

EXPLORING BEGINNING MATHEMATICS TEACHERS' PERCEPTIONS OF
UNIVERSITY-BASED TEACHER INDUCTION PROGRAMS

by

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ABSTRACT

University-based teacher induction programs are a relatively new form of beginning teacher induction which are housed in a university rather than provided by the schools where new teachers are hired. Like many induction programs, university-based programs seek to support new teachers as they transition into the teaching profession but are unique in that they exist both inside and outside of the teacher's school culture. For math teachers specifically, these programs have the potential to mitigate tension between the reform-oriented instructional practices they learned at the university and the traditional instructional techniques they experienced both in their own K–12 schooling and in their new jobs. In this dissertation I investigate how these university induction programs interact with beginning middle and secondary math teachers' goals and visions for instruction, the promoted actions of their schools, and other elements of the school culture and climate, to consider its role in teacher learning and development. Utilizing zone theory to understand this interaction, I investigated two university-based teacher induction programs 1) Desert Valley, which was specifically designed for middle and secondary mathematics teachers and 2) Oceanside, which was designed for all K–12 teachers regardless of content area. The findings from this study suggest that the beginning math teachers at Desert Valley felt supported in implementing reform-oriented math practices in their classroom but that their perceptions of their student capabilities had a limiting effect on how many of the ideas were integrated into their practice. The teachers from Oceanside perceived the program as providing more individualized, general supports which helped them to implement their own vision of instruction, which was typically aligned with their school colleagues. While both of these programs were

designed to support beginning teachers, the findings suggest that they also had the potential to create additional tensions for teachers as they navigated their school culture and climate.

CHAPTER 1: INTRODUCTION

For most school teachers, learning to teach is a process that starts with observation of teaching as learners (Darling-Hamond et al., 2005a), moves to some form of teacher education (e.g., university teacher education program, alternative certification, or lateral entry), and continues through induction or other types of professional development (Association of Mathematics Teacher Educators [AMTE], 2017; Feiman-Nemser, 2012). New teacher induction programs, designed to enhance both performance and retention (Ingersoll & Strong, 2011), serve as a crucial space for teacher learning and are generally provided by K–12 schools. Prior research has found mixed results regarding the impact of induction on new teacher retention, performance, and student achievement (e.g., Ingersoll & Strong, 2011; Johnson, 2011; Keese et al., 2023; Reeves et al., 2022; Ronfeldt & McQueen, 2017; Wang et al., 2008; Weschler et al., 2012). However, school culture and context seem to have a significant impact on the effectiveness of teacher induction (Allen, 2013; Bickmore & Bickmore, 2010; Fantilli & MacDougal, 2009; Weschler et al., 2012).

Some universities have begun to offer induction for new teachers, putting the program in a unique position of operating both within and outside of the school culture. Initial studies of these university-based teacher induction programs have shown some positive impacts on teacher retention, ability, and student achievement (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Molach et al., 2022). However, these studies mainly focus on measures of program success that are tied to program goals (Bastian & Marks, 2017); few have investigated how these programs interact with the goals of beginning math teachers or how their school context influences those goals.

My Experiences as a New Teacher

This project was inspired by my own experiences as a white, female, beginning math teacher. Prior to coming to the University of Missouri I was a high school Algebra I teacher in Northwest Ohio. As a new mathematics teacher, coming from a traditional 4-year teacher education program, I entered the profession of teaching hopeful and excited to implement research-based instructional strategies, which I had learned about in my own teacher education program. My goal was to engage students in rich, mathematical tasks that required critical thinking and problem solving. I wanted my classroom to be a space of shared authority where students had many opportunities to generate a variety of ideas and strategies. However, the type of instruction that was being promoted by the other teachers in my school was more traditional. The other teachers had a format of mathematics instruction that was teacher-centered and included a review of homework problems, notes on a new topic, and individualized procedural practice, which was in direct contrast to my own vision of instruction. I felt that I had no choice but to implement the type of instruction everyone else was using and wanted me to use as well. While I was provided a mentor teacher from my school through a traditional school-based induction program (Guarino et al., 2006; Keese et al., 2023; Wood & Stanulis, 2010), she too taught using direct instruction. Furthermore, she was teaching AP calculus while I was assigned to Basic Algebra I, two completely different courses. During these three years I believed I did not fit into my school culture, and I was continually wrestling with how to reconcile the tension I felt between the type of instruction I wanted to implement and what was expected of me. This study was largely inspired by these experiences.

As I struggled through my first three years of teaching, I wished for a different form of induction that could have created a community of support with other teachers who wanted to teach using similar pedagogies to myself. This study explored how university-based teacher induction can connect theory and practice between universities and classrooms, specifically by encouraging a reform-oriented approach to mathematics instruction for beginning teachers and helping them apply these practices within their school environments. This support was provided through professional development sessions that focused on reform-oriented mathematics instruction and strived to create a community of beginning mathematics teachers who had a similar vision, helping beginning teachers navigate a school culture that may potentially limit their pedagogical approaches. These university programs provide a unique opportunity to study new teacher development as they draw on the current research around best teaching practices (theory) while recognizing the challenges beginning teachers are facing every day in schools (practice). Because of their unique position, university-based teacher induction programs have the potential to have big impacts on beginning mathematics teacher development.

Purpose

This study emerges from the recognition that induction programs can be a place of beginning teacher development (Ingersoll & Strong, 2011) and that school culture plays a role in that development (Fantilli & MacDougal, 2009). However, few studies of university-based teacher induction programs have focused on this interaction of school culture, induction program, and beginning teacher goals. Through the lens of zone theory (Goos, 2013) I uncover the mechanisms through which university-based teacher

induction programs influence and support beginning mathematics teachers' instructional goals within their given school context. While some induction studies have considered school context (Allen, 2013; Bickmore & Bickmore, 2010; Fantilli & MacDougal, 2009; Weschler et al., 2012) they have focused on traditional induction programs, which exist only within the K-12 school. This study adds to this existing induction literature by revealing how induction programs work within, and outside of, a given school culture and how they can act as catalysts for teacher development. Furthermore, this study focused on university-based teacher induction programs, which are a special case of induction, and may support future development of these programs. Finally, this study focused on mathematics teachers as they have a unique challenge of grappling with the *dialogic* mathematics instruction, they are typically taught in their education programs (Munter et al., 2015) and the more *direct* instruction (Munter et al., 2015) that is prevalent in schools (National Council of Teachers of Mathematics [NCTM], 2014). Few studies have investigated how induction programs can support these beginning mathematics teachers specifically.

Through a multiple, comparative case study of two university-based teacher induction programs with different goals and supports, I investigated how these programs can support beginning mathematics teacher development within their given school context. Through interviews and a survey with beginning mathematics teachers in the programs, I sought to understand the interaction of the promoted actions of the induction program and school, the teachers' zone of proximal development, and their contextual constraints. This study is guided by the following research questions. The design, findings, and remaining chapter structure are outlined below.

Research Questions

1. What are beginning mathematics teachers' perceptions of how university-based teacher induction programs support their development within their school context?
 - a. Within each case, what is the relationship between teachers' perceptions of the Zone of Promoted Action (ZPA) of their university-based teacher induction program, their Zone of Proximal Development (ZPD), and their Zone of Free Movement (ZFM)?
 - b. Across both programs, how does the ZPA of university-based induction programs interact with the existing ZPA of the teacher's school?

Overview of the Study

Following case-study design principles (Yin, 2018), I conducted a multiple, comparative case study to answer the research questions above. The two cases of interest were two university-based teacher induction programs. The first program, Desert Valley, is in the southwest United States and provides support for first or second-year middle or high school mathematics teachers. The second program, Oceanside, is on the east coast of the United States and provides support for any K–12 teacher within their first three years of teaching. I surveyed 15 teachers from Desert Valley and 14 from Oceanside. The survey allowed me to characterize the Zone of Proximal Development (ZPD) of the teachers as well as potential tensions they might be experiencing between their induction program and their school culture. Of the 29 teachers surveyed, I interviewed eight from Desert Valley and four from Oceanside. In the interviewed I asked the teachers about their instructional goals, areas where they had room for development (ZPD), and how their induction program and school played a role in that development (ZPA/ZFM).

Within-case analysis revealed that the Desert Valley teachers engaged with the promoted actions of their induction program in four unique ways based on their Zone of Proximal Development: they began to adopt the ideas promoted but did not implement them (Loosely Defined ZPD), they implemented the ideas from their program (Clearly Defined ZPD), they had already been implementing the ideas and shared them with others (All-Encompassing ZPD), or they slowly took up the ideas over time (Shifting ZPD). Teachers' perceptions of their school context and students influenced if they thought they could implement the ideas from their induction program. Within-case analysis also revealed that the Oceanside teachers perceived having been supported to implement their vision of instruction, which was closely aligned to their school culture. The program created supports that addressed tensions teacher felt as they tried to implement their vision of instruction or navigate school culture or student behavior. Cross-case analysis revealed that teachers perceived their induction program as an additional set of promoted actions which could be in tension with the promoted actions of their school.

Broadly, these results suggest that while university-based teacher induction programs can support beginning teachers to implement dialogic instructional practices, the goal of the induction program and the teacher's perceptions of their students and school culture can have lasting impacts on how the teachers embraced the ideas. Moreover, while these programs can assist novice teachers and alleviate perceived challenges as they acclimate to their new profession, they may also introduce additional stress if the program's design is not well-aligned with school initiatives. Thus, more research needs to be conducted to further investigate how induction programs can focus

on content that promotes dialogic instruction while acknowledging and preparing teachers to accommodate their existing current school practices. Additionally, some teachers chose to align themselves with their induction program over their school policies and/or fellow teachers understanding what causes some teachers to do this would help teacher educators prepare future teachers to challenge traditional teaching narratives.

