numbers. When asked what changes would need to be made to move the lesson closer to be the ideal lesson and rank a 10, Mia would have structured

lessons at the start of the unit differently in order to lead up to this particular lesson. In Mia's ideal lesson, students would be able to end the lesson by generating their own problem using the ideas discovered in class. During the coaching conversation, Mia and the researcher talked about how to shift the lesson closer to a 10, and the researcher asked what the classroom would look like if students were able to produce the problem she wanted. Mia responded that students would need to be more involved with talking to each other and would have to talk to each other more. She felt that students might need some of the mechanical skills on solving or simplifying before she could ask them to produce an equation or expression, but that if students were talking to each other when learning the mechanical skills, they would have a deeper understanding of the concept.

Mia's PEERS goal for the coaching cycle I was "students will increase their involvement and interaction with mathematics through discussions in class."

Cycle 1: Learn. In the first coaching cycle, Mia chose a lesson for students to increase their involvement and interactions with mathematics where students are dividing polynomial functions. The lesson focused on the idea of the divisor is a factor if the division results in no remainder. Mia wanted students to gain the understanding of the connection of a remainder of the quotient of two polynomials and the x -intercept of the graph of the dividend. Specifically, when the remainder is zero, then the divisor is a factor $(x - c)$ of the dividend and an x -intercept occurs where $x = c$. For example, if $(x^2 - 7x + 12) \div (x - 4)$ and the remainder is 0, then $(x - 4)$ is a factor of $(x^2 - 7x + 12)$ and the graph will cross the x -axis at $x = 4$.

In preparation for the lesson the day before, students divided polynomials using a long division algorithm. Previously, Mia had not been using a graphing calculator as an exploratory tool in her classroom. She wanted to incorporate the tool more to aid in student discovery. For these particular problems, all the divisors were factors. Students then used a graphing calculator to verify the x -intercepts of the dividend and the behavior of the graph at the x -intercepts. This behavior of the graph at the x -intercepts is referred to as the multiplicity of the factor. Students also learned about the shape of the graph at particular x -intercepts. Graphically, multiplicity is seen in the graph crossing the x -axis (multiplicity of one), be tangent at the x -axis (multiplicity of two), or have an “S” shape or a change in concavity, where the graph flattens out at the x -axis (multiplicity of 3).

In the lesson the researcher and Mia were preparing, Mia was introducing a different method of dividing polynomials, synthetic division. Synthetic division is a procedure where a polynomial represented by its coefficients and constant is divided by a number that represents a possible x -intercept. She planned to use the following questions to prompt student thinking:

- If a divisor has a remainder of zero, what does that mean in terms of the graph?
- What are the behaviors of the polynomial at the x -intercept?
- What is the relationship between the x -intercept and the multiplicity at each x -intercept?
- Is there a relationship between the number of x -intercepts and their multiplicity and the degree of the polynomial?

Cycle 1: Improve. During each improve phase, the researcher asked the same four questions (what went well, what did you learn, were there any roadblocks and what’s

next).

What went well? Mia felt that students were connecting the remainder of zero to the idea that the number was an x -intercept and that the expression would be a factor of the polynomial. She felt that students were able to determine if the divisor was a factor using either long or synthetic division. Mia felt that students loved using the calculator as a method of verifying their work.

What did you learn? Mia stated that the calculator had not been previously used as a teaching tool, verify solutions and make connections between representations. She observed that if she had used the calculator as teaching tool instead of a quick method for getting an answer, she would be able to assist her students in seeing connections between multiple concepts at once. She was able to introduce a method (synthetic division) that was going to be used in conjunction with the Rational Zero Theorem in subsequent lessons, but not on that particular day. She wanted to tie the method of synthetic division and the relationship to the factors of the polynomial and knew that this lesson helped establish those ideas for students.

Were there any roadblocks? Mia felt that after teaching the class that she filmed, she taught the method of synthetic division too quickly. She adjusted her lessons for the rest of the day by slowing down. She also felt that she became more intentional with her directions. Mia felt that she had a hard time getting students to understand the restrictions of synthetic division and how she might present it to students to assist in clarifying their understanding of the topic.

What's next? Mia felt that she would be intentional in the questions that she asked students in the next two days, to help solidify and reinforce the concepts of polynomial division and the connections to multiplicity and the shape of the graph.

Cycle 2: Learn. In this lesson, Mia planned for students to practice finding all x-intercepts of a polynomial function and be able to write the factored form of the polynomial equation based on the x-intercepts. She also wanted students to determine the total number of real x-intercepts and the behavior of the graph at each x-intercept based on the multiplicity. Mia wanted students to make connections between factors and their degree, be able to determine the x-intercept using the Rational Zero Theorem, complete the division necessary, and if the x-intercepts were imaginary number, she wanted students to use the quadratic formula to find the expression that represented the final x-intercepts. Mia was wanting her students to continue to check their work with a graphing calculator after the x-intercepts were found using algebraic tools. She planned on using the following questions to prompt student thinking:

- What will you do to determine if a divisor has a multiplicity that is greater than 1?
- How do you condense $(x - 2)(x - 2)(x + 3)$ and how does that affect the graph?
- How will you look for multiplicity when you are finding the zeros?
- What could you have done differently to get the factored form?
- How many times did you use synthetic division to get to the final factored form?

At the end of the lesson, Mia asked students what they knew about polynomials and wrote all of their responses on the board. She stated that she practiced “wait time” to give students a chance to think and respond about what they knew.

Cycle 2: Improve. *What went well?* Mia felt that students were making connections between the number of x-intercepts and the multiplicity of the factored form to the degree of the polynomial (total number of x-intercepts along with multiplicity should equal the degree of the polynomial), students were connecting the behavior of the graph at the x-intercepts to the multiplicity of factored form and the when students had a multiplicity of three, a concavity change was occurring at the x-intercept.

What did you learn? Mia felt that it was important to give all students a chance to contribute to what they knew about polynomial functions as it gave students a chance to be a part of the class. She thought she should be giving students opportunities to make mathematical connections along a unit of study to help them pull the concepts together.

Were there any roadblocks? Mia did not identify any roadblocks in the lesson, but felt that she needs to give the students a chance to make connections more frequently.

What's next? Mia stated she would continue to plan lessons that give students the chance to make connections through questioning and plan for time in lessons for this to occur.

Cycle 3: Learn. In the last coaching cycle, Mia's lesson was on adding and subtracting rational expressions. The lesson was very mechanical in the sense that students were adding and subtracting fractions that included expressions for both

numerators and denominators (for example, $\frac{3}{x+4} + \frac{x}{x-2}$). Mia wanted students to understand why you needed common denominators and why it is helpful to have a least common denominator rather than any common denominator. Mia planned to ask the following questions:

- Why do we need common denominators to add or subtract?
- Why do we use the least common denominator?
- What would be the common denominator? How do you know that is the common denominator?
- Is one denominator a multiple of the other?
- What can you multiply by that changes the appearance but not the value of the fraction?

Cycle 3: Improve. *What went well?* Mia felt that having students explain why you need a common denominator to add and subtract was effective. Students explained with an example of pizza, you need to know what number of slices gives each person the same amount of pizza if they were cut differently. Another student described it as having the same denominator made the expressions like terms so you could add the numerators.

What did you learn? Students understood the concept of needing to find a common denominator. The lesson was not a stretch for students.

Were there any roadblocks? Mia reported no roadblocks.

What's next? When moving onto the next topic, Mia thought she would multiply by strategic values of 1 in order to add more complex fractions together in order for students to move into multiplying and dividing rational expressions and understanding how restrictions on the domain affect the graph. Mia continued to engage students into conversations in order to make connections among mathematical concepts and will ask more in depth questions to students. Full survey responses for each coaching cycle can be found in Appendix M in this dissertation.

Findings Correlated to Professional Development

Addressing the first research question of how does professional development on discourse impact secondary mathematics classroom discourse practices, Mia responded that she viewed coaching as an extension of PD, that coaching required that she look at her own practices within the classroom, and that discourse practices wouldn't have been implemented without coaching support. It appears that Mia viewed PD as a tool to help keep her accountable in continuing to facilitate discourse and reflect on her practice of facilitation.

Mia reported that before PD or coaching, she was planning once a week to implement discourse into her classroom. In the middle of the coaching cycles, she increased her planning to several times a week. By the end of the coaching cycles, she was planning once a week for discourse to occur in her classroom. Mia reported that after coaching, her ability to use discourse as a classroom strategy only increased after the first coaching cycles (6 to an 8 on a scale of 1 to 10). After the second and third coaching cycle, she ranked herself the same ability level before and after PD and coaching.

Qualitative Data Findings to Professional Development

The full transcript of the researcher's interview with Mia can be found in Appendix N of this dissertation. This section highlights some of the salient findings using quotes from the participant.

Mia appeared to view the initial PD as an introduction to the strategy of facilitating discourse and coaching was a way to keep her accountable to implementing the strategy into her classroom. Mia commented in her interview "it was definitely the M.O., the next logical step. Now that you've set up your room and these expectations,

now let's keep going with it" and "it's definitely the next step of beyond classroom management, class/relationships with students, environment safe spaces."

Mia stated that she wouldn't have attempted to facilitate discourse in her classroom without PD or coaching support. Stemming from a question about implementing facilitating discourse without PD, Mia said

I don't have time to sit there and think stuff out. I'm not researching how to improve instruction. I mean, professional development opens a teacher's mind to possibilities of what could happen with the time constraints and you know, work requirements. It's, it's hard to, to do that.

Without coaching support, Mia stated she would not have continued with the learning from PD and attempted it in her classroom.

Well, I wouldn't know what I was doing. I wouldn't know what would be effective. I wouldn't know. Um, you know, tried research. You know, I wouldn't, I don't just go in the kitchen and start making a recipe. I look it up, I research it. I look what the ingredients are. So when you're trying to do discourse in your, in your classroom without coaching or professional development, it would just be, I wouldn't have tried it at all.

When Mia viewed instructional coaching as an extended form of PD, she was intentionally facilitating discourse into her classroom.

Findings Correlated to Instructional Coaching

Addressing the second research question of in what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices, Mia felt the coaching cycles assisted in improving her facilitation skills of implementing

discourse into her classroom, helped her to plan more opened ended questions for each lesson and to reflect on her own practice as she facilitated discourse.

In the Identify phase, Mia was able to gain a clear picture of her actions in the classroom.

One of the processes in the instructional coaching is I had to watch a 45 minute video of myself in class. And when you, when you don't do that, you have, you really have no idea how you look in the classroom, how you behave, you, you think you're doing one thing, but you might be doing something completely different than what it showed me is whether I did it intentionally for subconsciously, I only talked to certain kids in the class. I did not. Mmm. I did not engage everybody at some point. And that was, that was an issue for me because I know in my mind I'm like, okay, all these kids are smart. I know they know it, but I'm not giving them an opportunity to express that knowledge either. And that's not fair.

Mia found after watching the forty-five minute lesson that she filmed that did not have “adequate questions to generate conversations.” This conclusion led to her and the researcher to plan more questions for students to answer in the next coaching cycles.

Mia purposely planned for her students to have questions to answer and discuss among themselves, but she also reflected on her own actions as the students were discussing. When asked in the interview if anything from the PD or coaching conversations stuck with her as she planned, facilitated or reflected, she said

Yes, I made sure that my, my, my, um, my small purposeful talk questions were open-ended. Um, I learned how to, anything, I learned how to, let me think, um,

let them brainstorm rather than take one answer and then move on. I'll let everyone contribute. Mmm. Yes. Um, also giving them time to think things out and to reflect and to communicate with each other and then giving them an opportunity to, uh, popcorn back. That information is very important.

Mia used the coaching cycle and the researcher to plan the questions to ask students. She found that she needed more than one question per lesson to have students discuss in the event that students didn't understand one question or that she wanted students to make more connections within the lessons.

I was assisted specifically because we set goals. Um, my coach gave me ideas about what to do. We, um, jotted down potential questions, uh, uh, we knew what the lesson was going to be ahead of time so we could, we could plan ahead.

Of course we did give ideas of yes. Uh, how to troubleshoot if it doesn't go well. I don't, well, I mean, I didn't go into any, in my lessons with just one question, you know, I didn't have just one possible discourse opportunity. There were several. So if one question or one opportunity wasn't, um, as well as the others, there were, there was enough to, to just to do the activity.

In addition to planning the questions to ask students, Mia felt reflecting on the lessons that she filmed were eye opening and beneficial to her. The filming allowed her to see what was really going on in her class and to watch her interactions with students.

When I would ask these, you know, open-ended questions and gave them time to communicate with each other, it was always a success. So reflecting, it wasn't like I had to reflect and go, Oh, that was, that did not work. The only time I was really reflecting was when after I watched that video and I could see myself or when I,

after I watched the video and I could see that, um, I limited who could who was responding or who I was listening to.

Mia became aware of her interactions with students to make sure that students had time to process the question(s) before having students share their thoughts and to be fair to all students to allow them each to contribute to the conversation. She thought that during the process of reflection, her students became more confident in talking about the mathematics they were learning. She had to learn to allow her students the freedom to think, converse, possibly be wrong, and address those misconceptions or have students continue to talk to address the misconceptions.

Well, they [students] were more confident talking to each other about math. They were confident in explaining themselves mathematically in class, in front of their peers. I became more comfortable with them talking about stuff, you know, releasing control and knowing that they could come at me with anything that I may not have thought of. And that's okay. I don't have to be the smartest person in the room. So letting go of that was a big deal. Uh, but this is about the students. Mmm. They, that's it. Just talking with each other and talking in class, brainstorming.

Mia felt that students were gaining knowledge in talking to each other and understanding the concepts behind the mathematics they were learning, leading to a deeper understanding of the topics. In a survey response, she said that as she facilitated classroom discourse, students were “learning more over time with continuous verbal communication about mathematics” and that discourse “helps students understand why they know what they know, not just memorizing steps but the ‘why’ behind the math.”

Summary

Mia had previously been involved in a coaching cycle with the researcher. She viewed coaching as an extension of PD and while the PD might instruct on a strategy, coaching is what assisted her in implementing the strategy into her classroom. She was able to see her own actions in the videos of her classroom to work on her practice of facilitating discourse.

Mia recognized that she needed multiple questions to pose to her students for any one given lesson. She worked with the researcher to plan those questions and also where would be the best place in the lesson to pose the questions to students.

Mia found that when she reflected on her practice of facilitating discourse, she had to relinquish some control to her students to allow them freedom to think and make connections and build off of the ideas of their peers. Without coaching support, she didn't think that she would have implemented the strategy of facilitating discourse into her classroom.

Summary

This case study sought to answer two research questions.

1. How does professional development on discourse impact secondary mathematics teachers' perceptions of classroom discourse practices?

2. In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?

Each participant chose to attend an initial PD over facilitating discourse in the secondary mathematics classroom. From the initial sample of fifteen participants, five were chosen to participate in the study based on proximity and previous working relationships with the

researcher. Four participants completed the coaching cycle while one participant dropped out of the study.

The findings presented in this chapter, by case, followed the same pattern of the researcher and the participant meeting in coaching cycles. Each participant filmed forty-five minutes of their class to form a clear picture of reality of their classroom and met with the researcher after both had viewed the video. Through a series of Identify questions (Knight, 2018), the researcher and participant formulated a PEERS goal to give structure to the coaching cycles. Each participant then completed three cycles of Learn and Improve. This chapter provided the structure of each lesson as well as the data collected through surveys after each Learn and Improve cycle as well as a final semi-structured interview with each participant.

Case 1

Julie had never been coached before as it pertained to her geometry classroom. Julie felt that the initial PD described what student discourse is and that instructional coaching helped her implement the strategy of facilitating discourse into her classroom. She did state that she felt that coaching was an extension of the PD as she went through planning lessons and activities for her students to complete and how she could engage them into conversations. In the planning of lessons, she became more thoughtful about what her students were talking about and the connections in the mathematics she wanted them to make. She felt through the conversations with the researcher in the Learn phase, she was able to discuss possible student responses and how she might respond to additional student questions. When reflecting over the lesson in the Improve phase, Julie felt she had time to think about what connections her students made and if she needed to

adjust the lesson for future use. She began to change how she questioned her students to make them dive back into the activity to continue to talk about an activity. Over the course of the coaching cycle, Julie felt that her students were participating in talking to each other more frequently and were not afraid to ask each other questions.

Case 2

Brandi had been coached before by an instructional coach at her previous campus. She knew that coaching was an extension of PD. Brandi wanted to plan activities for her students that engaged students in discussing the mathematics concepts in order to make connections between those concepts. She used the filming of her class to understand what her students were doing when she was discussing with another group. Through the video and reflecting on her lessons, Brandi focused on what was going well with the activity. She used this knowledge to plan more activities using similar strategies for future lessons. Brandi wanted to keep the positive outcomes continuing in her class. She felt that in her last coaching cycle, the activity planned met her PEERS goal in which students were able to work alone, then partner up with a neighbor to discuss the graphs, then each contribute to the conversation about a particular function. Brandi was able to continue the questioning of the students based on their answers and felt that given the opportunity to collaborate, students were able to make connections about the three functions and deeply understand the connections. She felt that she reached her goal of facilitating discourse into her classroom.

Case 3

Kristine had previously been coached by the researcher and viewed coaching as an extended form of PD. Within the Learn and Improve phases of the cycle, she focused

on what questions she would ask her students and where she would embed them in the lesson. Kristine was unsure that her students, many of whom had instructional support in her classroom, would be able to answer questions to the level that were planned. The researcher and Kristine discussed how she could scaffold questions if students were unable to answer. She knew that a few of her students were able to answer quickly but she didn't want the same students to answer all the questions. The researcher and Kristine discussed strategies for Kristine to use in her classroom to help all students contribute to the conversation. Kristine did not want to reinvent her lessons, rather she wanted to enhance them with students discussing math concepts and making connections within those concepts. Kristine was pleasantly surprised that her students were making connections with the last activity where they were determining the nature of the x -intercepts of quadratic equations.

Case 4

Mia had previously been coached by the researcher and viewed coaching as an extension of PD. Mia found the Identify phase of the coaching cycle to be beneficial to her practice of facilitating discourse as it showed her own actions when trying to engage students into talking about mathematics concepts in her class. She continued to view her actions with a critical eye as she filmed each coaching cycle. Mia found that planning several open-ended questions was helpful for her to engage her students. Teaching a Pre-AP course, Mia wanted to challenge her students in their thinking of concepts. In her interview, Mia referenced "letting go of control" of the conversations to let students develop their own connections and thoughts before presenting them to the class. Mia found if she gave her students time to think about the math concepts and she had some

questions planned to guide them to the connections she wanted them to make, the students were able to understand at a conceptual level and were not just following a process.

For each case, the participants engaged in a coaching cycle that was tailored to their own goal and needs. Each participant began to view their practice of facilitation slightly differently, but with a specific student outcome in mind. Each participant actively took part in the coaching cycle to improve their practice. The next chapter will discuss the findings as they relate to relevant literature.

Chapter V

Discussion

The purpose of this chapter is to describe findings from the previous chapter and describe how they support the research questions. The purpose of this study was to describe how PD and instructional coaching impact secondary mathematics classroom practices of discourse.

The research questions for this study are:

1. How does professional development on discourse impact secondary mathematics teachers' perceptions of classroom discourse practices?
2. In what ways does the secondary math teacher perceive mathematics coaching as impactful on their discourse practices?

This study was a case study. Each case is viewed as a stand-alone study as it relates to the research questions. Participants attended a PD session prior to the 2019-2020 school year starting, then met with the researcher in four total coaching cycles. The first cycle was dedicated to the Identify phase, and the following three cycles were dedicated to the Learn and Improve phases. Participants answered a survey after each coaching cycle, then participated in a semi-structured interview at the conclusion of all coaching cycles. The data was then analyzed by each case using coding where codes emerged from the data. The data was also compared across cases in a cross case analysis.

In answering the first research question, the findings suggest coaching is a form of professional development. In addition, the participants focused on implementing discourse as a classroom strategy, planning questions to ask students and where to place them in lessons in order for students to make connections among mathematical concepts,

and reflected on their own skill of facilitating discourse. In answering the second research question, the participants used the coaching conversations in the Learn phase to talk through the lesson, plan questions to ask and discuss possible student responses to the questions. The participants felt that video was a reflection tool for their own practices. During the Improve phase, the participants felt that the conversations gave them a chance to reflect on the lesson, improve their own facilitation skills, and improve lessons for future use.

Discussion of the Findings

Case 1

Research Question 1: Julie had never been coached before but was very willing and excited to engage in the process. She appeared to view coaching as a form of PD and wanted to focus on engaging her students in activities where they would need to discuss topics with each other. She noted in her interview that

I felt like we talked a lot about what discourse was and what it looked like in that [the initial] PD. And then like the coaching cycle is taking it and then putting into practice and, and kind of working through it and figuring out what it, what it looks like when you're planning and what it looks like in the classroom.

Because the PD was focused on the definition of discourse and what it might look and sound like in a math classroom, Julie was able to direct her teacher actions to help students learn (Garet et al., 2001). At several times in the PD, the table groups had discussions based on the learning. These times allowed for the learning to be “interactive and social and based in discourse” (Desimone, 2009, p. 182). When Julie shifted her attention to her classroom when working with the researcher, she was engaged in a longer

duration of PD as well as taking the feedback from the researcher and putting it into practice (Darling-Hammond et al., 2017; Garet et al., 2001).

From the surveys after each coaching cycle, Julie increased her self-rating on planning for discourse from a 2 (planning for discourse once per unit) before PD and coaching to a 4 (planning for discourse 3-5 days a week). First, this increase could be attributed to her understanding of what student discourse is (as defined in the PD) and the connections she saw her students making during the activities. The more frequently her students were engaging with each other, she saw students talking to each other on their own and without her prompting. Second, the increase could also be attributed to the success that she saw students have once they talked about math in class and wanted to continue to have students discussing mathematics. Third, the increase could have been due to her wanting her classroom to be more student centered where students were exploring with the mathematics more and it is possible she and her students were more comfortable with the discussions in class and she started to plan more frequently for discussion to occur. Lastly, Julie could have increased her self-rating in order to show the researcher (her colleague) that she felt she was growing through the coaching cycle.

Research Question 2: Julie specifically selected lessons with the intended goal of including questions she could ask students to make them dive back into their thinking. She felt that talking through the lesson in the Learn phase, determining student outcomes from the activity, and then designing questions to prompt thinking was beneficial to her in how the lesson would assist students in making connections. Julie was receptive to ideas from the researcher and also had to dive back into her own thinking about the lesson goal and how she would engage her students in making connections. Julie stated in

her Cycle 2 survey the coaching cycle “has helped me have the opportunity to have my own discussion about what I want to have happen in my classroom for each activity” and in her Cycle 3 survey stated “I could really see how this could benefit teachers by giving us a sounding board and helping us learn what works best for us in our content.” These discussions assisted Julie in helping her shape her classroom where students are active participants (Baker & Knapp, 2019).

The coaching cycle allowed for Julie and the researcher to plan collaboratively to improve the lesson (Aguilar, 2013). During these coaching conversations, Julie analyzed what she wanted her students to know at the end of the lesson and was very thoughtful about the questions she was going to ask during the lesson. Her confidence in creating questions appeared to grow as she progressed through the coaching cycle as well as being mindful of the connections she wanted students to make within a specific lesson. Julie stated in her surveys that “I am becoming more comfortable with the planning needed to make the activities more successful” and “it really helps to talk things out with someone.” She also made notes of how to change the activities for the next year to encourage students to talk to their groups about the activity. In one coaching conversation and notes from the researcher’s journal, Julie realized that the discovery of the area of the sector was a proportional relationship was listed specifically for students later in the lesson. She made a note to allow space for students to write in their own relationship that they developed in the activity. Julie used the Improve phase conversations to reflect on her practice in the classroom as well as the materials she was using with students.

Julie’s learning seemed to be situated within the context of the mathematics lesson. During coaching sessions, she framed what she wanted students to be able to

answer during the math lesson. As Julie took on the role of co-learner alongside the researcher during coaching sessions, she thought through what questions to ask and how to probe student thinking, thus allowing her to learn through context. This ties to socio-cultural theory in that the learning was put into context (Forman, 2013) and that students (both Julie and the researcher) were assisting each other in learning (Hickey, 1997). As the researcher and Julie talked about how to engage her students into making connections, Julie was the learner as described in Vygotsky's socio-cultural theory. She engaged in a setting where she was with her peer, the researcher, and through conversations of the lesson goal, the planned activity and where Julie could embed questions to ask students as well as how she could respond to students to assist in guiding their thinking rather than just tell them the answer. Julie was engaged in her zone of proximal development where she was learning from the conversation and furthering her understanding of what her students needed to engage in to maximize the learning in the classroom (Vygotsky, 1978). In the survey following coaching cycle 2, Julie said "It has helped me to have the opportunity to have my own discussion about what I want to have happen in my classroom for each activity. It also helps to discuss afterwards."

Julie indicated through the coaching cycles what she wanted students to gain from the activity and the conversations lead her to more thoughtful planning of questions. In her Cycle 1 survey, she said "I am becoming more comfortable with the planning needed to make the activities more successful." She appeared to engage in the coaching cycles with an open mind and was willing to put in the time into the coaching cycle to improve her practice.

Case 2

Research Question 1: Brandi had previously been coached and seemed to understand that coaching is an extension of PD. When asked if PD and coaching changed her classroom discourse practices in her interview, Brandi replied “it’s definitely made me reflect and change how often I was giving the students genuine and authentic opportunities for discourse.” Coaching is one method of extending the length of time that a teacher spends engaged in PD (Darling-Hammond et al., 2017; Desimone, 2009; Easton, 2008; Garet et al., 2001). Brandi indicated that the time she spent in the coaching cycles helped her follow through with her goal and focused on increasing student discourse in her classroom. This was evidenced in comments such as, “feedback from the coach is really helpful. It helps me build confidence and helps me evaluate myself as a teacher more accurately” and “I’m gaining insight into how to better facilitate discourse and creating new ideas for future units.” Brandi appeared to approach the coaching cycle as a student would approach learning a new concept (Darling-Hammond et al., 2017). She knew what she wanted her students to be able to do, and understanding that coaching enabled her to talk through her lesson goal and what she needed to do to adjust the lesson helped her reach that goal.

Before PD or coaching, Brandi rated herself as a 2 (planning once a unit for discourse) and after PD or coaching, she rated herself a 3 (planning for discourse once a week). Using the video as a tool of reflection (Knight, 2018), she saw her students engaging with each other and helping each other through the tasks and activities she planned. After PD and coaching, she increased her rating to an 8 (up from 6) on her ability to implement discourse into her classroom. Through the coaching cycles, she was

able to focus on what she wanted her students to do and was thoughtful about her actions to question students. Her reflection on the last activity included a comment about her really reaching her goal on student centered activities. In her interview, Brandi stated

I feel like I finally got as close as I could to really meeting that goal. ‘Cause that last activity I did was all about like it was completely student centered and completely about their own discourse and like feeding off what someone else had said to then bringing their own information.