In the subsequent chapters, I provide a comprehensive discussion of my research. Given this study's focus on university-based teacher induction support of beginning mathematics teacher development, Chapter 2 starts with an overview of teacher induction as a form of professional development that supports beginning teacher learning. Then, I share some initial research on university-based teacher induction programs as a new form of teacher induction. Next, I turn to the importance of focusing on mathematics teachers specifically and their unique situation of trying to implement dialogic instruction in schools that are still relying heavily on direct instructional methods. Finally, I describe Zone Theory (Goos, 2013), an overarching theoretical framework that is integrated through all aspects of the study.

In Chapter 3, I provide an overview of my research methods, beginning with the two cases that are the context of the study. As the study is holistic in design, the teachers in the study are not individual cases but contribute to understanding each induction program as a case itself. However, I share some demographic information about the teachers who participated in the study to contextualize their experiences. Finally, I describe the quantitative and qualitative data collection and analysis.

In Chapter 4, I first discuss the two cases separately to address research question 1a. Each section begins with an overview of the main themes within the case, followed

by the promoted actions of the induction program as perceived by the teachers. Given the fact that the two programs were designed with different teachers in mind, the findings are unique to each program and thus organized differently. Finally, I discuss the impact of university-based teacher induction programs broadly by looking across both programs, to address research question 1b.

In Chapter 5, I highlight the main findings as connected to prior research related to studying induction programs and the design of professional development for mathematics teachers. I then share the implications for future research, teacher education, and induction supports. After reflecting on the study, I acknowledge the limitations and conclude the study.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This chapter begins with a review of the literature on the design and impacts of traditional K–12 teacher induction. Next, I highlight the initial findings of studies on university-based teacher induction programs. As the focus of this study is on the impact of induction on beginning mathematics teachers specifically, I then discuss current goals of mathematics education teacher preparation and the potential for induction to support beginning mathematics teachers to implement dialogic mathematics instruction. The chapter concludes with a description of the theoretical framework utilized for this study, zone theory, highlighting the relevance of the framework in studying the interaction of the induction programs, beginning teachers, and their school context.

Literature Review

Teacher induction is a broadly used form of professional development that is designed specifically for beginning teachers (Feiman-Nemser, 2010). In traditional teacher induction beginning teachers are partnered with a mentor in their school, may have additional professional development opportunities, and potentially have a reduced workload (Feiman-Nemser, 2010; Wang et al., 2008). These induction supports are designed and implemented by the school district the beginning teacher works for (Reeves et al., 2022). The goal of traditional teacher induction is to help teachers learn how to teach (Ingersoll & Strong, 2011; Weschler et al., 2012) as well as increase teacher retention (Allen, 2013; Keese et al, 2023).

According to The National Academies of Science, Engineering, and Medicine (2020) “90 percent of teachers in 2008 reported having participated in induction

programs” (p. 161). Furthermore, as of 2019, 31 states required some form of mentoring or induction programs for novice teachers (ECS, 2019). With these programs so prevalent, many researchers have investigated the impact of induction programs finding some positive correlations between elements of teacher induction and retention (Johnson, 2011; Ronfeldt & McQueen, 2017), student achievement (Ingersoll & Strong, 2011; Keese et al., 2023), and teacher effectiveness (Reeves et al., 2022). However, Weschler and colleagues (2012) found no significant differences in student achievement between teachers who had, and had not, participated in induction programs. Additionally, school context was determined as a main contributor to teacher retention (Weschler et al., 2012). While traditional teacher induction has the potential to have lasting impacts on beginning teachers and their students, it does not always work out in this way, therefore other forms of induction are being considered.

University-based teacher induction programs have been developed as a new way to support beginning teacher learning and retention. A unique feature of these university-based teacher induction programs is that they exist simultaneously within the school context and outside of it as they typically send mentors into schools to work with beginning teachers, but the program content is created by the university (Bastian & Marks, 2017). Most university-based teacher induction programs provide support to a wide variety (i.e., grade level and content area) of teachers (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Molach et al., 2022). This is also true of traditional teacher induction situated within K–12 schools (Feiman-Nemser, 2010; Ingersoll & Strong, 2011). Few studies of university-based teacher induction programs have considered how school culture interacts with the work these programs are trying to do to

support beginning teachers. Additionally, these studies focus on all K–12 teachers regardless of the grade or content they teach. As different content areas have different pedagogical content knowledge it would follow that the programs may want to focus on a particular group of teachers (e.g., mathematics teachers) to help them build their content knowledge (Lannin et al., 2013; Shulman, 1986). I argue that mathematics teachers are uniquely positioned to have to navigate the implementation of a new type of instruction they may have never experienced themselves and thus should be a focus of study as they learn to teach mathematics from both their colleagues and their induction programs.

Teacher Learning Opportunities

Every year thousands of new teachers enter the profession coming from a multitude of pathways including undergraduate and graduate level coursework, alternative certification programs, “grow your own” programs that start in high school (Carver-Thomas, 2018), new graduate schools of education [nGSEs] which are not partnered with traditional universities (Carney, 2020), and others (Darling-Hammond et al., 2005b; ECS, 2019; Keefe & Miller, 2021). However, the impact these forms of teacher education have on beginning teacher effectiveness still needs additional research (Cochran-Smith & Villegas, 2015; Diez, 2010; Jensen et al., 2017; Morris & Hiebert, 2017). Specifically, the National Academies of Science, Engineering, and Medicine [NASEM] (2020) call for research that answers the question, “what are the factors in preservice teacher education that have the most impact on inservice teacher outcomes?” (p. 197). Morris and Hiebert (2017) relate the disconnect between what happens to PSTs during and after their teacher education to the “Bermuda Triangle of higher education [because] students sail in but no one knows what happens to them after they come out”

(p. 525). There is a need (Cochran-Smith & Villegas, 2015; Darling-Hammond & Bransford, 2005; Diez, 2010; Jensen et al., 2017; Morris & Hiebert, 2017; NASEM, 2020) for research that investigates the effect of teacher education programs on novice teacher practice and student learning outcomes (Diez, 2010). A few researchers have taken up this call.

Both Jansen and colleagues (2017) and Morris and Hiebert (2017) investigated how beginning elementary teachers implemented pedagogical strategies they learned during their preservice teacher education courses. Jensen and colleagues (2017) found that topics emphasized in methods courses were taught by the beginning teachers using conceptually based instructional strategies they had learned. On the other hand, topics that were not taught in the methods courses were taught using more traditional instructional approaches, not aligned with the methods instruction (Jansen et. al., 2017). Additionally, the novice teachers were more likely to accept less conceptually driven explanations from their students when they were not teaching a concept discussed in their methods course. Similarly, Morris and Hiebert (2017) found that beginning elementary teachers more completely attended to key mathematics topics in lesson planning when the topic was more fully explored in their teacher education courses. These studies suggest that what teachers learn in their teacher education programs can be transferred to their inservice teaching practices. However, topics that were not discussed during preservice teacher education were more challenging for beginning educators to teach effectively. This limited transfer of knowledge beyond what was the focus of their teacher education program suggests the need for additional, content specific supports for beginning mathematics teachers.

As mentioned above, not all inservice teachers learn to teach through traditional teacher education programs. As of 2018, 29% of the teacher workforce came through alternative certification pathways (Redding & Nguyen, 2021). These alternative certification programs can include employing teachers while they complete their training (e.g. lateral entry) or emergency permits with minimal requirements (e.g., Teach for America) (Humphrey & Wechsler, 2008). Some researchers have taken the time to study the impact non-traditional certification programs have on beginning teachers' instruction. Most studies focus on the effectiveness of the teachers who are granted certification through these alternative pathways by examining impacts on student achievement (e.g., Boyd et al., 2006; Darling-Hammond et al., 2005b; Ing & Loeb, 2008; Kane et al., 2008). Additionally, studies have found that teachers from alternative certification programs are more likely to leave the field of teaching, but this may be due to the characteristics of the schools where they are teaching (Grissom, 2008). One study conducted by Lannin and colleagues (2013) examined the development of Pedagogical Content Knowledge (PCK) of beginning alternatively certified teachers. They found that the two mathematics teachers struggled during their instruction mainly due to their limited PCK. Furthermore, their PCK did not improve even after some additional mathematics methods courses. Lannin and colleagues shared, "these findings also illuminate the importance of individualizing the professional development of teachers during their induction years" (p. 424). This study suggests the need, and importance, of having content specific professional development for beginning teachers. While this study (Lannin et al., 2013) did investigate alternatively certified teacher development once they are in the field, few

studies have focused on the teachers' applications of the concepts they learn about through alternative certification programs (Johnson & Birkeland, 2008).

Whether teachers learn to teach through traditional teacher education programs or through alternative certification pathways, these programs cannot prepare them to know everything there is to know about teaching (Feiman-Nemser, 2012; Steele & Hillen, 2012). Furthermore, so much of the knowledge teachers need for teaching is grounded in their specific school context with a particular group of students (Darling-Hammond et al., 2005b). For example, understanding systems in their school such as grading policies, communication with parents, and team planning (Darling-Hammond et al., 2005b). These teaching practices can only hope to be approximated in preservice teacher education because beginning teachers will only be able fully experience them once they have entered the profession. There is a need for additional learning opportunities for teachers after they earn their licensure, to support learning about teaching within their given school context.

One way to support teacher learning after they enter the field is professional development (PD). Professional developers have focused on many instructional practices such as utilizing rich mathematical tasks (Borko et al., 2014; Boston & Smith, 2009; Slavit & Nelson, 2010), facilitating mathematical discourse (Pang, 2016; Schwartz et al., 2021), attending to student thinking (Jacobs et al., 2007), or other practices (Fernandez, 2005; Ross et al., 2006). These forms of professional development are what Otten and colleagues (2024) would call *transformational PD*, designed to support substantial changes to teacher practice. Furthermore, this form of PD is sustained meaning that teachers devote a significant amount of time (e.g., weeks, months, or years) participating

in the PD with the hope being that teachers practice is significantly changed. On the other hand, *incremental PD* (Otten et al., 2024) is more modest in nature and closely aligned with existing teacher practice. Fewer studies have been conducted on the impact of incremental PD (Fuentes, 2024; Jansen et al., 2024). In this way, induction programs can serve as a link between preservice teacher education and inservice teacher professional development. As induction programs are a form of professional development that is designed to continue the development of beginning teachers once they enter the field (Feiman-Nemser, 2010).

Traditional Teacher Induction

Beginning teacher induction programs are designed to increase beginning teacher retention and improve performance (Feiman-Nemser, 2010; Ingersoll & Strong, 2011) and “are based on the belief that after completing the initial teacher preparation certification program, beginning teachers are at the *beginning* of the process of learning to teach” (Stanulis et al., 2007, p. 135). These programs are typically housed within the schools’ teachers are working in and can include a variety of elements (Guarino et al., 2006; Keese et al., 2023; Wood & Stanulis, 2010). According to the 2015-2016 *National Teacher and Principal Survey* (U.S. Department of Education, 2016) 66.5% of the 3,348,800 public school teachers who took the survey indicated that they participated in a formal induction program. Induction programs are exceedingly prevalent, but they vary considerably depending on the context. However, one element seems to be consistent across programs mainly, some level of mentoring (Feiman-Nemser, 2010; Ingersoll & Strong, 2011). Despite their prevalence, much is to be learned about induction effectiveness regarding student achievement, retention, and effects on teaching practice.

Studies have found conflicting results about the effectiveness of teacher induction programs at retaining novice teachers after their first year of teaching (National Academy of Science, Engineering, & Mathematics [NASEM], 2020). Many studies (e.g., Bickmore & Bickmore, 2010; Burger et al., 2021; Courtney et al., 2023; Guarino et al., 2006; Hellsten et al., 2004; Keese et al., 2023) about teacher induction focus mainly on conceptualizing the content and structure of teacher induction programs.

What is Teacher Induction?

Teacher induction can range from formal programs designed to increase teacher retention (Allen, 2013; Ronfeldt & McQueen, 2017; Smith & Finch, 2010), to a socialization process (Bickmore & Bickmore, 2010; Feiman-Nemser, 2010; März & Kelchtermans, 2020), to an informal phase in the process of learning to teach (Feiman-Nemser, 2010; Voss & Kunter, 2020; Wang et al., 2008). Induction programs can include mentoring, common planning time, observations, reductions in teaching load, extra planning time, workshops or seminars, additional resources, orientations, etc. (Bickmore & Bickmore, 2010; Reeves et al., 2022; Wang et al., 2008). This form of induction, through mentoring, typically involves the assignment of a more veteran teacher in the school to a beginning teacher. Then the mentor and beginning teacher meet for some amount of time throughout the school year, whether formally or informally, so that the veteran can provide feedback, advice, or support to the beginning teacher (Andrews & Quinn, 2005; Burger et al., 2021; Hellsten et al., 2004; Polikoff et al., 2015).

According to the 2011-2012 *School and Staffing Survey* (NASEM, 2020), on average across school type (i.e., rural, city, suburb, town) about 77% of teachers had mentors, 57.5% had common planning time, and 61.5% participated in seminars.

Similarly, the 2015-2016 *National Teacher and Principal Survey* (U.S. Department of Education, 2016) found that 74.3% of the public-school teachers were assigned a mentor in their first year of teaching. Ronfeldt and McQueen (2017) found comparable patterns of participation in their study, 79% of beginning teachers participated in teacher mentoring, 73% in seminars, and 62% had a common planning time. In summary, over the past ten years a majority of beginning teachers have continued to participate in forms of induction, mainly through mentoring. With the prevalence of induction so widespread researchers have asked the question, what are the effects of teacher induction on retention, student achievement, and teacher practice?

Effects of Teacher Induction

Effects on Retention. A common purpose of teacher induction program research is to determine the program impact on beginning teacher retention (Allen, 2013; Guarino et al., 2006; Ingersoll & Stong, 2011; Keese et al., 2023; Ronfeldt & McQueen, 2017; Smith & Finch, 2010). Many elements of induction have been correlated with positive effects on teacher retention, with the main contributor being mentoring.

The purpose of having a mentor is to help novices feel supported both personally and professionally (Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; NASEM, 2020). In a large scale study using the Beginning Teacher Logitudinal Survey and the Schools and Staffing Survey data, Ronfeldt & McQueen (2017) found that having a mentor reduced a teachers odds of leaving the profession within the first five years by 27% to 32%. Furthermore, having a mentor reduced the odds that a teacher would migrate to another school by 41% to 55% (Ronfeldt & McQueen, 2017). These findings are similar to Smith and Ingersoll's (2004) study that found that having a mentor reduced

the odds of teacher attrition by 30%, with the most pronounced effect being when the mentor was within field (e.g., mathematics) (Guarino et al., 2006; Ingersoll & Strong, 2011). Bickmore and Bickmore (2010) found that when assigned mentors followed school policy, meaning they met with the novices weekly and logged about the experience, novice teachers were more likely to remain in the school the following year. These studies suggest that mentoring and induction can have powerful impacts on beginning teacher retention.

Effects on Student Achievement. The findings related to the impact of induction on student achievement are mixed. In a review of the literature, Ingersoll and Strong (2011) examined four studies that found positive correlations between beginning teacher participation in induction programs and student achievement. Across the four studies, mentoring was a key element of the induction programs, which is consistent with the findings cited above (Bickmore & Bickmore, 2010; Guarino et al., 2006; Ingersoll & Strong, 2011; Rondfeldt & McQueen, 2017). One of these studies (Thompson et al., 2004) found that students of teachers who engaged in high levels of induction performed better on the standardized test than did students of teachers who had low levels of engagement in induction. Similarly, Fletcher et al. (2008) also found a positive correlation between a more intense mentoring model and higher gains in reading scores for beginning teachers' students. Rockoff (2008) discovered that beginning teachers who had more mentoring hours had higher student achievement scores when compared to their peers with less mentoring hours. On the other hand, Glazerman and colleagues (2010) only found a modest positive effect on achievement after teachers had participated in induction for three-years. While these findings suggests positive impacts of teacher

induction on student achievement, the authors are careful in the claims they make. These findings were also aligned with the findings of (Papay et al., 2012). Each of these studies do show some positive correlations between induction and student achievement but these all seem to be tied to content-focused, sustained mentoring (e.g., Isenberg et al., 2010).

Across the literature, studies trying to connect induction to positive affects on student achievement have mostly found that participating in induction has about the same effects on student achievement as not participating (Glazerman et al., 2010; Holt, 2012; Isenberg et al., 2010; Nickels, 2011; Wechsler et al., 2012). In a large randomized control trial with elementary teachers (k-6) in thirteen districts across the United States, Glazerman and colleagues (2010) found the student achievement of first year teachers participating in the comprehensive induction program was not significantly different than that of their peers participating in typical school induction programs (Isenberg et al., 2010). It is important to note that this study was not comparing teachers who had no induction to teachers with comprehensive induction. On the other hand, Wechsler and colleagues (2012) found no significant differences between student achievement scores of teachers who had participated in induction and those who had not. While the goal of most induction programs is not primarily to impact student achievement (Fieman-Nemser, 2010) logically it follows that a positive impact on teacher practice has the potential to improve student achievement. The study by Glazerman and colleagues (2010) may point to this conclusion as positive impacts on student achievement did not show up until teachers were in their third year of teaching. This positive impact was solely identified in the teachers who had received two years of intensive induction. These studies suggest

that as a whole, teacher induction may not improve student achievement, but certain elements, such as content focused mentoring (Isenberg et al., 2010) may.

Other Effects of Induction. In addition to studies focusing on retention and student achievement, other studies of new teacher induction have focused on a variety of outcomes including teacher feelings of efficacy (e.g., Kutsyruba et al., 2019; Reeves et al., 2022; Wechsler et al., 2012), teacher attitudes and feelings of support (e.g., Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; Burger et al., 2021), and teacher skill (Ingersoll & Strong; 2011; Thompson et al., 2004; Wechsler et al., 2012). Many of these studies draw on teacher self-reports to provide insight into induction through the lens of the teachers.

Teacher self-efficacy is defined as a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning" (Tschannen-Moran & Hoy, 2011, p. 783). A common theme among the induction literature is that participating in teacher induction is linked to stronger feelings of self-efficacy among teachers (Kutsyruba et al., 2019; Reeves et al., 2022; Wechsler et al., 2012). In a large study of 736 U.S. teachers of grades 7–9 across 158 schools, Reeves and colleagues (2022) tried to predict which elements of teacher induction improved teacher self-efficacy. They used a self-efficacy measure comprised of three factors: classroom management, instruction, and student engagement (Tschannen-Moran & Hoy, 2001). The research team found that certain elements of induction, including online courses or seminars, reflective writing, and reduced teaching load led to higher teacher self-efficacy (Reeves et al., 2022). These findings are similar to that of Weschler and colleagues (2012) who found that teachers who participated in a variety of induction activities had

significantly higher predicted mean self-efficacy scores than that of their peers who did not participate in a variety of induction activities. Furthermore, these researchers found that induction activities that had a strong instructional focus led to significantly higher predicted self-efficacy scores (Weschler et al., 2012). These findings suggest that higher self-efficacy is not necessarily inherent from participating in induction but that certain elements of induction can have more of an impact on teacher self-efficacy.

Part of self-efficacy is teachers' perceptions of elements of teaching where they can grow their teaching skills. Induction programs have been found to support beginning teacher growth and development (Reeves et al., 2022; Thompson et al., 2004; Weschler et al., 2012). Wechsler and colleagues (2012) analyzed teachers' professional growth through self-reports and found that beginning teachers perceived induction supports as improving their skills and knowledge. Factors such as supportive school context, strong mentoring, strong focus on induction, and a variety of induction supports each led to statistically significant higher mean-predicted levels of self-reported growth (Weschler et al., 2012). In a comparable study Reeves and colleagues (2022) found that online activities, such as virtual communities, team teaching with experienced teachers, and reflective journaling were all significantly correlated with higher scores on their teacher practice measure. While these studies relied on self-reports of teacher skill, observational studies have shown similar relationships. For example, Thompson and colleagues (2004) found, based on survey data from 287, 3rd–5th grade teachers, and a smaller sample of observations, that teachers who had high levels of engagement in the induction elements outscored their peers on seven of nine measures of teaching practice (Thompson et al.,

2004). Taken together, these studies suggest that induction has the potential to help teachers learn to teach.