Brandi felt that her students were engaging with each other and building off each other’s ideas when she said “students are talking to each other to compare answers and check work. They are helping each other understand what to do to complete the task.” When she was watching the video, she was focused on watching her students interact and recalling how they interacted in class to determine if she met her goal.

Research Question 2: Brandi felt that the video of her class focused her on what was really happening in her class. Through the Identify phase, she seemed to become aware of what her students could and would do to help each other when she was working with another group. In a coaching conversation, Brandi noted that she saw her students not only being kind to one another by greeting a new student to the class, but also she saw them directing a student on what to do when she was lost on where to start in the activity. She was aware the group of students were working on the activity, but she hadn’t realized how frustrated the one student was until she watched the video. Filming her class through the rest of the coaching cycles allowed her to keep her focus on her goal and what skills she wanted her students to build (Czajak & McConnell, 2016). The video was a tool that allowed her to reflect on her actions in the classroom, and allowed Brandi to focus on

what her students were doing. She continued to plan activities around skills her students had developed and the video showed her what was working (Easton, 2008). In a survey, Brandi said “this [watching the video] has helped me get creative and notice/observe new things happening in my classroom.” Brandi also created activities that gave her students multiple access points into the content (Forman, 2013). The activities allowed students to return to previous questions and add to their work as they discussed with each other. The coaching cycle described by Knight (2018) appeared to keep Brandi centered on the change in her own practice of facilitating discourse and the question cycle for the Improve phase gave her a chance to reflect on her students’ actions during these conversations and planning future activities. Brandi reflected in her interview “having a coach is just a fresh set of eyes on what you’re doing and they bring new perspective and new ideas that you’re just not, that you’re just missing. Even though it’s there, you’re just missing it sometimes.”

While Brandi focused on “what went well” to design her activities, she wanted her students to continue to talk to each other while building new knowledge (Vygotsky, 1978). She focused her planning to make improvements to her classroom and used the coaching meetings to reflect on those improvements (Aguilar, 2013). Brandi felt that during the coaching cycle, the time she was able to spend brainstorming with the researcher on what would work best for her students was most beneficial to her. When discussing how she and the researcher worked together in the coaching cycles, she said

we talked about roadblocks that helped me in like brainstorming and planning for the next time I was going to be working on discourse with my kids. And even then like whenever we’d be planning we would talk about you have time for this

or how can you make this better? Like trying to troubleshoot it before I did it. This planning time for improvement is one reason that research suggests coaching is a tool for teacher growth (Aguilar, 2013). Brandi took an active role to reflect on her classroom and the coaching conversations in order to plan for and facilitate student discourse (Czajka & McConnell, 2016). During her interview, Brandi was asked if she and the researcher worked together to make progress on her goal. She replied

each time we both watched the video and then we had our meetings that was where we really like reflected on like, what I was doing actually still aligned with the goal? Was it still working towards that goal? And so I definitely think we did that.

Case 3

Research Question 1: Kristine had previously been coached and indicated she viewed coaching as an extension of PD. In her interview, Kristine said “the instructional coaching you gave me pertaining to that session [the PD session], it would be an extension of that session” and “I think the instructional coach helps me implement some things that I’ve learned in professional development better.” She felt like a coach could assist her in implementing a strategy into her classroom (Darling-Hammond et al., 2017; Desimone, 2009, Garet et al., 2001). Kristine taught a MMA class where the lessons she worked with the coach on contained content that had been instructed in previous classes for the students. Given Kristine’s comfort level with the content and knowing that her students had seen the material before, she was willing to try to facilitate more discourse into her lessons (Penuel et al., 2007). She wanted her students to be more critical thinkers about the mathematics being taught. Kristine said in her first survey that facilitating

discourse is “getting the students to think for themselves and discuss their problem solving methods.” She then followed that statement with “my students are pretty low, so finding problems and questions for them in order to think for themselves but be successful at it has been a challenge.” She wanted her students to be able to make these connections through questions she was asking her students and through meaningful activity (Lave & Wenger, 1991).

Kristine’s comments on her students being “low” might indicate deficit thinking about her students. Deficit thinking can be described by believing that some students are more successful than others based on their socio-economic status or support at home (Eller, 1989). When a teacher sets certain expectations of their students, the students are influenced how they perform. Another view of deficit thinking is that students are viewed and their capabilities determined by their weaknesses instead of their strengths (Gorski, 2008). While placing the blame on the student is a prevalent description in literature on deficit thinking, it is possible that Kristine described her students as “low” based on the course that she taught and not the actual deficit belief of blaming her students for being “low” (Patton Davis & Museus, 2019; Valencia, 1997). Because MMA is labeled as a third math course by the State of Texas, students often take the course to earn their third and final math credit. Two of Kristine’s classes had students who required additional classroom support, but Kristine did not indicate that any one particular group of students was struggling with the questions she was asking her students to engage in discourse. Kristine and the researcher did discuss strategies on how to engage all of her students in class, such as telling students that each group would be responsible for answering a

question that particular day, or how to scaffold a particular question if a group couldn't answer it directly without giving away what she wanted as an answer.

Kristine rated herself as a 1 (never planned for discourse) before PD or coaching. At the end of the coaching cycles, she rated herself as a 2 (planning once a unit for discourse). While her view of her students being "low" likely factored into the frequency of planning for her students to discuss mathematics topics, she relied on the coaching cycles to assist in where students could talk with each other and make connections about the mathematics concepts (Gorski, 2008). As she practiced facilitating discourse with her students, she said in her coaching cycle 2 survey "watching the students discover answers on their own and feel confident" was something she felt was a positive outcome of having students talk about math in the classroom. Kristine did feel that the students were making connections by the last coaching cycle where they were tying the concept of x -intercepts on the graph to the solutions from the quadratic formula. In her last coaching cycle survey, Kristine said a benefit to facilitating discourse in her classroom was "getting the students to have an "ah ha" moments without telling them. They are making more connections with the math." In her interview, she said she "got excited that those connections happen" during the lesson and making the connections between the algebra and the graph of a quadratic function without her directly telling students the connection.

Research Question 2: While Kristine described her students as "low," at the start of the coaching cycles, by the end of the cycles she did appear to see growth her students and the connections they were making about the mathematics concepts. Kristine may have started the coaching process with a deficit view of her students and what they are capable of, she did find at the end that they were thinking independently with some prompts about

the concepts and how they connect together (Eller, 1989). She even stated that she found her own growth in thinking about her students when she said in the interview “I don't know that if it was growth in my students or my understanding that my students did have the ability to make connections that I didn't think that they would make on their own.”

During the coaching cycles, Kristine wanted assistance in embedding questions into her lessons. She had lesson goals for each of her lessons and what connections she wanted her students to make, and the researcher assisted in crafting questions to ask students, including how to scaffold the question if needed. While the strategy of posing questions to students is supported by NCTM's Mathematics Teaching Practices (2014), Kristine needed assistance in creating the questions and placing them in the lesson. As Kristine and the researcher discussed these questions and planned together, they engaged in a meaningful activity. In her coaching cycle 3 survey, Kristine said “I like the opportunity to discuss how to implement discourse before the lesson, and the opportunity to discuss how it went after. It helps me to make adjustments for next time.” Learning through discussion is central to Vygotsky's (1978) socio-cultural theory and in this process, Kristine was engaged in her zone of proximal development. Through these discussions, she was building on her knowledge of how to plan for and facilitate discourse into her classroom. As she facilitated the questions in the lessons, the students were then building on their own prior knowledge through a series of interactions with each other, the mathematics content being presented to them, and were interacting with Kristine as the facilitator (Jaramillo, 1996).

Case 4

Research Question 1: Mia had previously been coached by the researcher and she indicated in her interview that coaching was an extension of PD. She stated that participation in the current coaching cycle enabled her to focus on her actions during a discussion and felt that coaching kept her accountable at monitoring her practices. In the first coaching cycle survey, Mia said that the coaching cycle is working for her through “self-reflection by watching videos is very telling of what is really going on in my class.” In her final interview, Mia stated “the only time I was really reflecting was when after I watched that video and I could see myself or when I, after I watched the video and I could see that, um, I limited who could, who was responding or who I was listening to.” In coaching conversations in between the first coaching cycle and the final interview, the researcher has notes that Mia continued to watch for her own interactions with her students and who she was calling on for their answer. This active learning on Mia’s part continued the duration of the PD through coaching and feedback (Darling-Hammond et al., 2017; Desimone, 2009; Garet et al., 2001, Penuel et al., 2007).

Mia’s rating of herself to facilitate discourse of a 3 (planning once per week) to a 4 (planning for 3 of 5 days a week) suggests she may have used her previous coaching experience prior to this study to engage her students in discourse. In the prior coaching experience, Mia had engaged in PD and read an article about questioning students and how the teacher’s questioning could direct students to an answer or assist students in diving back into their own thinking (Herbel-Eisenmann & Breyfogle, 2005). She stated that she appeared to become more aware of her own actions through coaching on how she questioned her students.

Research Question 2: The video that Mia watched as part of the Identify phase of a full class period was eye-opening to her. It allowed Mia to truly see her actions while facilitating a discussion (Knight, 2018). She saw herself interacting with the same few students, primarily the ones that could answer her questions or make mathematical connections the fastest. In her interview, Mia said that watching herself on video

showed me is whether I did it intentionally for subconsciously, I only talked to certain kids in the class. I did not. Mmm. I did not engage everybody at some point. And that was, that was an issue for me because I know in my mind I'm like, okay, all these kids are smart. I know they know it, but I'm not giving them an opportunity to express that knowledge either. And that's not fair.

She stated that watching the video helped her realize she had not been allowing students adequate wait time to think about her question before calling on various students share their thoughts. As she reflected on her practice, she realized that she had not been enabling all students to share their thoughts and contribute to the discussion. Her reflection on this particular part of her practice continued throughout all of the coaching cycles and suggests that she was truly reflecting on her teaching practice (Aguilar, 2013). In each of the surveys after a coaching cycle, in response to “what’s working with the coaching cycle,” she stated “self-reflection on the videos.” During her interview, Mia was asked how PD and coaching impacted her classroom discourse practices. She stated

I learned how to...let them brainstorm rather than take one answer and then move on. I let everyone contribute. Also giving them time to think things out and to reflect and to communicate with each other and then giving them an opportunity to...popcorn back.”

As she shifted her practices to be more inclusive for her entire class, she appeared to become a stronger facilitator in helping more students share what they know to allow other students to build off of their knowledge (Melhuish, et al., 2019). Mia's shift in her own practices allowed students to engage into the conversation (Cobb & Yackel, 1995).

Mia stated in her interview that she provided more than one open-ended question in each lesson. The students gained confidence in sharing their thoughts along with her facilitation skills. This encouraged her to embed more open-ended questions into her lessons. Mia said in her interview "I had to think about questions and when, when would it be a good idea to have an open-ended question and time to reflect and time to process information." She appeared to be thoughtful about placing questions into her lessons and what connections she wanted students to make at different moments in a lesson. When designing the questions, Mia thought about what prior knowledge her students had and that her questions had several places where they could access the question. These changes in her classroom allowed for students to engage more into the conceptual learning she wanted to take place. Research describes a classroom like Mia had shifted hers to become a reformed classroom (Forman, 2013).

Themes

During cross case analysis of the findings of this study, several themes emerged. First, several participants doubted that their students would make connections on their own during the discussions. Through the coaching conversations and careful planning of questions and also thinking about potential student responses, the participants were better prepared to lead the discussion in their classrooms. As the participants found success with the discussions, they were more apt to use discussions as a strategy in their classrooms on

a more regular basis. More high school mathematics classrooms should shift to include student discourse as a strategy.

Second, the coaching cycle, as described by Knight (2018) had positive impacts on the participants as they worked on implementing a new strategy into their classrooms. Through the Identify, Learn, and Improve phases (Knight, 2018), the participants felt that the time spent planning to implement discourse including talking through how the lesson might go, questions to ask the students, and potential responses that students might ask were beneficial before they tried the strategy in their classrooms. After the lesson, the participants felt that the time spent in conversation while reflecting on the lesson helped them shape future lessons. The participants in the study used these coaching conversations to be co-learners while engaged in socio-cultural theory to learn in their own zone of proximal development. Third, the researcher had to shift to meet the needs of the participant where they were within their own learning and skill of facilitating discourse during each coaching conversation. Fourth, the participants also engaged in the video of their classroom and watching the video to reflect on the lesson for both student and teacher actions. They were able to use the video to see and hear what students were discussing and used this to understand that students were on task during the lesson. Seeing that students were engaged in the learning and making connections within the mathematics concepts, the participants were more willing to plan more lessons that involved more discourse.

Lastly, an unintended finding of the study revolved around Kristine's deficit thinking about her students in the special education classroom. The researcher had to shift to a directive coaching model (Knight, 2018) to help Kristine plan questions and

strategies to engage her students. While Kristine may have started the coaching cycle process thinking her students wouldn't make connections on their own, she found that in setting her classroom expectations for students to talk, they were actually learning from the conversations they were having amongst themselves. When she planned for students to talk, Kristine felt that the students were making connections between the math concepts.

Limitations of the Study

The limitations of this study include the sample size of teachers who attended the initial PD, the participants were all on the researcher's campus, surveys used were written by the researcher thus the validity of the surveys have not been verified, the reliability of the coding of the data as the researcher was the only person who coded, and the final interviews might have been swayed as they occurred over Zoom in April of 2020 in the middle of the COVID-19 outbreak.

Of the 400 secondary mathematics teachers in the school district, only 15 chose to attend the initial PD that was offered in late summer 2019. Because so few attended, the sample of teachers eligible and available to participate in the study was small. Study participants were selected based on their proximity to and previous working relationship with the researcher. This was done so that coaching could take place in person with the participant and researcher. Future research could include a new set of participants and more instructional coaches who would follow the methodology outlined in this study.