Induction has also been shown to strengthen beginning teachers' feelings of support (Andrews & Quinn, 2005; Burger et al., 2021; Reiman et al., 2010). The hope is that by ensuring beginning teachers feel supported they will be more likely to remain in the profession, thus improving teacher retention (Andrews & Quinn, 2005; Ingersoll & Strong, 2011; Sutchter et al., 2019). Using a 20-item survey with 135 first-year teachers, Andrews and Quinn (2005) found that teachers who had assigned mentors felt more supported than teachers who had no assigned mentors (Andrews & Quinn, 2005). Relatedly, Bickmore and Bickmore (2010) found through interviews with five first- and second-year teachers, that mentors were most frequently mentioned by beginning teachers as supporting their personal needs. Another indicator of support is job satisfaction, which has been linked to a sense of autonomy and principal support (Reiman et al., 2010). Reeves and colleagues (2022) found that online virtual communities were a significant predictor of beginning teacher job satisfaction. Taken together, these studies suggest that teacher induction can have direct impacts on how beginning teachers feel about the support they are receiving and their satisfaction with their teaching job.

Across the literature there is evidence to show that beginning teacher induction supports can improve teacher retention, self-efficacy, sense of growth in teaching practice, and feelings of support. There is some evidence to show that induction can improve student achievement, but these results are mixed and of the positive findings most only occur later in the induction process (i.e. third-year (Glaserman et al., 2010)). This implies that although induction may not lead to immediate improvements in student

achievement, it can help retain teachers in the profession long enough for them to enhance student achievement after gaining a few years of teaching experience. An important note about all these findings is that each induction program studied is unique both in elements and implementation and thus there are nuances to findings that show positive or neutral effects of induction (Pultorak & Lange, 2010). Some of these nuances are directly tied to the limitations of induction programs that are housed in K–12 school buildings.

Limitations of Induction

The literature also suggests some limits to how teacher induction may be able to impact beginning teacher retention, practice, student achievement, and/or feelings of support. Both school culture/climate and mentor/mentee alignment have been identified as critical to effective induction programs (Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; Hammerness & Matsko, 2012; Wang & Odell, 2007; Weschler et al., 2012; Wood & Stanulis, 2010). Bickmore and Bickmore (2010) share, “school climate is foundational to the effectiveness of induction programs, regardless of the components of the process” (p. 1007). This suggests that while research may show certain elements of induction as effective, the climate in which the induction program is happening can directly impact the outcomes of induction. Feiman-Nemser (2010) discusses different types of professional cultures that can exist in schools including veteran-oriented, novice-oriented, and integrated professional cultures. She argues that most schools with integrated professional cultures allow for novice enthusiasm and idealism while also providing veteran expertise, creating continued professional development for everyone (Bickmore & Bickmore, 2010; Feiman-Nemser, 2010; Flores, 2010). However, this type

of culture is rare and too often beginning teachers are thrown into “sink-or-swim” induction (Feiman-Nemser, 2010).

When beginning teachers participate in induction programs situated in schools that do not have a supportive culture, the effectiveness of the induction decreases. In studies of induction programs, which accounted for school culture/climate, the research suggests that beginning teachers in schools with unhealthy school climate felt less supported (Andrews & Quinn, 2005) and had increased teacher attrition (Kelly, 2004; Kutsyuruba et al., 2019). In Weschler and colleagues (2012) study, using a measure of school climate that included instructional leadership, principal support, teaching environment, and availability of materials, they found that an encouraging and supportive climate was correlated with increased retention, efficacy, and self-reports of practice. This was not the case for teachers who worked in less supportive school climates (Weschler et al., 2012), and others found that even when beginning teachers were not assigned mentors, if they were in supportive school climate they still scored higher on a feelings of support scale (Andrews & Quinn, 2005). Andrews and Quinn (2005) hypothesized that teachers who scored lower on the feelings of support scale were in unsupportive school climates, with one teacher sharing she had no support from the administration and “she did not think she mattered as much as the more experienced teachers” (p. 112). This type of climate would be what Feiman-Nemser (2010) calls a veteran-oriented climate, which is not ideal for beginning teachers and can cause additional stress for them. One beginning teacher in Fantilli and MacDougal’s (2009) study named school culture that was at odds with his vision of instruction as contributing to his feelings of isolation and discouragement. Collectively these studies suggest that the

climate and culture of the school in which teacher induction programs are housed can have significant impacts on beginning teachers' experiences and their feelings of support.

The alignment of mentors and mentees can also impact the effectiveness of teacher induction. As mentioned, most induction programs include some form of mentoring for beginning teachers (Feiman-Nemser, 2012; Ingersoll & Strong, 2011; Kutsyruba et al., 2019; Ronfeldt & McQueen, 2017; Wang et al., 2008). The purpose of one-on-one mentoring is to provide novice teachers with support both personally and professionally (Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; Hellsten et al., 2009). In a study done with 12 novice teachers, Hellsten et. al. (2009) found that the level of support that novice teachers felt was dependent on (a) if their mentor was assigned to them, (b) how engaged the mentor was, and (c) if the novice teacher had more than one mentor. Hellsten et. al. (2009) determined that when novice teachers did not feel supported by their assigned mentors they reached out to other teachers in their building for additional support. By seeking out their own mentors the novice teachers felt more supported and had a variety of experiences to help them grow professionally (Hellsten et. al., 2009; Kutsyruba et al., 2019). Hellsten and colleagues (2009) and Andrews and Quinn (2005) both shared that the biggest reason for lack of support by the mentor came from disengagement by the mentor or a mismatch in mentor/mentee assignment. Thus, a match among instructional beliefs of mentor/mentee is critical for effective mentoring (Kutsyruba et al., 2019; Wang & Odell, 2008; Wood & Stanulis, 2010); this match can lead to positive impacts on teacher retention (Owen and Solomon, 2006). However, many beginning teachers experience a lack of alignment either in content area or grade level between them and their mentor (Johnson & Birkeland, 2003; Hellsten et al., 2009), which

can be due to lack of mentors in school buildings or funds to train new mentors (Wood & Stanulis, 2010). Thus, alignment of mentors and mentees in traditional K–12 induction programs is a challenge and can have significant impacts on effectiveness of teacher induction.

The limitations of induction presented here are just a few of the elements that can impact the effectiveness of induction programs. Other limitations include mentor training and preparation (Desimone et al., 2013; Kutsyuruba et al., 2019; Polikoff et al., 2015) and school funding (Feiman-Nemser, 2012; Pultorak & Lange, 2010). These elements alongside school culture and mentor/mentee alignment can be hard for traditional K–12 schools to overcome. Some schools have used state funding to help cover the cost of mentor training as well as substitute teachers (Pultorak & Lange, 2010) but not all states have this funding available. Since these induction programs are housed within the given school culture or context it is hard for beginning teachers to seek support in navigating the school culture/climate. This may present an opportunity for alternative teacher induction programs to address some of these limitations; in this study, I hypothesize that university-based teacher induction programs may serve as such an alternative.

University-Based Teacher Induction

Unlike traditional induction programs which are developed and implemented by teachers and administration in K–12 schools, university-based teacher induction programs are created and housed within a university. In this model, the university partners with local K–12 schools to provide induction supports to the new teachers in the building, with some programs only working with their recent graduates (Hammerness & Matsko, 2012) and others working with any new teacher regardless of university

affiliation (Bastian & Marks, 2017). The goal of these programs is to bridge the gap between preservice teacher education and induction, as well as increase teacher retention and teaching ability (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Maloch et al., 2022; Stanulis et al., 2007). The main components of these university-based teacher induction programs appear to be similar: mentors/coaches, regular professional development sessions, and summer workshops. However, how these elements are implemented, and the content embedded in them, can be vastly different. Initial findings about the effectiveness of these programs have been similar to that of traditional K–12 teacher induction. There are positive correlations between participation in university-based teacher induction programs and teacher retention, teacher evaluations, and student achievement (Bastian & Marks, 2017; Keese et al., 2023). However, little research has been done on these programs. Molach and colleagues (2022) call for additional research to understand what elements of university-based induction programs best support beginning teachers.

School University Partnership

Whereas traditional teacher induction programs are created within the school setting and implemented by school administrators and students, university-based teacher induction programs involve partnering with local school districts (Hunt, 2014). One of the main challenges of these partnerships is navigating tensions that arise when a district's vision for instruction is different from that of the university (Stanulis et al., 2007). Stanulis and colleagues (2007) wrote extensively about this experience with an induction program housed at the University of Michigan. University faculty worked with first-year program graduates, veteran teacher leaders, retired teachers, and administration

to create a vision of what they wanted beginning teachers in the induction program to learn. They then met with 10 induction consultants to create a curriculum that matched their vision (Stanulis et al., 2007). Similarly, the North Carolina New Teacher Support Program [NC NTSP] worked with school districts, university faculty, community stakeholders, Teach for America, and the New Teacher Center to develop a university-based teacher induction program (Zugelder, 2019). One of the main challenges these groups faced was bridging theory and practice, which is a common issue in teacher education (Hunt, 2014; Stanulis et al., 2007). Most teacher education programs are focused on reform-oriented research-based teaching practices, which are often in contrast with today's classrooms that are not significantly different from those decades ago in terms of the type of instruction students are experiencing (Hiebert, 2013). Many teachers continue to utilize more traditional instructional approaches characterized by direct instruction (NCTM, 2014). As beginning teachers navigate these "two worlds" (Feiman-Nemser & Buchmann, 1985) they may feel tension reconciling what they learned with their current school culture.

University-based teacher induction programs have the potential to bridge these "two worlds" because they exist both inside and outside of the school culture. In most university-based induction programs, the design, structure, and content are determined by members of the university, which exists outside of the school, but university-provided mentors visit the teachers within their school setting (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Maloch et al., 2022). This allows the mentor to become familiar with the school culture and help their beginning teachers navigate it. This was a key tenet of the Stanulis and colleagues (2007) induction program framework with the

goal of the program being, “helping novices learn ways to ‘fit in’ to their school culture while continuing to learn to teach” (p. 138). Additionally, these university-based teacher induction programs typically partner with districts to develop some of the content of the professional development (Bastian & Marks, 2017; Zugelder, 2019). Thus, these programs have the potential to address one of the limitations of traditional induction programs by helping novices navigate school culture.

Elements of University-Based Teacher Induction

Mentoring or coaching is one of the only elements of university-based teacher induction that is consistently included across most programs (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Maloch et al., 2022). However, how mentors are assigned, and the work they do can vary drastically between programs. Some programs assign mentors to beginning teachers based on content area, grade level, or specialization (e.g., bilingual education) (Maloch et al., 2022). In other programs, beginning teachers are partnered with mentors based on teaching context, for example, “a coach who taught in a predominantly Latino school is often intentionally paired with teachers working in similar environments” (Hammerness & Matsko, 2012, p. 569). Some programs, such as NC NTSP, did not identify how mentors and beginning teachers were paired except to say that all mentors are trained in “high-leverage pedagogies that transfer across all content areas and levels” (Zugelder, 2019, p. 58). The frequency of mentoring sessions and interactions also vary depending on program with some programs having mentors/mentees meet biweekly (Hammerness & Matsko, 2012) and others meeting as needed (Maloch et al., 2022). Thus, mentoring in these university-based teacher induction

programs can look vastly different depending on the vision of the program, the beginning teacher needs, and goals for teacher learning.

Another common element of university-based teacher induction programs is opportunities for professional development, such as summer institutes or support for communities of novices (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Maloch et al., 2022; Zugelder, 2019). These elements are often designed by the university and can address a variety of topics including content (e.g., mathematics, science, etc.), context (e.g., urban education (Hammerness & Matsko, 2012)), or other topics the beginning teachers have requested (Maloch et al., 2022; Stanulis et al., 2007). In one unique example, graduates from the University of Chicago MAT program participate in a university-based induction program for an additional three years past graduation in the Chicago Public Schools context. During this time, the program focuses on helping beginning teachers navigate a variety of contexts including: an urban school, the local geographical, the socio-cultural, the district, and the children, classroom, school context (Hammerness & Matsko, 2012). The teacher educators working within this program see it as an extension of their teacher education program, which focuses on equity, social justice, and cultural competency (Hammerness & Matsko, 2012). Through coaching, mentors help novices question their surroundings and act as change agents in their schools to ensure they are not “perpetuating low expectations and the pedagogy of poverty” (Hammerness & Matsko, 2012, p. 569). This provides one example of how university-based teacher induction programs may specialize their content.

Effectiveness of University-Based Teacher Induction Programs

Initial findings related to the few studies of university-based teacher induction programs have shown positive correlations between university-based teacher induction and retention as well as some impact on teacher practice (Bastian & Marks, 2017; Zugelder, 2019), which is similar to that of K–12 induction programs. Bastian and Marks (2017) conducted a study of the effectiveness of NC NTSP on teacher retention and performance. In their study they compared the teachers participating in NC NTSP with two control groups to address the small sample size of one (Bastian & Marks, 2017). To study teacher effectiveness they used two measures, value-added scores, and teacher evaluation ratings. Retention was measured by whether teachers (a) stayed at the same school and (b) stayed in the same district. Overall, Bastian and Marks (2017) found no significant differences between NTSP teachers and either of the samples for teacher effectiveness. However, NTSP teachers were significantly more likely to return to the same school as the year prior. The NTSP region with the most instructional coaching had more positive results than others. Overall, this study suggests that university-based teacher induction programs can have positive impacts on teacher retention but the effects on teacher learning (i.e. teacher effectiveness) can vary drastically based on the elements of the program.

While university-based teacher induction programs are relatively new, the initial findings are like that of traditional K–12 induction programs. University-based induction programs can have positive impacts on teacher retention but more limited impacts on teacher practice (Bastian & Marks, 2017; Zugelder, 2019). These programs have the potential to attend more to the needs of beginning teachers as they operate both inside

and outside of the school setting (Maloch et al., 2022). This allows for more flexibility with time and resources (e.g., there is no need for a substitute so the mentor can observe the beginning teacher). This allows for more conversations about the school context as the mentor/coach and program are not part of the school context. These programs typically include mentors/coaches, professional development, and some sort of one-time institute (Bastian & Marks, 2017; Hammerness & Matsko, 2012; Maloch et al., 2022). However, the content of the programs can vary drastically ranging from content (Stanulis et al., 2007), to teacher needs (Bastian & Marks, 2017; Maloch et al., 2022), to context (Hammerness & Matsko, 2012). Yet, all the programs mentioned thus far are for any beginning teacher grades K–12, regardless of content area or grade level taught. This raises the question, do all beginning teachers have the same learning needs?

Experiences of Beginning Mathematics Teachers

Reforms in mathematics education over the past 30 years have encouraged mathematics teachers to use what Munter and colleagues (2015) call “dialogic instruction,” which is characterized by engaging students in rich mathematical tasks (NCTM, 2014) that they work on collaboratively and share their solutions (Boston et al., 2017; Grossman et al., 2005). This type of instruction has been endorsed by major mathematics education organizations including NCTM (1989; 2000; 2014) and AMTE (2017). With a push for dialogic instruction, mathematics teacher preparation programs have focused their instruction on these ideas (Bosica et al., 2021; Sowder, 2007). However, this type of instruction often does not align with what beginning mathematics teachers have experienced in their own schooling, in their field experiences, or in K–12 schools (Green, 2014).

As teachers learn about dialogic instruction in their preservice teacher education, their beliefs about best teaching practices can shift. Prior research has shown that teacher beliefs can directly impact instruction (Boyd & Ash, 2018; Giboney Wall, 2018; Lo, 2021; Raymond, 1997; Vesga-Brazo, 2022). Furthermore, not only do beliefs impact practice; practice also impacts teacher beliefs (Phillip, 2007). Lo (2021) found that PST K–12 school experiences had significant impacts on their beliefs about teaching mathematics. For example, if a PST had more traditional K–12 mathematics experiences (e.g., note taking, individual practice, etc.) they were more likely to believe that was what good mathematics instruction looks like. As PSTs beliefs shift and their vision of instruction becomes more dialogic they can experience tension when they enter the teaching profession, which may still utilize direct instructional practices (Nolan, 2016; Surette, 2020).

This tension can be characterized as a lack of coherence between university preparation and the induction phase of learning to teach (Alles et al., 2019). Alles and colleagues found that 51.6% of the teachers in their study perceived a large gap between their professional preparation at their university and the supports they received in their induction program. Thus, understanding how university-based teacher induction programs interact with these beginning mathematics teachers in their school context may shed some light on how mathematics teachers learn to teach.

The tension faced by beginning math teachers can lead them to gravitate towards more direct teaching approaches, in contrast with the dialogic approach typically promoted at the university (Anagnostopoulos et al., 2007; Lewis, 2014). As beginning mathematics teachers work through these tensions it can cause stress that has direct

impacts on their teaching (Lewis, 2014). For example, Lewis (2014), looked at how six beginning mathematics teachers (i.e., within their first three years of teaching) implemented reform-oriented mathematics instruction. Lewis (2014) noticed that when beginning teachers tried to implement reform-oriented mathematics instruction it caused a lot of stress, stemming from a misalignment of what the teacher wanted/expected the classroom to look like and how the lesson unfolded. Furthermore, Lewis (2014) claimed that the struggles novices had with implementing reform-oriented instruction came partly from a lack of knowledge about content and pedagogy. One key finding from the study was that teachers who struggled the most with implementing reform-oriented instruction had less support in their school as compared to their peers who were more successful (Lewis, 2014). This support came from colleagues who were willing to help the beginning teachers reach their pedagogical goals (Lewis, 2014). However, not all beginning teachers in the study had these types of support, which is a space where induction could help. This aligns with the importance that school culture can play in implementing instruction aligned with reform-oriented practices.

In a related study, Nolan (2016) observed beginning mathematics teachers who were trying to implement reform-oriented instruction in their schools. The two teachers in the study were in schools which they perceived did not support their reform-oriented visions of mathematics instruction. Similarly to Lewis (2014), these two teachers struggled to implement reform-oriented instruction and had to adapt to their school culture to mitigate the tension. Both teachers decided to be secretive about their instruction as to not allow other teachers in the building to know what they were doing. For example, one teacher stated, “I don’t really bring up what I do in my classroom too

much in the staff room.” (p. 322). The other teacher in the study similarly shared, “we didn’t tell anyone what we were doing” (p. 323). This secrecy allowed the two beginning mathematics teachers to teach in more reform-oriented ways, even when their school culture was not supportive of it, but ultimately one of the two teachers left the field of education entirely.

If novice mathematics teachers are introduced to this dialogic vision of instruction (Munter et al., 2015) during their teacher education programs and choose to implement it in their classrooms, they may encounter additional challenges. For these beginning mathematics teachers, the findings suggest that they may be challenged to implement a vision of instruction that differs from their own K–12 experiences and their current colleagues. As the novice teachers navigate this tension they may get stuck between two worlds (Anagnostopoulos et al., 2007), their universities, and K–12 schools. However, with the creation of university-based teacher induction programs, which operate at the intersection of university and K–12 schools, these programs have the potential to help beginning mathematics teachers navigate these two worlds, implement and refine their own visions of mathematics instruction, and find a place in their school culture.