The validity of the surveys are a limitation as the researcher was unable to find published surveys that would measure a teacher's perceptions of facilitating discourse in the secondary mathematics classroom. The surveys used in this study were created by the

researcher and were not validated by an outside source. Future research endeavors could include validating surveys used by instructional coaches for coaching in general or specific surveys for secondary mathematics classrooms.

The coding in this study was completed by the researcher. Because coding is typically performed by at least two researchers, the reliability of the coding is a limitation as there was no agreement to what was found in the data. In future research, two or three instructional coaches could use this methodology to replicate the study, coach secondary mathematics teachers, then code the findings separately to determine if there are similar results.

Finally, the interviews were conducted over Zoom after the region went under COVID-19 safety precautions and schools were operating through an online format. The participants may or may not have been comfortable with the format of the interview. If this study were to be repeated, the researcher could conduct the interviews in person.

Implications of the Findings

The results of each of the case studies indicate that instructional coaching was viewed by the teachers in this study as a form of PD. When asked in their interviews if they saw instructional coaching as a form of PD, they all responded positively. Each participant talked about how planning with the researcher helped in talking through their lesson, identifying what they wanted students to be able to connect together, then frame questions around those ideas to help students make those connections. Talking through the lessons and learning within the context of their classrooms put the participants in a student role, and they were able to build off the ideas from the conversation. These actions put the teacher in their zone of proximal development and their learning is an

example of Vygotsky's (1978) socio-cultural theory of learning through discussion. All participants felt that students were more successful at making connections within the mathematics lessons through questioning to help the students return to their own thinking about the mathematics. Two of the participants stated that using video helped shape their own understanding of either their own actions in the classroom or insight as to what their students were actually doing during the activity. The participants seemed to feel instructional coaching assisted them in implementing a discourse strategy into their classrooms. Reflection on their classroom practice appeared to help shape future facilitation of discourse in their classrooms.

The current study held several interesting results. First, the participants felt the most useful element of the coaching cycle came through conversations with the researcher. This ties directly to learning through socio-cultural theory where the participants are learning through conversations (Vygotsky, 1978).

This study could be improved by adding a PD or a component of PD that focuses on questioning. All participants used questioning in their classrooms as they facilitated discourse. Asking meaningful questions is one of NCTM's (2014) effective math teaching practices and participants might have benefitted from PD to hone their questioning skills. In the Improve phase, a set of standard questions were asked to participants. This study would benefit from a series of questions that were asked in the Learn phase to help guide the researcher and participant through the lesson. Suggested questions are:

- What is the goal of this lesson/activity?

- What would you want students to gain as a result of completing this lesson/activity?
- Where do you think students would benefit from either an open ended question or a place to pause to think about the mathematics they are learning?
- What connections to prior learning do you need students to make?
- What questions could you ask to guide students to making the connection?
- Think about how a student might answer that question. What else could you say, state, or question to prompt them to continue to think about their answer?
- How might you engage a student who is relying on their group or partner for the answer?

Lastly, the participants in this study were asked in their interview what support they would want or need in order to continue to facilitate discourse into their classrooms. Julie, Kristen and Mia stated they would like to be held accountable for continuing to engage their students in discourse in the classroom through informal conversations and check-ins from the researcher. They saw that their students are capable of and willing to discuss mathematics, and want the researcher to check in with them that they are using the strategies they learned from the coaching cycles. Finally, Brandi said that she wanted to continue to film her class to keep her accountable and reflect on her practices. The participants in this study seemed to want to continue to facilitate discourse in their classrooms in the future and reflect on their practices. The researcher needs to continue to support these participants as they continue working to facilitate discourse.

Each participant found value in at least one element of the coaching cycle, though

it differed for each person. Julie found that by talking through the mathematics activity, she became more thoughtful in planning questions for students based on what outcomes she wanted students to gain from the activity. By talking through the activity and what she wanted students to be able to connect together, she was learning through the context of what she was teaching (Forman, 2013). Julie also began to think about how the actual activity should be different for future assignments. She was learning through the conversation, becoming the learner as she and the researcher talked through potential questions to ask, how students might answer them, and how she might respond back to the students (Vygotsky, 1978).

Brandi seemed to find if she reflected on the “what went well” in a lesson, she could structure future lessons around what her students excelled in in order to bring that structure back for her students to be successful and push them forward. She found that brainstorming activities helped her focus on how to engage her students in discourse and how she could best utilize her students’ strengths. She used the video of her classroom to understand what students were assisting each other with on their own and what roles certain students took on while she was working with other students.

Kristine’s experience also showed that talking through her lesson with the researcher was beneficial and prepared her for the role of facilitator. She was able to better engage students in thinking critically about the mathematics. She was willing to try various strategies to include all of her students and not just the ones who were the most outspoken. Kristine seemed to find that her students were capable of the thinking she wanted them to do and make connections between the concepts. She planned with the researcher to give students the opportunity to make these connections and used her role as

a facilitator to guide students to those concepts.

Lastly, Mia focused on her own practice of facilitating and becoming aware of how she interacted with her students. She used the video to reflect on her own actions in the classroom to become aware of how she was engaging students into thinking about the questions she was posing. She did use the coaching cycles to plan questions with the researcher, but really focused on her own facilitation with self-reflection with the video. Not only did she plan for students to discuss with each other to make connections in the mathematics they were studying, she also changed how she engaged her students in the conversation and let them build on each other's ideas.

Future Recommendations

To further explore the effect of coaching on teachers' classroom practice, empirical studies involving secondary mathematics classrooms in conjunction with instructional coaching need to be carried out. There are few studies that examine how including both of those components affects outcomes for students and teacher practices.. Studies involving surveys for evaluating the effectiveness of instructional coaching need to be validated and published, allowing district-level mathematics coaches to examine the effectiveness of their coaching and professional development. While this study focused on secondary mathematics discourse practices, surveys on how participants feel that they did or did not benefit from instructional coaching could also be studied.

Research supports students engaging in discourse in the mathematics classrooms. However, further studies should investigate how teachers have implemented discourse into their classrooms, effective facilitation strategies, and how to best support teachers who are working on that teaching skill.

Conclusion

Further research is needed on instructional coaching and the perceived impact it has on secondary mathematics classroom practices. This study suggests that instructional coaching has a positive effect on mathematics teacher practices as they implemented discourse into the classroom. These results seem to indicate that more teachers might be willing to engage in a coaching cycle knowing that it has benefits for their classroom practices.

This study sought to determine how PD impacts secondary mathematics teachers' perceptions of discourse practices and how they perceive coaching as impactful on their discourse practices. Participants reported that instructional coaching is an extension of PD and that it assists teachers in taking learning from PD and putting it into practice in their classrooms. The process of coaching allowed for the participant and researcher to talk through a lesson or activity and plan questions to ask students. The questions were posed to allow students to think deeply about the mathematics they were learning and help in making connections between mathematical concepts. Participants also reported using the video to reflect not only on what their students were doing, but also on their own practice of facilitating discourse. They felt that students were making connections about and between mathematical concepts without the participant directly telling students. The researcher will continue to follow up with participants and assist in planning when needed. The researcher plans to continue the coaching cycle with new participants in the coming school year. This study supports that the coaching cycle provides timely and content focused PD for teachers. The reflective nature of the coaching cycle allows for a teacher to have a clear picture of reality of their classroom,

set a goal to work towards, and finally reflect to improve their craft as the cycles progress.

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Appendix A

Pre-Professional Development Survey Questions

1. On a weekly basis, how often do students discuss mathematics in your classroom?
(Short Answer)
2. On a weekly basis, how often do you plan for students to discuss mathematics in your classroom? (Short Answer)
3. In your planning prior to today, did you plan for expected student responses?
Describe what you do. (Short Answer)
4. Have you ever worked with an instructional coach before on your goal(s)? (Yes, No, Some; but we never reached a goal)
5. What do you hope to get out of today's session on discourse in the math classroom? (Short Answer)
6. Please type your first and last name (optional)

Appendix B

Post-Professional Development Exit Survey

All questions were rated as

(5) Strongly Agree; (4) Agree; (3) Neutral; (2) Disagree; (1) Strongly Disagree.

1. The staff development was of high quality.
2. The staff development was timely.
3. The staff development was relevant to my needs.
4. The staff development format and structure facilitated my learning.
5. The staff development enhanced my understanding of how to plan for discourse.
6. The staff development enhanced my understanding of how to implement discourse into my classroom.
7. The staff development helped me gain new information and skills.
8. The staff development provided important resources for me.
9. The staff development gave me resources to structure my classroom so that discourse can occur.

The following questions were all short answer.

1. How will you use what you have learned?
2. What was the most useful part of this PD? Why?
3. What was the least useful part of this PD? Why?
4. What additional support do you need?
5. Please type your first and last name along with your campus.

The following question was used to determine if PD participants were willing to participate in the research study.

1. Are you interested in working with your campus coach or Researcher on discourse?
 - a. Campus Coach (Researcher will pass along the information)
 - b. Researcher (I'm OK being a part of her research study.)
 - c. Researcher (I'm NOT OK being a part of her research study.)
 - d. I need time to think about this, can you ask my campus coach to follow up with me?

Appendix C

Survey on Background Information collected from participants who were selected to participate in the study.

Instructions: For my study, I need some demographics on my participants. If you don't feel comfortable answering, please leave it blank.

1. Name (short answer)
2. How long have you been teaching (not including this year)? (short answer)
3. How many years have you been at your current campus (not including this year)? (short answer)
4. When is the best time to meet?
 - a. Before School
 - b. After School
 - c. During Conference Period
5. If during your conference period, tell me what time of day that is: (short answer)
6. What is your age? (short answer)
7. What subject(s) are you currently teaching? (short answer)
8. What is your ethnicity? (short answer)
9. What is your highest level of education (completed, not in progress)? (short answer)
10. What is your highest degree in? (short answer)
11. Teaching Certification: were you certified to teach math from an undergrad program? (Yes or No)
12. Are you alternatively certified? (Yes or No)
13. If alternatively certified, what is your degree in? (short answer)

Appendix D

Survey given to participants at the completion of each coaching cycle.

1. Before professional development, I rate myself as a ____ on planning to implement discourse.
 - a. (5) I planned daily to implement discourse
 - b. (4) I planned 3 of 5 days a week for discourse
 - c. (3) I planned once a week for discourse
 - d. (2) I planned once a unit for discourse
 - e. (1) I never planned for discourse
2. Before coaching, I rate myself as a ____ on planning to implement discourse.
 - a. (5) I planned daily to implement discourse
 - b. (4) I planned 3 of 5 days a week for discourse
 - c. (3) I planned once a week for discourse
 - d. (2) I planned once a unit for discourse
 - e. (1) I never planned for discourse
3. Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).
 - a. Scale of 1 to 10, 1 being lowest and 10 being highest.
4. Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).
 - a. Scale of 1 to 10, 1 being lowest and 10 being highest.

This is the structure of the coaching cycle: Video of full class period, watch video, reflect w coach and set a PEERS goal. The participant and coach/researcher meet about lessons to plan when and where discourse will occur within that lesson.

The following questions were all short answer questions:

5. Give me a brain dump about the coaching cycle and how it is helping you grow in your practice.
6. What's working with the classroom discourse?
7. What's not working with the classroom discourse?
8. What's working with the coaching cycle?
9. What's not working with the coaching cycle?
10. What is the value of implementing discourse as a classroom strategy?
11. What impact do you feel implementing discourse had on your students?

Appendix E

Interview questions after all coaching cycles were completed.

1. Did you view instructional coaching as an extension of the professional development session you attended in July or August of 2019?
2. Do you view instructional coaching as an extension of PD currently?
3. Has attending the initial PD and instructional coaching changed your classroom discourse practices? How?
4. In what ways has PD (including instructional coaching) impacted your classroom discourse practices?
 - Did anything from the PD or coaching conversations stick with you as you planned, facilitated, or reflected?
 - a. Can you give an example during planning a lesson?
 - b. Can you give an example during facilitating a lesson?
 - c. Can you give an example during reflection on a lesson?
 - d. Any other examples of ways PD has impacted your classroom discourse practices?
5. Would you have implemented discourse practices without PD? What would have been different if you had tried without PD and/or coaching support?
6. How did working with a coach improve or not improve your practice as a teacher?
 - a. Can you elaborate (if the answer is yes or no)?
 - b. Can you give any specific examples?
7. Did working with an instructional coach assist you specifically in planning and executing discourse into your classroom?
 - a. If so, in what ways?
 - b. If no, in what ways would it have been helpful?
8. Did you feel that you and your coach worked together to gain a clear picture of reality, set the PEERS goal, and identify a strategy to meet the goal? (Identify Phase)

- a. Can you give any examples?
9. Did you feel that you and your coach worked together to learn the strategy, give ideas of how it might work with your students and how to troubleshoot if it doesn't go well? (Learn Phase)
- a. Can you give any examples?
10. Did you feel that you and your coach worked together to review each cycle and progress towards the goal, and plan next steps? (Improve Phase)
- a. Can you give any examples?
11. What did you find most useful in the coaching cycle (identify, learn, improve)?
12. What growth, if any, did you see in your students as a result of implementing more discourse into your classroom?
- a. If you didn't see growth, why do you think that is? What could you have done differently?
13. What support do you see yourself needing to continue using discourse as a teaching strategy?