Adding to the Literature

Building on the work of others who have investigated the impact of university-based teacher induction programs (e.g., Bastian & Marks, 2017; Hammerness & Matsko, 2012; & Maloch et al., 2022), I hope to understand the impact university-based teacher induction programs can have on 7-12 mathematics teachers. Furthermore, I hope to build upon the knowledge base from prior work and extend it to more fully understand how university-based teacher induction interacts with school context to support beginning

mathematics teachers' instructional goals. Instead of focusing on the effects of induction which are typically studied (e.g., retention, student achievement, and teacher practice), I want to investigate the beginning mathematics teachers' perceptions of the program within their given school context. As many others have found, school culture and context can play a role in beginning teacher feelings of support (Andrews & Quinn, 2005; Feiman-Nemser, 2010), effectiveness of induction programs (Kelly, 2004; Kutsyruba et al., 2019; Weschler et al., 2012), and teacher practice (Lewis, 2014; Nolan, 2016). I hope to add to this literature by identifying ways that university-based teacher induction programs, a relatively new concept, can work within a given school context to support beginning mathematics teacher development. Furthermore, few studies have focused on the impacts of induction programs on a specific group of teachers, namely mathematics teachers, and I hope to understand how these university-based teacher induction programs support mathematics teacher learning.

Theoretical Framework

Learning to teach is a multi-phase process that extends across a teachers' career, typically including formal opportunities like preservice teacher education, new teacher induction, and professional development as well as informal opportunities such as conversations with colleagues and experiences in the classroom (Feiman-Nemser, 2012). For beginning teachers specifically, induction supports are offered as a form of teacher development bridging the gap between preservice teacher education and inservice teacher professional development (Feiman-Nemser, 2012). Sociocultural perspectives (Goos, 2008; Kelly, 2006) construe teacher learning as happening through social interactions

between new teachers and their colleagues, administration, students, parents, peers, and others (Kelly, 2006). Building from this idea, I utilize Goos' (2008; 2013) zone theory to unpack how school culture and university-based teacher induction programs impact beginning mathematics teachers' development.

Zone theory highlights how beginning teachers' goals for their instruction interact with ideas that are being promoted by their induction program and school as well as any constraints or affordances which may be impeding or promoting valuable beginning teacher experiences. Furthermore, zone theory draws attention to the ways teachers adjust their goals to meet the demands of their environment. In the sections that follow, I expound upon how a sociocultural perspective and the use of zone theory can provide new insights into how university-based teacher induction programs support new teacher learning within their given school context. Through the lens of zone theory, I hope to explain how beginning teachers past and current visions of instruction interact with their environment to shape the learning opportunities which inform the type of educator beginning teachers are and want to become.

Sociocultural Theory of Teacher Learning

John-Steiner and Mahn (1996) state that sociocultural theories are based on the concept that "human activities take place in cultural contexts, are mediated by language and other symbol systems, and can be best understood when investigated in their historical development" (p. 191). This idea is central to understanding the experiences of beginning teachers as they enter the teaching profession. One of the purposes of beginning teacher induction is to help teachers learn about and adapt to their new school culture (Hellsten et al., 2004; Reeves et al., 2022; Surette, 2020). Thus, any study of the

impacts of teacher induction on beginning teacher learning must account for the situatedness of the beginning teacher in their school context.

As noted, Nolan (2016) found that the pressure beginning mathematics teachers felt to align their instruction with that of their more traditional colleagues caused one beginning mathematics teacher to hide her more dialogic instructional practices. One misinterpretation of this study could have been that the teachers were able to implement dialogic instruction in their mathematics classroom. While this may have been the case, the tension created in doing so was too much for the one teacher to handle. Accounting for the situatedness of the teacher in their school context told a clearer story of how school culture impacts teacher action. Lewis (2014) similarly found that beginning teacher pedagogy was influenced by their perception of the type of pedagogy their colleagues expected of them. Again, the situated nature of the teacher in the school needs to be considered as any change in pedagogy was not based solely on the decisions of the teacher but reflective of the impact of the school culture. Both studies show the impact school culture can have on beginning teacher pedagogy, and thus learning. Therefore, it is important to consider the many sociocultural elements of beginning teacher learning as they take on their new teaching positions within school districts.

Zone Theory

Zone theory, created by Valsiner (1997) is one sociocultural theory of teacher learning in which Valsiner built on Vygotsky's (1978) Zone of Proximal Development (ZPD). According to Vygotsky (1978) the Zone of Proximal Development is, "determined through the problems a child cannot solve independently but only with assistance" (p. 87). The main idea is that the ZPD is a space of growth for a child where

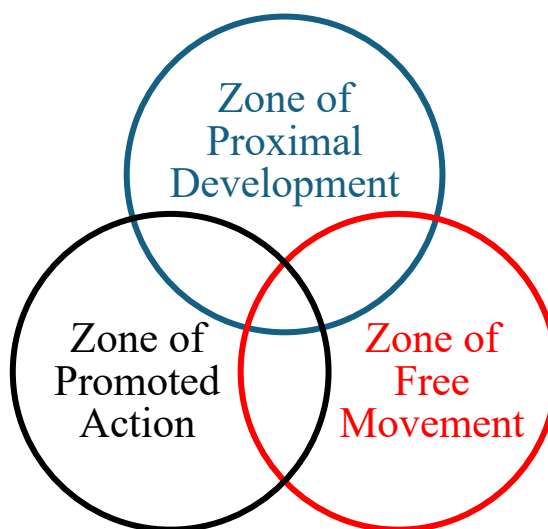
they are completing tasks that are just beyond their ability to complete individually.

Valsiner (1978) extended this idea to include additional zones: the Zone of Free Movement (ZFM) and the Zone of Promoted Action (ZPA). Initially, Valsiner (1997) used zone theory to make sense of children's action but Goos (2008a; 2008b) adapted zone theory to be used with teachers.

This theory allows for the conceptualization of teacher-as-learner (Goos, 2014; Lane & Ríordáin, 2020). Specifically, beginning teachers are learning to teach both within their school context as well as through their university-based teacher induction program. These zones can be in alignment with one another or can be in tension, but they all influence the learning of the teacher. A representation of the three zones can be found in Figure 1. In the next sections I will elaborate on each of the three zones, and how the zones can be in tension or alignment.

Figure 1

Representation of Relationships Between Valsiner's Zones (Goos, 2014, p. 443)



The Zone of Proximal Development

Vygotsky (1978) defines the ZPD to be “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). However, this definition is used with children solving problems. Goos (2013) took this definition and modified it for use with teachers defining ZPD as “a set of possibilities for development that are in the process of becoming realized as individuals negotiate their relationship with the learning environment and the people in it” (p. 523). The key distinction between these definitions is that Vygotsky (1978) was considering how students learn with adult supervision whereas Goos (2013) was thinking of teachers as directors of their own learning. The ZPD includes teachers’ current visions of instruction, content knowledge, and beliefs as well as possibilities for developing new beliefs, knowledge, and vision (Geiger et al., 2017; Goos & Bennison, 2018). Teacher ZPD is influenced by prior experiences as well as their current environment. Additionally, prior teaching experiences can influence teacher ZPD; for example, past experiences with students may impact current beliefs about pedagogical strategies that promote student learning (Goos & Bennison, 2018).

ZPD is a fluid space that is constantly in a state of development as teachers have new experiences (Goos, 2013; Hunter et al., 2020). The ZPD also represents what the teacher can do in the near future, as well as their large-scale goals for their teaching (Goos, 2013). For example, if a teacher wants to facilitate discussions with their students that promote conceptual understanding but do not yet have the pedagogical content knowledge to facilitate the discussion, this would be in their ZPD. Facilitating discussions is part of their beliefs about effective instruction but their content knowledge

is not fully developed in this area of teaching. If the teacher increased their content knowledge, then they would be better able to facilitate discussions, so facilitating discussions effectively is something the teacher can do in the near future.

Prior studies have operationalized ZPD to include teacher's beliefs (about students, content, and teaching), knowledge (content and pedagogy), and teaching skills and experiences (Geiger et al., 2017; Goos & Bennison, 2018; Hunter et al., 2020; Lane & Ríordáin, 2020). These facets of teacher ZPD interact with the environment and influence teacher pedagogy. For example, Goos (2013) worked with a teacher who had teacher-centered beliefs about teaching, which stemmed from his own experiences as a student. His experiences of teacher-centered classrooms, which relied heavily on textbooks, led him to believe this was the best approach for teaching mathematics. When he began his teaching career, his instruction followed this same format. Thus, part of understanding ZPD includes making sense of teacher prior experiences in schools as well as learning about teaching.

The Zone of Free Movement

In expanding Vygotsky's (1978) Zone of Proximal Development, Valsiner (1997) added the Zone of Free Movement (ZFM). The ZFM includes a teacher's perceptions of their access to the environment (Goos, 2008b). Previous research has included perceptions of students, curriculum and assessment requirements, access to resources, support, school environment, and organizational structures as part of the ZFM (Geiger et al., 2017; Goos, 2013; Goos & Bennison, 2018; Hunter et al., 2020; Lane & Ríordáin, 2020). Each of these elements can provide access to, or hinder, what teachers can do in their given environment. Important to note here is that the ZFM is not about what

teachers have access to, but instead their perceptions of their access (Lane & Ríordáin, 2020).

One dimension of ZFM is a teacher's beliefs about their students' capabilities. For example, if students were able to successfully complete a given mathematics task, but their teacher perceived they could not, then doing that task would not be in the teacher's ZFM. While beliefs are part of ZPD and ZFM, beliefs as part of the ZFM are specifically about students. These beliefs associated with ZFM are about the teacher's current environment (e.g., student abilities, student behavior). If a teacher believes their students are capable, or not, of completing a task that will dictate what tasks they implement in their classroom. Thus, their beliefs about the students in their school context are part of their ZFM.