Appendix F

Identify Questions

1. On a scale of 1-10, with 1 being the worst lesson you've taught and 10 being the best, how would you rank that lesson?
2. What pleased you about the lesson?
3. What would have to change to move the lesson closer to a 10?
4. What would your students be doing differently if your class was a 10?
5. Tell me more about what that would look like.
6. How could we measure that change?
7. Do you want that to be your goal?
8. If you could hit that goal, would it really matter to you?
9. What teaching strategy can you use to hit your goal?
10. What are your next steps? (Knight, 2018, p. 98)

Appendix G

Julie's Survey Responses

Table 2

Cycle 1 Survey Responses

Survey Question	Julie's Response
1. Before professional development, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
2. Before coaching, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
3. Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	3
4. Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	5
5. Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	It has helped me to be more thoughtful in planning for student discussion during exploration and discovery activities. It is also helpful to share ideas with someone else.
6. What's working with the classroom discourse?	Students are making connections and sharing ideas.
7. What's not working with the classroom discourse?	Students are not having discussions about their understanding as much as they are talking about and comparing their answers.
8. What's working with the coaching cycle?	I am becoming more comfortable with the planning needed to make the activities more successful.
9. What's not working with the coaching cycle?	I would like more specific feedback based on what students are doing in the video.
10. What is the value of implementing discourse as a classroom strategy?	Students learn from each other and they deepen their understanding by

	discussing the concepts they are learning.
11. What impact do you feel implementing discourse had on your students?	They are becoming more used to me asking questions to help them communicate their ideas.

Table 3**Cycle 2 Survey Responses:**

Survey Question	Julie's Response
1. Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
2. Before coaching, I rate myself as a ____ on planning to implement discourse.	(4) I planned 3 of 5 days a week for discourse
3. Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	5
4. Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8
5. Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	It has helped to have the opportunity to have my own discussion about what I want to have happen in my classroom for each activity. It also helps to discuss afterwards.
6. What's working with the classroom discourse?	Students are getting more comfortable talking about problems and questions that they have.
7. What's not working with the classroom discourse?	Some students are still shy about discussing things with their neighbors or intimidated, thinking that their classmates will judge them.
8. What's working with the coaching cycle?	It really helps to talk things out with someone.
9. What's not working with the coaching cycle?	It has been hard to make the time for it, but I wish I could do it more.

10. What is the value of implementing discourse as a classroom strategy?	Just like I am learning more from bouncing my ideas off of someone else, students can learn and understand things better the same way.
11. What impact do you feel implementing discourse had on your students?	I think overall they have become more comfortable talking about math throughout the process.

Table 4***Cycle 3 Survey Responses***

Survey Question	Julie's Response
1. Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
2. Before coaching, I rate myself as a ____ on planning to implement discourse.	(4) I planned 3 of 5 days a week for discourse
3. Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	6
4. Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8
5. Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	As we completed the third cycle, I could really see how this could benefit teachers by giving us a sounding board and helping us learn what works best for us in our content.
6. What's working with the classroom discourse?	I believe that the more students have opportunities to talk to one another about math, the more they will learn. It is really interesting to hear how many different ways students can explain math to one another when they are comfortable with discourse.
7. What's not working with the classroom discourse?	I feel that there are some students whose personalities prevent them from being

	comfortable with discourse right away. For some, it will take time for them to trust their classmates enough to engage in true discourse.
8. What's working with the coaching cycle?	I think the conversation in planning for discourse and the reflection after are very valuable in determining how the lesson/discourse worked in the classroom and what I can do to continue to improve.
9. What's not working with the coaching cycle?	Again, I wish I could do this more, but finding time for it is sometimes difficult.
10. What is the value of implementing discourse as a classroom strategy?	The classroom has become more student-centered as we have implemented discourse more. It allows students to share ideas and ask questions in smaller groups which is lower-risk for them. They become more confident in their thinking in the small group, which makes them more likely to share to the class.
11. What impact do you feel implementing discourse had on your students?	My students have grown in their ability to communicate their ideas and their confidence in sharing with each other.

Table 5

Julie's responses to surveys after each coaching cycle.

	Coaching Cycle 1	Coaching Cycle 2	Coaching Cycle 3
1. Before professional development, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse	(3) I planned once a week for discourse	(3) I planned once a week for discourse
2. Before coaching, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse	(4) I planned 3 of 5 days a week for discourse	(4) I planned 3 of 5 days a week for discourse
3. Rank your ability to implement discourse as a classroom strategy	3	5	6

before coaching (where coaching
is an extended form of
professional development).

4. Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	5	8	8
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Appendix H

Researcher ([00:00](#)):

Okay. Do I have your permission to record our, um, our interview?

Julie ([00:04](#)):

You do.

Researcher ([00:07](#)):

Okay.

Um, so just so that you know, um, I did send out the email that the emails, I did send out the questions ahead of time so you could look over them. Um, you requested the PD slides. Were you able to look at those?

Julie ([00:19](#)):

Yes.

Researcher ([00:21](#)):

Okay. And, um, so the first, the first set of questions refer to my first research question, which is about professional development. So we're just going to start with those. So, um, part one, number one, did you, did you view instructional coaching as an extension of professional development of the professional development session you attended in June or July in July or August of 2019?

Julie ([00:50](#)):

Yes. So, um, I felt like we talked a lot about what discourse was and what it looked like in that PD. And then like the coaching cycle is like taking it and then putting it into practice and, and kind of working through it and figuring out what it, what it looks like when you're planning and how it looks like in the classroom.

Researcher ([01:12](#)):

So in that, okay. Uh, okay. So now, now do you view instructional coaching as an extension of PD?

Julie ([01:22](#)):

Yes. Yes. And I felt like a lot of, a lot of the PD in general that we do is about content and how we deliver content. But this is kind of an extra piece that adds into that and kind of lets you plan, helps me plan the discourse within the content because it's kind of there all the time and it's a piece that now I'm more thoughtful about.

Researcher ([01:44](#)):

Okay. Has attending the initial PD and instructional coaching changed your classroom discourse practices?

Julie ([01:52](#)):

Yes. It's just made me more thoughtful about it, more planful. Um, so that I'm thinking about it more as I'm getting ready to, you know, get a lesson going are already have thought about what questions I might ask and what I want students to actually be talking about and how I can sort of make that happen within each, each lesson.

Researcher ([02:14](#)):

Okay. That was my binder of research questions that just fell down on the floor.

Julie

Okay.

Researcher

Um, in what ways has PD including instructional coaching impacted your classroom discourse practices? So then there's some sub questions under that one. Um, you can, you can just answer or you want me to walk you through the sub questions?

Julie ([02:39](#)):

I mean, I sort of thought about each one of those questions, kind of to answer the big question, but yeah.

Researcher ([02:47](#)):

Anything from PD or coaching stick with you as you plan facilitated or reflected?

Julie ([02:53](#)):

Yeah, I think, um, the, the part where we talked a lot about anticipating what students would talk about and if they're not talking about it, how to sort of steer the conversation. I think that was one of the most valuable things to me.

Researcher

Okay.

Can you talk, so that was during planning a lesson, what about when you facilitated the lesson?

Julie

So when we're facilitating then, since you've already thought about what you're going to ask and what you want them to talk about, then it kind of made me feel more comfortable as I was walking around to kind of, since I had an idea of what I wanted to hear, um, and I had an idea of how I could maybe get people going in the right direction. I was much more prepared. So during the lesson I may have as question that I've already planned to ask if I see a group that's kind of off task or off topic.

Julie ([03:50](#)):

And um, and then I also had follow up questions for groups that were getting it figured out quickly and they needed something to kind of keep them going.

Researcher

Okay. What about during reflection of the lesson?

Julie

So, um, for reflection I felt like it gave me an opportunity to improve. So I know

like if I'm going to do the same things next year, um, it gave me an opportunity to kind of analyze whether those things that I was using, my questions or my prompts for kids were working, whether I needed to word things differently. Um, and it gave me an opportunity to see how kids react to things, um, in, in reality versus what we think they're going to do, uh, so that I can sort of adjust it. And I know that in some cases we even changed kind of how the lesson was written or how the activity was written to try to make it fit better, um, and support the discourse better.

Researcher ([04:49](#)):

Any other examples of ways PD has impacted your classroom discourse practices?

Julie

Um, I don't think so. I think that kind of covers it all.

Researcher

Okay. Would you have implemented discourse practices without PD?

Julie

So, I mean, yes, I've always valued that as, you know, I wanted students to be talking to each other. I want them to talk about math. Um, so it's always been something

that's been something I want to be happening. Um, I just feel like this has made me better at it. Um, better at, at trying to figure out what I can do as a teacher to sort of promote it and make kids feel more comfortable with it.

Researcher ([05:34](#)):

What would have been different if you had tried PD, if you had tried to implement without PD and/or coaching support?

Julie

I just don't think I would have thought it through as well. I wouldn't have thought ahead of time about things that kids were going to ask or things that they may be doing that I don't want them to do. Um, how to address those. Like some of the things like we talked questions to ask that I wouldn't necessarily have formally had. Like, here's some questions that I know I can ask to make this work. Um, and so then everything that happens in the classroom is kind of not as, as, I don't know how I want to say that. It's not necessarily steering in the right direction all the time if you don't have that stuff planned ahead at a time. So, um, kids, maybe you're not really talking about what you want them to talk about, you know, and you know, I've always want them to talk, but if they're going to talk about what's the right answer versus how do we figure this out, um, it's not as valuable.

Researcher ([06:38](#)):

Okay. So that's, those are the questions on the professional development. And

now we're going to move into the second set of questions, which talks about, or answering my second research question about, um, you perceiving math coaching as impactful on discourse practices.

So, um, I kind of in the email, I think I kind of gave you a, um, an overview of the review, a review of the coaching cycle and kind of what we did. Um, in the identify phase, we watched, you watched a 45 minute chunk of your class, um, to get a clear picture of reality. From that we said appears goal, which would, which is why I dropped my notebook. Your PEERSgoal was, um, “students will engage in exploration and tasks to dive deep into critical thinking and connect mathematical concepts.” So that is your particular goal. Um, so after we set the goal, then we went into kind of like a mini coaching cycle of a pre-conference, um, filming your class, doing it, and then a post conference.

And within each one of those we kind of did like, um, we talked me through the activity, we did some planning of, of what, what discourse do you might be able to have the kids do sample responses. Um, then in the learning phase, after you had watched and I had watched the film, we talked about, um, what went well, what did you learn, were there any roadblocks and what's next? And that was in the post conference and then we went through that three times. So these, these next set of questions kind of refer back to that.

So the first one is how did working with a coach improve or not improve your practice as a teacher?

Julie ([08:35](#)):

Okay. So, um, I think that it improved my practices because it, even if I'm not, I mean it helps to have a second person who's talking through things with you. And even even like we want the kids to do, if a kid can explain something to someone else, they get it better. And as I'm kind of explaining an activity to someone, I'm thinking of things that, that maybe I need to, to be figuring out beforehand. Um, and so just kind of having that second point of view, um, helps a lot. Um, so I guess I'll, I'll keep going.

Specific example. So I know that when we were talking about the sector area activity, um, and we were doing two different things that day and we're trying to figure out how to make sure that kids were connecting what was happening in, they were doing a Desmos activity and then they were doing an actual like on paper activity and we were trying to figure out how to have them make those connections. And so it helped to talk with you about like how, how do we make sure, like what question can we ask these kids to have them in their heads, make those connections, make sure that they get it figured out. And so that definitely was a way that that would help me. And normally, I mean without having that second point of view and without having the coaching cycle going on, I might have just kind of had them do them and not necessarily push them to make those connections as well.

Researcher ([10:09](#)):

Um, I think that answers all of question one cause you elaborated and you gave specific examples. Uh, did you read question number two? Did you feel that you and your coach worked together to gain a clear picture of reality? Set the piers goal and identify a strategy to meet the goal?

Julie ([10:25](#)):

Yeah, so I feel like I'm watching the first video, like the whole like, you know, video your class and you know, that's very nerve wracking the first time you do it and it gets a little easier after that. But it really kind of helped me see where things were in the classroom as far as what kids were doing. Um, and then that helped us sort of figure out what the goal is and how to meet it and where we want kids to kind of get with it. Like, we want them to progress, um, and get better at it, but we needed to see where they were to start it.

Researcher ([11:02](#)):

Okay.

Do you feel that you and your coach worked together to learn the strategy, give ideas of how it might work with your students and how to troubleshoot if it doesn't go well?

Julie ([11:12](#)):

Yes. So I think like in our pre conferences we talked a lot about what we wanted to hear, what that discourse would, would sound like in the classroom, um, for each activity. And then talked about how to, how to, how to push kids in the right direction. And, and we did sort of talk about what are some of the issues that might come up and how can we sort of help kids steer around those issues and get to where as a group they're understanding what they need to get.

Researcher ([11:41](#)):

Okay.

Do you feel that you and your coach worked together to review each cycle and progress towards the goal and plan next steps?

Julie ([11:49](#)):

Yes, I think, um, I think we will a couple of times where we had some questions that I had used. So we decided we needed to change them a little bit and maybe something a little different, um, in the future or, um, just kind of seeing how things work and, and coming up with ideas for maybe how to tweak it a little bit better. Um, and then also even with the materials we talked earlier about like tweaking our lesson materials to help that what's on the paper actually steer them more towards the discourse piece rather than just, you know, give them the things that they need to find answers on their own.

Researcher ([12:29](#)):

Okay.

What did you find most useful in the coaching cycle? The identify the learn or the improve phase?

Julie ([12:37](#)):

Mmm. I think the improve, which, you know, I've, I feel like I learned a lot from each lesson that we did, you know, in, within the lesson. And then after, in that reflection piece, I think I learned more afterwards than I did before. I'm, the planning is important, but I felt like I really kind of learned about it by being able to watch that video of my own kids and see what they're really doing.

Researcher ([13:09](#)):

Okay.

What growth, if any, did you see in your students as a result of implementing more discourse into your classroom?