While teacher beliefs (e.g. beliefs about student ability) may impact their ZFM, teacher's perception of their environment is the biggest contributing factor to ZFM. The ZFM suggests to teachers what actions are permitted or possible (Goos, 2014). This includes teachers' perceptions of resources, requirements, and school culture (Goos, 2008; 2013; Goos & Bennison, 2018; Lane & Ríordáin, 2020). For beginning teachers especially, learning about these different elements can take time as they transition into their new school and culture (Hammerness & Matsko, 2012). Additionally, beginning teachers' perceptions of their access to the school environment, such as being told what resources to use, can have negative impacts on their learning by preventing them from trying new instructional strategies (Fantilli & MacDougal, 2009). Changes to teacher ZFM can come from moving environments (Goos & Bennison, 2018) or modifying perceptions about the constraints of the environment, such as their views of their

students' abilities (Goos, 2013). ZFM can have significant impacts on what teachers want to and are able to do in their classrooms and is critical to understanding teacher experiences.

The Zone of Promoted Action

The final zone in Valsiner's (1997) theory is the Zone of Promoted Action (ZPA). The ZPA is composed of the many concepts/ideas/actions that are promoted by colleagues, teacher education, or professional development within the teacher's environment (Goos, 2008a; 2008b; 2013). These promoted actions can include types of instructional strategies, testing requirements, classroom management strategies, and others. ZPA can come from inside the school context as well as outside (Goos, 2013). In the case of ZPA coming from inside the school, promoted actions could come from colleagues who might suggest different instructional approaches (Geiger et al., 2017) or administrators who might offer suggestions for classroom management. ZPA arising from external sources may include additional professional development (Lane & Ríordáin, 2020) or teacher communities (Hunter et al., 2020) and professional organizations.

Like ZPD, ZPA is also affected by prior experiences. Beginning teachers especially, may rely heavily on the actions that were promoted by their pre-service teacher education programs to inform their current instructional decisions (Goos, 2013). Prior studies have included professional development, informal interactions with colleagues, institutional norms, cultural structures and norms, and curriculum as all influencing teacher ZPA (Geiger et al., 2017; Goos, 2013; Goos & Bennison, 2018; Hunter et al., 2020; Lane & Ríordáin, 2020). The ZPA is less about what the environment

is actually promoting and more focused on teacher perception of the promoted actions. ZPA does not always align with teacher ZFM and this can create some tensions. A model of how the three zones interact can be found in Figure 2.

The Interaction of Zones

The ZFM and ZPA are both features of the environment which encourage or inhibit teachers from teaching in ways that align with their ZPD. The interaction between the ZFM and the ZPA is called the ZFM/ZPA complex (Goos, 2013), shown in Figure 3. The ZPA can be a subset of the ZFM, meaning that all promoted actions are within a teachers ZFM (Goos, 2014). For example, Goos (2014) studied a school that both promoted and supported technology integration. However, this is not always the case as sometimes what teachers are being asked to do (ZPA) they perceive as outside of their capacity to execute (ZFM) because they think their students cannot complete the given activity (Goos, 2008b). For example, if a school was promoting teachers to prepare students for state testing, with the goal of all students scoring proficient, but a teacher did not believe their students were able to score proficient then there would be a misalignment of the ZFM and ZPA. The ZFM/ZPA complex has direct impacts on teacher learning within their environment.

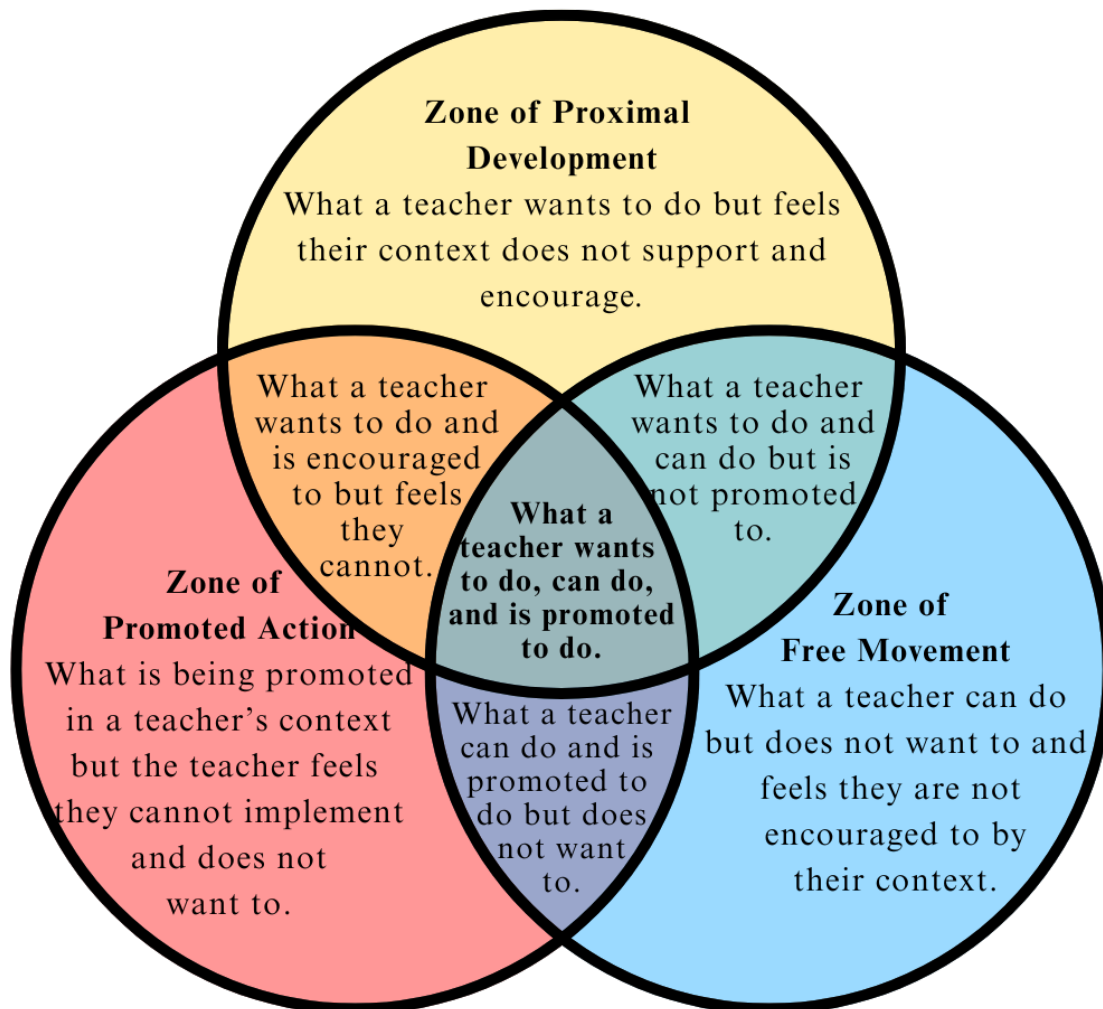
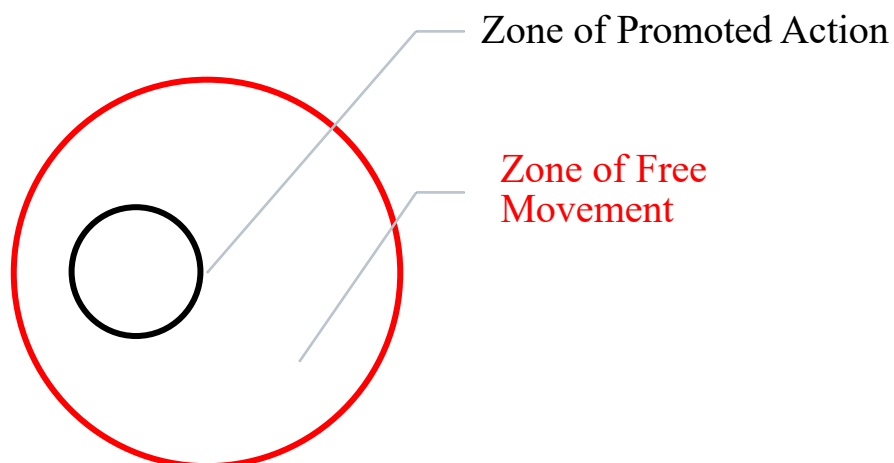
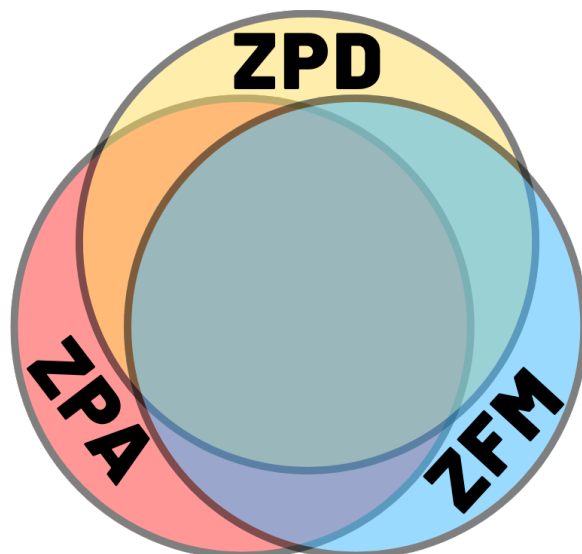
Figure 2*Interaction of ZPD, ZFM, and ZPA.*

Figure 3

Example of ZFM/ZPA complex (Goos, 2014, p. 444)

***Zone Alignment***

When putting the ZFM/ZPA complex in relation with the ZPD there can be two general scenarios: alignment or tension. When teachers experience alignment of the ZFM/ZPA complex with their ZPD they are able to teach in ways which align with their visions of instruction (Figure 4). The alignment of the three zones is represented by the extensive area of overlap of the three circles in Figure 4. The more aligned the zones are the more area teachers have, to enact the type of instruction they want to that is within their ZPD. For example, if a teacher wanted to teach mathematics using technology (ZPD), they taught at a school with other teachers promoting technology integration (ZPA), and technology was available to them (ZFM), then they would be more likely to continue teaching with technology (Goos, 2008a). The alignment between their ZPD and ZFM/ZPA complex allows them to teach using these strategies because they are experiencing low tension.