Julie ([13:17](#)):

Um, I felt like they became a lot more comfortable and confident. Um, there were some students that were already talkers that would, you know, be the one that always spoke for their group or that, um, we're always willing to give an answer. Um, and once we got kind of further into this, I saw some of the kids that didn't necessarily say anything before, they're starting to contribute even in small ways. Some of them just contribute to the conversation at the table or even some of the ones that are not confident. They would ask a question of their neighbor rather than staying silent and just sitting there and not, not getting it and not communicating to anyone. They were getting to that point where they could feel like they could say, Hey, you know, I don't, I don't really understand what you just said. Can you, can you tell me again or can you explain it again? Um, I heard some more of that, which I thought was kind of the good stuff.

Researcher ([14:12](#)):

Uh, lastly, what support do you see yourself needing to continue using discourse as a teaching strategy?

Julie ([14:20](#)):

Um, I think it would be good to have some sort of, um, I don't know, just conversation here and there about how it's going. Um, maybe some sort of just check in. Um, and then I also was thinking about, um, it would be nice to partner up with someone else who maybe has been through this too. Um, even though they're probably going to be a different content area and just be able to kind of talk to each other about it, um, and sort of keep it going so that there's a little bit of accountability in there to somebody else rather than just do myself. Um, I think that kind of helps push me when I know that it's something that I'm going to be talking about later or something that I need to reflect on with someone else there.

Researcher

Okay. Um, so just so that, you know, that's the end of our interview questions then, next steps. Um, well here, that's the end of the interview. Let me stop the video.

Appendix I

Brandi's Survey Responses

Table 6

Cycle 1 Survey Responses:

Survey Question	Participant Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	3
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	6
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	I feel that this second coaching cycle gave me more insight into how my students are working together when given a group task.
What's working with the classroom discourse?	Students are talking to each other to compare answers and check work. They are helping each other understand what to do to complete the task.
What's not working with the classroom discourse?	Students are not talking about the connections they are making as much as I would like them to.
What's working with the coaching cycle?	Feedback from the coach is really helpful. It helps me build confidence and helps me evaluate myself as a teacher more accurately. It is also helping me to improve the activities that we are using to help students make more connections and understand the concepts better next time.
What's not working with the coaching cycle?	Nothing at this time.

What is the value of implementing discourse as a classroom strategy?	Student discussions help all students understand the material from the highest student who is often explaining to the lowest who may not be as comfortable speaking.
What impact do you feel implementing discourse had on your students?	I think they are getting more comfortable talking to one another.

Table 7**Cycle 2 Survey Responses:**

Survey Question	Participant Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	5
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	7
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	This has helped me get creative and notice/observe new things happening in my classroom.
What's working with the classroom discourse?	Students are beginning to form connections and use better academic vocabulary.
What's not working with the classroom discourse?	Facilitating in a timely manner. Discussions could use extended time.
What's working with the coaching cycle?	Learning from the feedback and gathering new ideas.
What's not working with the coaching cycle?	No response
What is the value of implementing discourse as a classroom strategy?	The kids are making their own connections and taking control of their learning.

What impact do you feel implementing discourse had on your students?

The kids are gaining confidence in their own abilities and sharing out more.

Table 8

Cycle 3 Survey Responses:

Survey Question	Participant Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	4
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	I'm becoming a better facilitator in a student centered classroom.
What's working with the classroom discourse?	Students gaining confidence and collaborating better.
What's not working with the classroom discourse?	Have to make a point to pre-load for activity and catch up absent students.
What's working with the coaching cycle?	I am gaining insight into how to better facilitate discourse and creating new ideas for future units.
What's not working with the coaching cycle?	No response
What is the value of implementing discourse as a classroom strategy?	Students of all levels are participating, gaining confidence, and bonding.
What impact do you feel implementing discourse had on your students?	The kids are more open to thinking through a problem, discussing where they are struggling or feel stuck, and working through it with others.

Table 9***Brandi's responses to surveys after each coaching cycle.***

	Coaching	Coaching	Coaching
	Cycle 1	Cycle 2	Cycle 3
Before professional development, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse	(3) I planned once a week for discourse	(3) I planned once a week for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse	(3) I planned once a week for discourse	(3) I planned once a week for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	3	5	4
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	6	7	8

Appendix J

Researcher ([00:00](#)):

All right. So before we begin, is it okay that I record this meeting?

Brandi

Yeah.

Researcher

Okay. I'm going to ask you a series of questions. Um, the first set are going to talk about, uh, professional development and then the second part referred, uh, specifically to us working together in the coaching cycle. Um, so the first set or are addressing my initial, um, research question of how professional development on discourse impact secondary mathematics classroom discourse practices. So question number one, did you view instructional coaching as an extension of the professional development session you attended in July or August of 2019?

Brandi ([00:40](#)):

Yes.

Researcher ([00:43](#)):

Okay. Do you view instructional coaching as an extension of PD? Currently?

Brandi ([00:48](#)):

Yes.

Researcher ([00:50](#)):

Has attending the initial PD and instructional coaching changed your classroom discourse practices?

Brandi ([00:57](#)):

Yes.

Researcher ([00:58](#)):

Can you tell me how?

Brandi ([01:00](#)):

Yeah. Um, it's definitely made me reflect and change how often I was giving the students genuine and authentic opportunities for discourse. And it made me a better facilitator for student discourse and, um, it helped me just to, you know, find my own misconceptions and mistakes and just get better at being a facilitator.

Researcher ([01:31](#)):

Okay. In what ways has PD, including instructional coaching impacted your classroom discourse practices? Did anything from the PD or coaching conversations stick with you as you plan, facilitated or reflected?

Brandi ([01:48](#)):

Yes. Um, so from our conversations I always reflected on, I enjoyed the part where it was like, what went well? Because I think a lot of times we focus on maybe what didn't go well and then you spend so much effort just trying to fix that part instead of when we looked at the pieces that did go well and how to just maybe expand that. And I liked doing the “what went well,” “what didn't” because I just, I didn't spend so much time on the negative and like killing myself being like, well I ran out of time. How do I fix this? I spent more time saying this went well so I can do that more often type thing.

Researcher ([02:30](#)):

So that was during a reflection. What about during planning a lesson?

Brandi ([02:35](#)):

Um, so I used that, uh, the “what went well” was when I would plan the next one and implement more of that and see how could I build off what went well from the previous one.

Researcher ([02:46](#)):

Okay. What about during while you were facilitating?

Brandi ([02:51](#)):

Um, I say like while I was facilitating that was probably when I thought more about the what didn't go well from, um, our conversations to avoid making like those teacher miscues happen again where either didn't question enough or I didn't leave something open-ended enough or I didn't give a kid enough time. That was I think during

the facilitating where I had the, I used the, what didn't go well in my mindset to fix.

Researcher ([03:21](#)):

Okay. Any other examples of ways PD has impacted your classroom discourse?

Practices?

Brandi ([03:30](#)):

Um, I mean just in general. I like doing it more often, way more often because I saw how much more like things and ideas stuck for kids who maybe previously like they could do the one worksheet, but then the next day they came to class. Like we had done nothing the day before. So seeing that made me do it more often cause they were just retaining more information.

Researcher ([03:55](#)):

Okay. Would you have implemented discourse practices without PD?

Brandi ([04:01](#)):

Not nearly to the degree that I did. I would have had like sentence stems and like little closure, like maybe conversations but nothing to the extent that I did because of the PD.

Researcher ([04:14](#)):

Okay. What would have been different if you had tried it without PD and or coaching support?

Brandi ([04:21](#)):

I wouldn't have done it as often and I wouldn't have grown as fast as I did because I wouldn't have had someone to help me reflect and give me food for thought. So I definitely wouldn't have done it as often and improved as much.

Researcher ([04:37](#)):

Okay. That's the end of part one. Um, so before we get onto the questions or part two, I just want to recap, um, hold on. I gotta find recap your goal and kind of go through the coaching process that we did. So remember that the first thing we did is you filmed it, well not we, you filmed an entire 45 minute class and then you watched, you watched it and you got a clear picture of reality. And I'm looking for, I thought we had updated your goal, but maybe we didn't. I printed out all those emails.

So, um, after we, after you watched the classroom that I watched the classroom, we were talking about it, the goal that the peers goal that we wrote was "students will make connections about in between math concepts, through student discourse and student centered activities." Um, and then we went through kind of like, um, a cycle within a cycle.

So that was the identify phase. And then we went through three kind of mini cycles, which were pre-conference where you talked about the activity, we planned for some discourse, you executed that. And then in the post conference we talked about the questions, what went well, what, um, what would, uh, what went well, what did you learn, were there any roadblocks and what's next? Um, and then that was kind of the, our improve phase. And we went through that three times. So that's the coaching cycle that

these next series of questions are going to, um, talk about.

So the first question is how did working with a coach improve or not improve your practice as a teacher?

Brandi ([06:26](#)):

Mmm. Like I said, like having another person to help you look at what you're doing. It's just like having someone like peer edit a paper. You're because you're doing it, you're missing things that are common to you or things that you see every day or bad habits you have cause they're habits. So having a coach is just a fresh set of eyes on what you're doing and they bring new perspective and new ideas that you're just not, that you're just missing, even though it's there, you're just missing it sometimes.

Researcher ([06:56](#)):

Okay. Can you give any specific examples? Did working with an instructional coach assist you specifically in planning and executing? I feel like that's supposed to be a number two anyway. Um, so you kind of gave an example. So next question.

Did working with an instructional coach assist you specifically in planning and executing discourse into your classroom?

Speaker 2 ([07:19](#)):

Yes, because having our like coaching cycles, it's, it helps on the follow through. Like there's a lot of things as teachers where we were very creative and like we have a lot of ideas like, Oh I want to try this and I want to do this and then it never comes to fruition. And having a coach there to assist with planning help me to make sure that I was

following through on implementing ideas and planning these ideas for my classroom cause I didn't just, it wasn't something I forgot to do.

Researcher ([07:51](#)):

Okay. Did you feel that you and your coach worked together to gain a clear picture of reality? Set the peer's goal and identify a strategy to meet the goal?

Brandi ([08:02](#)):

Yes.

Researcher ([08:03](#)):

Can you give any examples?

Brandi ([08:05](#)):

Yeah, that's a really meaty question. Sorry. Let me read it again.

Um, we definitely worked together to get a clear picture of reality and recording and watching the video and Mmm. That was one where I had like a million comments cause that was so interesting to see. And then setting the peers goal. Mmm.

I mean I am probably jumping ahead and like my thoughts but whenever I hear my peers goal and I think about the final activity I did, like I feel like I finally got as close as I could to really meeting that goal. Cause that last activity I did was all about like it was completely student centered and completely about their own discourse and like

feeding off what someone else had said to then bring their own information. So once I like hear my goal again and think about that last activity, I mean I think we definitely got to the goal or at least got close.

Researcher ([09:03](#)):

Okay.

Did you feel that you and your coach worked together to learn the strategy, give ideas of how it might work with your students and how to troubleshoot if it doesn't go well?

Brandi ([09:14](#)):

Yes, we definitely, when we talked about roadblocks that helped me in like brainstorming and planning for the next time I was going to be working on discourse with my kids. And even then like whenever we'd be planning we would talk about do you have time for this or how can you make this better? Like trying to troubleshoot it before I did it. And that helps a lot. Like having the sheet of the sentence stems go home with the kids the night before. Like that was a lot of troubleshooting that helped for it to go well.

Researcher ([09:52](#)):

Okay.

Did you feel that you and your coach worked together to review each cycle and progress towards the goal?

Brandi ([09:58](#)):

Sorry, my computer froze. Oh, can you say it again? My computer froze.

Researcher ([10:04](#)):

Okay. Did you feel that you and your coach worked together to reveal each cycle and progress towards the goal and then plan next steps?

Brandi ([10:12](#)):

Yes. Um, each time we both watched the video and then we had our meetings and that was where we really like reflected on like, was what I doing actually still aligned with the goal? Was it still working towards that goal? And so I definitely think we did that.

Researcher ([10:35](#)):

What did you find most useful in the coaching cycle? The identify, learn or improve?

Brandi ([10:42](#)):

Ooh. Mmm Hmm. I mean definitely the, the learn phase. Cause that's, I mean, that's the meat of it. Like, that's the doing and that's where you get to, uh, you know, troubleshoot and make your mistakes. But I really also did enjoy the identify because it's, I mean it's really eye opening to like see that reality first and compare it to what you thought was happening before you do start to learn.

Researcher ([11:17](#)):

Okay.

What growth, if any, did you see in your students as a result of implementing more discourse in your classroom?

Brandi ([11:27](#)):

Um, I really think for all of them like confidence grew because feeling like, you know, what you're talking about and having something to add to the conversation and not feeling left out or lost helps. Um, with the activities that we did, there was an entry point for all the kids and I did see them start to make connections between, you know, attributes of different, like multiple functions we had talked about. And so they definitely grew in confidence I think definitely grew in being able to connect key attributes across all functions. So that's why I can't wait to do it again next year. I'm so excited.

Researcher

What support do you see yourself needing to continue using discourse as a teaching strategy?

Brandi

Um, I think honestly like to maintain like recording my classroom because it's just such a honest way of looking at what you're doing and what you're getting out of it. I'm definitely going to keep setting a date for myself like once a month or each six weeks to

record and watch again and like go through my own mini cycle with it continuously.

Researcher ([12:44](#)):

Okay. All right. I'm going to stop the video.

Appendix K

Kristine's Survey Responses

Table 10

Cycle 1 Survey Responses:

Survey Question	Kristine's Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(1) I never planned for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(1) I never planned for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	4
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	It has helped me purposely plan questions and lessons for discourse. My coach has helped me find places in my existing lessons where discourse can help.
What's working with the classroom discourse?	It's getting the students to think for themselves and discuss their problem solving methods.
What's not working with the classroom discourse?	My students are pretty low, so finding problems and questions for them in order to think for themselves but be successful at it has been a challenge.
What's working with the coaching cycle?	My coach is helping me integrate discourse appropriately in my existing lessons.
What's not working with the coaching cycle?	Nothing...
What is the value of implementing discourse as a classroom strategy?	Getting the students to think and problem solves for themselves helps in their understanding. In order to defend your solution the students must have a deeper understanding of the situation.

What impact do you feel implementing discourse had on your students?

It is making them deeper thinkers and better problem solvers.

Table 11

Cycle 2 Survey Responses:

Survey Question	Kristine's Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	2
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	6
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	I enjoy it. It is helping me help the students make connections in math.
What's working with the classroom discourse?	Watching the students discover answers on their own and feel confident.
What's not working with the classroom discourse?	Sometimes they students don't want to participate and just want to be told the answer.
What's working with the coaching cycle?	Helping me to implement discourse in the classroom successfully.
What's not working with the coaching cycle?	Nothing
What is the value of implementing discourse as a classroom strategy?	Watching the students confidence in problem solving grow.
What impact do you feel implementing discourse had on your students?	It is making them more confident learners.

Table 12**Cycle 3 Survey Responses:**

Survey Question	Kristine's Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(2) I planned once a unit for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	3
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	7
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	It helped me find places in my lessons to have to kids have meaningful discussions and discovery.
What's working with the classroom discourse?	Getting the students to have "ah ha" moments without telling them. They are making more connections with the math.
What's not working with the classroom discourse?	It seems that the same students are always engaged and tell the other students the answers. Some students just wait for the other students to discuss and figure it out.
What's working with the coaching cycle?	I like the opportunity to discuss how to implement discourse before the lesson, and the opportunity to discuss how it went after. It helps me to make adjustments for the next time.
What's not working with the coaching cycle?	The only thing working against us is time.
What is the value of implementing discourse as a classroom strategy?	Getting the students to think for themselves and make connections with the math.
What impact do you feel implementing discourse had on your students?	A better understanding of certain topics.

Table 13

Kristine's *responses to surveys after each coaching cycle.*

	Coaching	Coaching	Coaching
	Cycle 1	Cycle 2	Cycle 3
10. Before professional development, I rate myself as a ____ on planning to implement discourse.	(1) I never planned for discourse	(2) I planned once a unit for discourse	(2) I planned once a unit for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(1) I never planned for discourse	(2) I planned once a unit for discourse	(2) I planned once a unit for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	4	2	3
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8	6	7

Appendix L

Researcher ([00:00](#)):

All right. So I just started the recording. Is it okay that I record our, our meeting?

Kristine

Yes.

Alright. So before, um, I started the, when I scheduled the interview, I sent you all the questions ahead of time. The first part of the questions are going to talk about professional development and then the second set of questions ask about, um, the coaching cycle to answer my two different research questions. So for the first set of questions, the first question is, did you view instructional coaching as an extension of the professional development session you attended in July or August of 2019?

Kristine ([00:39](#)):

Mmm. Alright. Yes, I don't really know how to answer that cause I had already done a professional instructional coaching before. I mean, I had an instructional coach before I did the professional development session, but I do feel like the, the instructional coaching that you gave me pertaining to that session, it would be an extension of that session.

Researcher ([01:00](#)):

Okay.

Kristine ([01:02](#)):

Does that make sense?

Researcher

Yes, it does.

Kristine

Okay.

Researcher

Do you view it instructional coaching as an extension of PD? Currently?

Kristine ([01:12](#)):

Sometimes yes and sometimes no. I think that there are things that the instructional coach does that can be seen as, um, I think the instructional coach helps me implement some things that I've learned in professional development better. But I also think there are things that you do that probably I don't necessarily pertain to the professional development that I've done, like data and data stuff. Mmm. Maybe some curriculum stuff if I haven't sat in a professional development for curriculum for curriculum, if that makes sense.

Researcher

([01:45](#)):

Yes.

Kristine

([01:46](#)):

Okay.

Researcher ([01:47](#)):

Okay. Has attending the initial PD and instructional coaching changed your classroom discourse practices?

Kristine ([01:57](#)):

Yes. I have found places in my lessons to be more intentional about the questions that I ask the kids rather than just telling them something. So, um, maybe different ways to phrase something, different ways to ask questions, having them do things like that.

Researcher ([02:17](#)):

Okay.

In what ways has PD including instructional coaching impacted your discourse practices? So there's a several sub questions under there. The first sub question is, did anything from PD or coaching conversations stick with you as you plan, facilitated or reflected?

Kristine ([02:39](#)):

Um, probably less of me facilitating the lesson and allowing them to think

through some of the questions that I'm asking instead of just giving them stuff that they had to know.

Researcher ([02:55](#)):

So that's kind of during, that's when you were facilitating?

Kristine ([02:59](#)):

Okay. Yes. Oh, well as I was planning intentionally embedding questions.

Researcher ([03:06](#)):

Okay. And facilitating, asking the questions and giving an, ok. What about during reflection?

Kristine ([03:18](#)):

Mmm. Sometimes yeah. Did I give them too much information to begin with? Did I not ask them in the right way? Did they get everything I needed them to understand in the way that the lesson was presented.

Researcher ([03:32](#)):

Okay. Any other examples of ways PD has impacted your classroom discourse practices?

Kristine ([03:42](#)):

Mmm. I don't know that it's another way, but just like I said, it's given me, um, when I'm doing a lesson to intentionally make sure that I am, um, embedding questions

for them to talk amongst themselves and have a little discourse and be able to come up with an answer. So for me it was probably more in the planning phases that helped me.

Researcher ([04:26](#)):

Okay. Would you have implemented discourse practices without PD?

Kristine ([04:34](#)):

So I would have, um, probably thought that I was implementing discourse practices without the PD and I maybe have done some of it, but I'm not to the extent that I did after the PD nor, um, correctly knowing what discourse actually really was intended for.

Researcher ([05:36](#)):

Okay. What would have been different if you had tried to implement PD, uh, implement discourse without PD and, or coaching support? I think you kinda already answered that.

Kristine ([05:47](#)):

Yeah. Okay. I just don't know that I would have done it the right way. Ask the right questions, really understood the definition of what the intention of discourse in the classroom was.

Researcher ([05:57](#)):

Okay. So that's the end of part one for part two. I sent um, kind of a paragraph about the coaching cycle and let me get my binder to recall your peers goals. Um, so the

first thing we did, I'm just going to recap the coaching cycle real quick just to kind of bring it back to your mind. Um, we, you filmed a 45 minute class period and then you watched it and you reflected on what you saw, which is the identify phase based on what you saw. We set up here's goal, which was powerful, easy, emotionally compelling, reachable and student focused. And then we kind of went through a like, um, a cycle within that cycle where we reviewed your peer school, we looked at a lesson, we planned on implementing the strategy. We set a time for you to film. That was the learning phase. And then after you filmed, we each watch the video and then we met in a post conference where we had answered four questions. What went well? What did you learn? Were there any roadblocks and then what's next? And that was part of the improve phase. So these next questions are based on the coaching cycle. Okay.

Your peers goal, if you recall, is students will engage in critical thinking about the math concepts to be engaged in learning.

Kristine ([07:40](#)):

Okay.

Researcher ([07:42](#)):

My first question is, how did working with a coach improve or not improve your practice as a teacher?

Kristine ([07:50](#)):

Um, again, I think that, um, going through for me it was the planning part. And so going through the lesson and intentionally finding places where I could ask questions,

um, stated the right way or you know, to teach something a little bit differently, I think that was very helpful.

Researcher ([08:08](#)):

Okay. Did working with an instructional coach assist you specifically in planning and executing discourse into your classroom?

Kristine ([08:16](#)):

Yes.

Researcher

Can you explain?

Kristine

I just think that, I think that my earlier answer kind of did, but, um, yeah, I mean you helped me, you know, find places in my lesson, especially because I teach kids that, um, probably don't think a lot for themselves. Um, do basically menial tasks when asked they, um, they're not typically your critical thinkers, I would think. And so, you know, finding places to ask questions in my lesson that I think that they would respond to was very helpful.

Researcher ([08:52](#)):

Okay. Did you feel that you, your coach worked together to gain a clear picture of

reality, set the peer's goal and identify a strategy to meet the goal?

Kristine ([09:04](#)):

Yeah, no, I do. And I think like three, any of my classes are probably different than the reality of somebody else's class. And I think when we were planning, um, we took into the consideration the students that were sitting into my classroom and what, what the, what the best idea in my class would be.

Researcher ([09:23](#)):

Okay. Did you feel that you and your coach worked together to learn the strategy, give ideas of how it might work with your students and how to troubleshoot if it doesn't go well?

Kristine ([09:33](#)):

Yeah. Um, I feel like the planning was probably better than the reflecting.

Researcher

Can you explain that?

Kristine

Huh?

Researcher

Can you explain? Can you expand on that a little bit?

Kristine

Yeah. And I don't necessarily think it was, um, on anybody's fault or anybody's part. I just think the time restraints with teaching a class and living life and stuff like that, I probably put more time into actually planning a lesson than I did sitting back and reflecting on the lesson. And how did it go? Um, I mean, I think we reflected a little bit, but I think I probably put more time in planning than reflecting.

Researcher ([10:15](#)):

Okay.

Do you feel that you and your coach worked together to review each cycle and progress towards the goal and plan next steps?

Kristine ([10:24](#)):

Yes.

Researcher

Can you give any examples?

Kristine

You met with me before the lesson. Then we did the lesson and then we met after the lesson and then we talked about implementing the next lesson. So I mean we did talk about what, what went well and what went, you know, what didn't go well and how to,

you know, improve the next time. So yes.

Researcher ([10:42](#)):

Okay. What did you find most useful in the coaching cycle? Identify, Learn, Improve?

Kristine ([10:47](#)):

Identify again, again, the planning piece and, and, and not having to reinvent the wheel with everything, which I think is stressful as a teacher is when somebody is trying to tell you to change something and um, you know, the time involved and if it's not broke, don't fix it. Doesn't mean it can't get better and just tweaking something, um, a little bit, taking what you have and tweaking it to make it better fit the kids and the stuff like that. So that helped.

Researcher ([11:16](#)):

Okay. What growth, if any, did you see in your students as a result of implementing more discourse into your classroom?

Kristine ([11:25](#)):

So I don't know that if it was growth in my students or me understanding that my students did have the ability to make connections that I didn't think that they would make on their own.

Researcher ([11:43](#)):

Do you have a specific example?

Kristine ([11:47](#)):

Um, I think was it when we were doing quadratics and finding the X, and I remember a couple of my kids having this like aha moment or like when we got a negative underneath the radical sign just to solve them algebraically and they're like, Oh, that means it doesn't cross the X axis. Right? So there are no X intercepts. So them just being able to see what's coming ahead based on what they already knew and what we'd already talked about and making some connections between graphically and algebraically that I didn't have to tell them. Mmm. And again, my students are really low, so I get excited that those connections happen. What's this making work? What is this making sense?

Researcher:

Yes. Yes.

Researcher: ([12:55](#)):

What support do you see yourself needing to continue using discourse as a teaching strategy?

Kristine ([13:06](#)):

Um, probably check ins from the coach to make sure that I'm implementing them and intentionally using it. I don't necessarily know that I would need a full coaching cycle

again, but just check-ins or just the availability of having somebody there and saying,
“Hey, I’m trying to fits in discourse into the selection, uh, less than how would I do it?
What’s the best way to do it? “

Researcher

Okay. All right. I’m going to stop the recording. Okay.

Appendix M

Mia's Survey Responses

Table 14

Cycle 1 Survey Responses:

Survey Question	Mia's Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	6
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	Watching the video showed me I talk to specific kids and not everyone....yikes
What's working with the classroom discourse?	Kids are learning from each other.
What's not working with the classroom discourse?	I lack adequate questions to generate conversation.
What's working with the coaching cycle?	Self-reflection by watching videos is very telling of what is really going on in my class.
What's not working with the coaching cycle?	It takes a lot of time to go through the process.
What is the value of implementing discourse as a classroom strategy?	Kids solidify what they know by explaining verbally to each other. I can also clear up misconceptions if I hear them.
What impact do you feel implementing discourse had on your students?	Not sure yet.

Table 15**Cycle 2 Survey Responses:**

Survey Question	Mia's Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(4) I planned 3 of 5 days a week for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(4) I planned 3 of 5 days a week for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	10
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	10
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	Making me be more intentional with my open-ended questions Giving kids more opportunities to make connections to material taught in class
What's working with the classroom discourse?	Kids are comfortable talking with each other. They are willing to take risks
What's not working with the classroom discourse?	No response
What's working with the coaching cycle?	Videoing and forced self-reflection
What's not working with the coaching cycle?	Taking this survey: Initial questions should only be answered prior to 1st video and after all videos are completed.(my opinion)
What is the value of implementing discourse as a classroom strategy?	Students will learn more over time with continuous verbal communication about math concepts.
What impact do you feel implementing discourse had on your students?	Deeper understanding about concepts, better communicators with their peers.

Table 16**Cycle 3 Survey Responses:**

Survey Question	Mia's Response
Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Before coaching, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse
Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	7
Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	7
Give me a brain dump about the coaching cycle and how it's helping you grow in your practice.	Encouraging me to have more meaningful, deep conversations about concepts.
What's working with the classroom discourse?	Having kids talk more with each other to enforce ideas or concepts
What's not working with the classroom discourse?	No response
What's working with the coaching cycle?	Self-reflection on classroom discourse
What's not working with the coaching cycle?	This survey. Questions are the same but you need this information.
What is the value of implementing discourse as a classroom strategy?	Helps students understand why they know what they know. Not just memorizing steps but the 'why' behind the math.
What impact do you feel implementing discourse had on your students?	Deeper understanding, broader knowledge.

Table 17***Mia's responses to surveys after each coaching cycle.***

	Coaching	Coaching	Coaching
	Cycle 1	Cycle 2	Cycle 3
1. Before professional development, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse	(4) I planned 3 of 5 days a week for discourse	(3) I planned once a week for discourse
2. Before coaching, I rate myself as a ____ on planning to implement discourse.	(3) I planned once a week for discourse	(4) I planned 3 of 5 days a week for discourse	(3) I planned once a week for discourse
3. Rank your ability to implement discourse as a classroom strategy before coaching (where coaching is an extended form of professional development).	6	10	7
4. Rank your ability to implement discourse as a classroom strategy after coaching (where coaching is an extended form of professional development).	8	10	7

Appendix N

Researcher ([00:01](#)):

Uh, before the interview, I just want to, I just started a recording. Is it okay with you that I record our conversation?

Mia

Absolutely.

Researcher

Okay. The purpose of the recording is so that I can get a transcript of, um, um, of the conversation and of your responses. So I did send you the interview questions a couple of days ago. Yes. And, um, there was some information on the coaching cycles, so anything that you need like a review of like, can you refresh me on the coaching cycle? Can you refresh me on the PD? Just let me know and I can do that. Um, the first series of questions are, um, I'm looking at answering one of my research questions about professional development on discourse and how it impacts the second year secondary math instructional practices.

Mia

Okay.

Researcher

So the first question is, did you view instructional coaching as an extension of the professional development session you attended in July or August of 2019.

Mia ([00:59](#)):

Can you remind me what we went over on those professional developments?

Researcher ([01:05](#)):

In the professional development? We talked about, um, like setting up your classroom as a safe space. We talked about building relationships with your students and that they could build relationships with each other so that these conversations could happen. Um, we talked about modeling strategies, modeling vocabulary that you would want them to be using. Um, and I just closed my browser. Otherwise I would have had the PD, um, up. But the initial PD really was about setting up your classroom from day one as opposed to, um, like jumping in about conversations.

Mia ([01:42](#)):

Right. Okay. So was the instructional coaching and extension of the professional development? Yes. Yes it was.

Researcher ([01:50](#)):

Did you view that as an extension of the PD before you, before we started?

Mia ([01:58](#)):

Like did you have to connect them together? But it was definitely the M.O., the next logical step. Now that you've set up your room and these expectations, now let's keep going with it.

Researcher ([02:13](#)):

Okay. So question two, do you view instructional coaching as an extension of professional development? Currently,

Mia ([02:23](#)):

yes. It's definitely the next step of beyond classroom management, class/relationships with students, environment safe spaces. Yes. It's okay. Definitely the next step

Researcher ([02:37](#)):

Number three has attending the initial PD and instructional coaching changed your classroom discourse practices?

Mia ([02:46](#)):

Yes, it has. Um, one of the processes in the instructional coaching is I had to watch a 45 minute video of myself in class. And when you, when you don't do that, you have, you really have no idea how you look in the classroom, how you behave, you, you think you're doing one thing, but you might be doing something completely different than what it showed me is whether I did it intentionally for subconsciously, I only talked to

certain kids in the class. I did not. Mmm. I did not engage everybody at some point. And that was, that was an issue for me because I know in my mind I'm like, okay, all these kids are smart. I know they know it, but I'm not giving them an opportunity to express that knowledge either. And that's not fair.

Researcher ([03:48](#)):

Okay.

In what ways has professional development including instructional coaching impacted your second, your classroom discourse practices? So let's go with that first sub question a is, did anything from the PD or coaching conversations stick with you as you planned, facilitated or reflected?

Mia ([04:07](#)):

Yes, I made sure that my, my, my, um, my small purposeful talk questions were open-ended. Um, I learned how to, anything, I learned how to, let me think, um, let them brainstorm rather than take one answer and then move on. I let everyone contribute. Mmm. Yes. Um, also giving them time to think things out and to reflect and to communicate with each other and then giving them an opportunity to, uh, popcorn back. That information is very important.

Researcher ([04:52](#)):

So those are all examples of when you were facilitating in your classroom. What about during planning?

Mia ([05:02](#)):

Sure. So during the planning I was, I had to think about questions and when, when would it be a good idea to have a, have an open-ended question and time to reflect and time to process information. I also had to plan how my room was set up. You want to make sure that it was, it was, uh, it was set up in a way where they would be able to be, uh, communicate effectively with each other.

Researcher ([05:26](#)):

Okay. What about when you were reflecting over a lesson?

Mia ([05:35](#)):

Mmm. Uh, honestly when I did the prep work, my room, they already had, had felt safe in my classroom with each other, with talking. When I would ask these, you know, open-ended questions and gave them time to communicate with each other, it was always a success. So reflecting, it wasn't like I had to reflect and go, Oh, that was, that did not work. The only time I was really reflecting was when after I watched that video and I could see myself or when I, after I watched the video and I could see that, um, I limited who could, who was responding or who I was listening to.

Researcher ([06:19](#)):

Okay. Any other examples of how professional development has impacted your classroom discourse practices?

Mia ([06:30](#)):

Uh, other than what I've stated, no.

Researcher ([06:34](#)):

Okay. So question five, would you have implemented discourse practices without professional development?

Mia ([06:41](#)):

No. No, because I don't have time to sit there and think stuff out. I'm not researching how to improve instruction. I mean, professional development opens a teacher's mind to possibilities of what could happen with the time constraints and you know, work requirements. It's, it's hard to, to do that.

Researcher ([07:10](#)):

Okay. What would have been different if you tried to implement discourse without PD and, or coaching support?

Mia ([07:19](#)):

Well, I wouldn't know what I was doing. I wouldn't know what would be effective. I wouldn't know. Um, you know, tried research. You know, I wouldn't, I don't just go in the kitchen and start making a recipe. I look it up, I research it. I look what the ingredients are. So when you're trying to do discourse in your, in your classroom without coaching or professional development, it would just be, I wouldn't have tried it at all.

Researcher ([07:51](#)):

Okay. Okay. So that's the end of part one. And then part two, I know in your

document you can scroll down. Um, we, um, just to recap of what we did for the coaching cycles. So you kind of talked about the identify phase already where you watched a 45 minute class period of you teaching and then we set a goal.

I, um, have your goal in my notebook, but I need to open up and look at it because I forgot. Hold on. Um, students will increase their involvement and interaction with mathematics through discussions in class. That was your peers goal. Um, and so after we set that, then we went through a preconference, a filming and a post-conference cycle. We did that three parts we did three times that was in the learn phase. And then within that we did an improve phase at the end of each, um, post-conference, we talked about roadblocks. What do you want to do next, um, what you learned in the, what you learned from your students and you know, really kind of what happened. So that's the cycle. So both of the whole thing is the coaching cycle and then we kind of have like mini cycles within the big one.

Mia

Right.

Researcher

Okay. So thinking about that specifically, number one, how did working with a coach improve or not improve your practice as a teacher?

Mia ([09:28](#)):

Well, working with a coach improve my practices because they were there to facilitate me through the thinking process of what was constructive, what was, what was,

what worked, what didn't work, just guided me through that whole process.

Researcher ([09:45](#)):

Okay. Do you have any other specific examples? So the follow up to that was did working with an instructional coach assist you specifically in planning and executing discourse in your classroom

Mia ([10:04](#)):

specifically? Yes. Yeah. Uh, I was assisted specifically because we set goals. Um, my coach gave me ideas about what to do. We, um, jotted down potential questions, uh, uh, we knew what the lesson was going to be ahead of time so we could, we could plan ahead. Um, uh, plus, uh, she set me up with some technology, so that was like, Oh yeah, I'm recording this lesson. She gave me the supplies I needed to be successful for sure.

Researcher ([10:47](#)):

Okay. Number two, did you feel that you and your coach worked together to gain a clear picture of reality, set the peer's goal and identify a strategy to meet the goal?

Mia ([10:59](#)):

Absolutely.

Researcher ([11:02](#)):

Did you have any, sorry, any examples?

Mia ([11:06](#)):

Well, just like I said before, we, we, we, uh, we talked about first we decided what lessons we could, uh, engage a discourse in the, in the lesson. Um, we talked about what the, what the lesson objectives were and then what would be adequate, uh, question, questioning possibilities. Mmm. Then we always reflected after each one to make sure. Was it a, was it, did it work? Was it, Mmm, could have been done differently. I think one of the, I think if I remember correctly, one of the lessons, it should have happened, you know, like a day before or maybe it was the day after. I actually did it on the first day, but it should happen on the second day. Something like that. But yeah, we were always reflecting on if it was at all.

Researcher ([11:54](#)):

Okay. Do you feel that you and your coach worked together to learn the strategy, give ideas of how it might work with your students and how to troubleshoot if it doesn't go well? That's question three.

Mia ([12:10](#)):

Yes. Yeah, I do. I mean, as I sit here now, Mmm. I don't know if, if, um, if this was a, would be appropriate or not, but to maybe like watch a video of someone who is not doing this course correctly, that we do something like that.

Researcher ([12:29](#)):

No, we only watched an example of a teacher who did do the discourse correctly.

Mia ([12:33](#)):

Ooh. You can't remember. But that would be something like here's something what not to do or, you know, what do you think about that? Just to reflect and say, Oh, that was terrible. Or Oh, that was great. You know, but I don't know if that's appropriate or not. Number three, is that what we're talking about?

Researcher

Yeah.

Mia

Do you feel that you and your coach worked together to learn the strategy? Of course we did give ideas of yes. Uh, how to troubleshoot if it doesn't go well. I don't, well, I mean, I didn't go into any, in my lessons with just one question, you know, I didn't have just one possible discourse opportunity. There were several. So if one question or one opportunity wasn't, um, as well as the others, there were, there was enough to, to just to do the activity.

Researcher ([13:35](#)):

Okay. Number four. Did you feel that you and your coach worked together to review each cycle and progress towards the goal and plan? Next steps?

Mia ([13:44](#)):

Yes. Lots of appointments. Lots of scheduling. Yes we did.

Researcher ([13:55](#)):

Okay. Do you have any examples?

Mia ([13:59](#)):

Well, uh, just constant communication and reflect in times, uh, made, uh, made appointments on the calendar to make sure that we talked about it. We didn't wait too long after it happened, so it'd be fresh on our mind. Um, we took notes, we had a Google form that we filled out to reflect after each, after each, um, discourse opportunity. Oh look at me remembering that.

Researcher ([14:27](#)):

Number five. What did you find most useful in the coaching cycle? The identify, the learn, the improve, all, none?

Mia ([14:33](#)):

I think. Mmm. The identify and the learn or the most helpful, you know, the beginning, initial you setting a goal and then the learn part. Working on the strategy, giving ideas. That was very helpful. Yes.

Researcher ([15:04](#)):

Okay. What growth, if any, did you see in your students as a result of implementing more discourse into your classroom?

Mia ([15:13](#)):

Well, they were more confident talking to each other about math. They were confident in explaining themselves mathematically in class, in front of their peers. I became more comfortable with them talking about stuff, you know, releasing control and knowing that they could come at me with anything that I may not have thought of. And that's okay. I don't have to be the smartest person in the room. So letting go of that was a big deal. Uh, but this is about the students. Mmm. They, that's it. Just talking with each other and talking in class, brainstorming.

Researcher ([16:03](#)):

So let me ask you a follow up question. As you gave up a little bit of control to let them talk, do you think students were able to think outside the box a little bit?

Mia ([16:17](#)):

I do. A little bit, yes I do. And they gave them an opportunity to process the information too. If I'm just up there the whole time, talk, talk, talk, and I don't give them a mental break too truly dissect what was going on, that's not helpful. So yes, I, yeah.

Researcher ([16:35](#)):

Okay. And number seven, what support do you see yourself needing to continue using discourse as a teaching strategy?

Mia ([16:50](#)):

What support? I mean, I don't know if I need necessarily support, but an accountability of am I still using it? Maybe in that regard. Um, maybe a reminder to do it

or to maybe as a, a goal on T-TESS. Is that a T-TESS thing? So making that, what am I,

Researcher ([17:20](#)):

did you not use that as one of your team, your, your peers goal? Did you not use that as part of one of your T-TESS goals?

Mia ([17:27](#)):

I'm pretty sure I did.

Researcher ([17:29](#)):

Well, I mean TTESS is kind of out the window, right?

Mia ([17:32](#)):

I think so. Yeah. It's just a long time ago. I don't, I can't, like I said struggling.

Researcher ([17:39](#)):

I understand. Okay.

Mia ([17:43](#)):

So, but you know what, like a follow up professional development would be, is helpful. Even if doesn't do this program. When kids think, pair, share with each other, it's, it's so beneficial. You just can't get past that. I there, there's not a lecture in the world that I could give that's not, it's not going to be as impactful as them talking it out and working it out together. That's when they solidify the information.

Researcher ([18:18](#)):

Okay. Um, okay, so just so that, you know, our next steps are, my next steps is I'm going to write up your case. So I'm doing a case study. So every individual is their own case. You'll be assigned, um, a pseudonym. And then once I write it up, I'm going to send it to you.

Mia

Okay.

Researcher

And I'm going to let you read through it because it's what's called a member check to where what I have written down about your case is accurate and it allows you as the participant to verify yes, this is correct or no, you have not represent the case correctly. Okay. Um, I, I don't know when I'm going to get it written up. My goal is to have my cases written up by the end of may. Um, but I'll call or text you and email you and you know, we'll get through that cause that'll have, you know, I'll give you some time to read over it and then think about it and then get back with me. Okay. So that's kind of what's next. I'm going to stop the recording now.