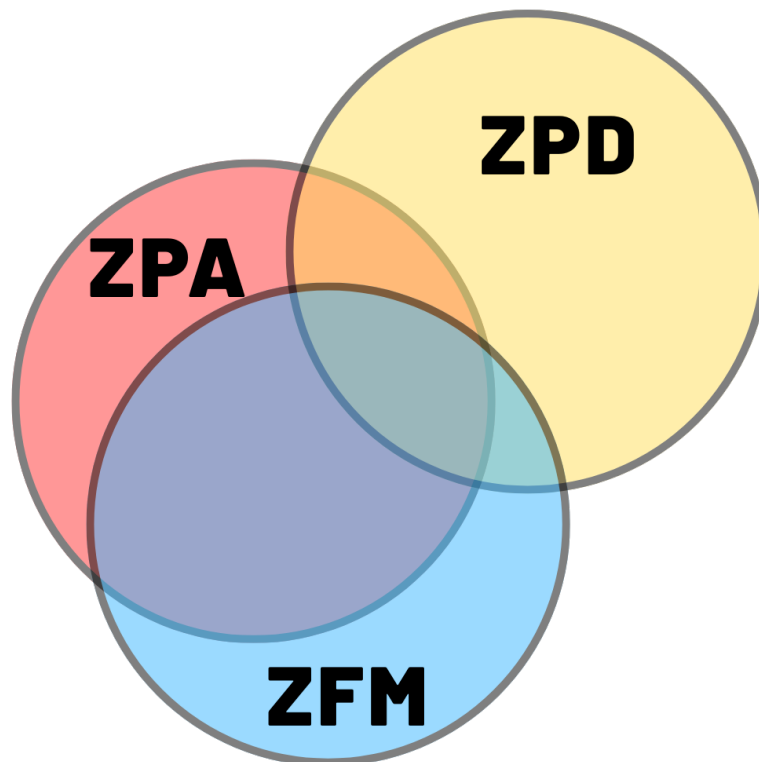
Figure 4*Alignment of Zones****Zone Tension***

However, teachers may also experience misalignment between their ZPD and their ZFM/ZPA complex, which can cause tension. While not all misalignments may be perceived as tension (i.e., a teacher may not care that their teacher team disagrees with them), the literature (Goos, 2008a; 2008b; 2013; Goos and Bennison, 2018) supports the use of the word tension to characterize a lack of alignment between two zones. For example, in a study conducted by Goos and Bennison (2018) with mathematics teacher educators (MTEs), two MTEs wanted to collaborate to plan courses for preservice teachers (ZPD) but this was discouraged by their university (ZFM). An example of zones in tension can be found in Figure 5. In Figure 5, the area of overlap between the three zones is much smaller than that of Figure 4, showing a reduced area for the teacher to implement their preferred instructional strategies. These tensions Goos (2013) refers to as

productive tensions if they result in changes being made to zones to bring them into alignment.

Figure 5

Zones in Tension



Zone Movement

Two ways teachers can bring their zones into alignment are either through (1) adjusting their environment or their perception of the environment (ZFM) or (2) finding alternatives sources of promoted action, such as joining different professional learning communities (ZPA) (Goos, 2013). For example, Lane and Ríordáin (2020) described a teacher who believed in constructivist teaching practices (ZPD) but when planning lessons typically focused on end of course assessments (ZFM). Since the end of course

assessments were required, the teacher felt they had to implement them and thus plan their instruction to align with them. There was a tension between their ZPD and ZFM; to reconcile this the teacher shifted their perceptions of her ZFM to include the use of constructivist practices as a way of preparing students for end of course assessments (Lane and Ríordáin, 2020). If teacher's ZPA is not in alignment with their ZPD they may seek alternative environments that promote ideas which align with their ZPD. These additional environments might include professional development (Goos & Bennison, 2018), course offerings (Goos, 2008b), or others. When teachers bring their zones into alignment it creates an opportunity for growth and learning (Goos, 2013). Identifying how beginning teachers navigate these tensions between their ZPD, their ZFM, and their ZPA (especially as influenced by their university-based teacher induction program) can help the field of mathematics education better understand how and why teachers take up and use ideas promoted in teacher education and induction during these formative years (or not).

Prior Research

Prior studies have used zone theory to explore mathematics teacher educator identity development (Goos & Bennison, 2018), out-of-field teachers (i.e., teachers who were teaching mathematics while having no certification or training to teach math) beliefs and practice (Lane and Ríordáin, 2020), teacher beliefs about students' capabilities (Hunter et al., 2020), teacher technology integration (Goos, 2005; 2008b; 2013), and the impact of environment on teacher practice (Geiger et al., 2017). Across these studies, zone theory has been utilized to study teachers in a variety of settings. Zone theory has been used to study preservice teachers (e.g., Goos, 2008b; 2014), inservice teachers (e.g.,

Geiger et al., 2017; Goos, 2013; Goos & Bennison, 2018; Lane and Ríordáin, 2020), and mathematics teacher educators (Goos & Bennison, 2018). While none of these studies solely examine beginning teachers, Goos (2005) did track one teacher from preservice teacher education into their first few years of teaching, as part of a larger study.

Several research projects have utilized zone theory to study teachers-as-learners (e.g., Goos, 2008a; 2008b; 2013; 2014; Hunter et al., 2020; Lane and Ríordáin, 2020). In these studies, the focus of the analysis is on how the environment impacts teacher development. A common theme across these studies is that not only does the environment come into tension with teacher ZPD, but it can also shape teacher ZPD (Goos, 2008b; Hunter et al., 2020; Lane and Ríordáin, 2020). While most studies have focused on only a handful of teachers and explained their zones in depth, Lane and Ríordáin (2020) alternatively used zone theory to help make sense of the impact of a professional development (PD) on teacher practice. Using reflective writing, Lane and Ríordáin (2020) were able to identify teacher zones and productive tensions that arose because of the PD. For example, when the teachers reflected on the impacts of utilizing student-centered instructional practices it created a productive tension for them because they had to wrestle with the misalignment of their beliefs about using direct transmission (ZPD) and what they saw students were able to do in this new approach (ZPA/ZFM). Across these studies zone theory has been critical in helping researchers to make sense of the way the environment effects teacher learning and instruction.

Aside from the themes being similar, the methods researchers used were also alike. Many of the studies utilized a case study methodology to unpack the zones of one or a few participants (e.g., Geiger et al., 2017; Goos, 2005; 2008b; 2014; Goos &

Bennison, 2018). This case study approach allowed the researchers to understand the zones of each participant more fully as well as identify tensions that arose between zones. Interviewing participants multiple times was another way to make sense of how teachers' zones changed over time (Goos, 2014).

To learn about teacher zones, similar methods were used such as surveys for understanding teacher beliefs, knowledge, and experiences as part of their ZPD (e.g., Goos, 2008a; 2008b; 2013; 2014). For example, Goos (2013) used the Mathematical Beliefs Questionnaire to make sense of how teachers were developing their teacher identities (ZPD). Goos (2014) also created a survey to measure teacher Pedagogical Content Knowledge (PCK) as part of their ZPD. Thus, surveys have mainly been used to help better understand teacher ZPD, but Goos (2014) cautions the use of surveys alone as they do not fully capture all dimensions of the zones. Therefore, interviews were employed to better understand how teachers perceive these zones (e.g., Geiger et al., 2017; Goos, 2008a; 2008b; 2013; 2014; Goos & Bennison, 2017; Hunter et al., 2020). Through interviews Goos and Bennison (2018) explored teacher beliefs, knowledge, contexts, professional learning experiences, and ultimately their plans for the lesson they were about to teach. The interviews allowed the researchers to make sense of the teacher zones and the alignment or tension that existed between them (Goos & Bennison, 2018). This helped them to make sense of the lesson they observed and why the teacher used specific pedagogical moves (Goos & Bennison, 2018). Others have collected observation data (e.g., Geiger et al., 2017; Goos, 2008b; 2013;) or documents (e.g., Goos, 2013; Lane and Ríordáin, 2020) to make sense of the various zones. Observation data has been used to make sense of zone alignment (Geiger et al., 2017; Goos & Bennison, 2018), whereas

document analysis has been used to document teacher changes in ZPD over time (Goos, 2013; Lane and Ríordáin, 2020). These common methods help to paint a clearer picture of differing teacher zones.

In Summary

While the research on traditional induction, and its impacts is vast (e.g., Allen, 2013; Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; Fletcher & Strong, 2009; Ingersoll & Strong, 2011; Keese et al., 2023; Wang et al., 2008), fewer studies have been done on the impacts of university-based teacher induction programs (e.g., Bastian & Marks, 2017; Hammerness & Matsko, 2012; Molach et al., 2022; Stanulis et al., 2007). Furthermore, these studies focus mainly on the impacts of induction on teacher retention and less so on the impacts of these induction programs on beginning teacher learning. Finally, none of these studies consider the interaction of the program and the school context in which the teachers are working in. Goos (2008a; 2008b; 2013) and others (Geiger et al., 2017; Goos & Bennison, 2018; Lane and Ríordáin, 2020) have taken the time to investigate the interaction of teacher knowledge and beliefs (ZPD) and school culture and climate (ZPA/ZFM). Understanding how teachers learn within their context has helped them to understand why teachers do, or do not, implement different promoted practices (Geiger et al., 2017; Goos & Bennison, 2018; Lane and Ríordáin, 2020). Utilizing zone theory as a theoretical framework, allowed me to understand how the promoted actions of university-based teacher induction programs interact with individual teacher goals and school culture.

Thus, I use zone theory to address the following research questions about university-based teacher induction programs operating outside of the given school environment:

1. What are beginning mathematics teachers' perceptions of how university-based teacher induction programs support their development within their school context?
 - a. Within each case, what is the relationship between teachers' perceptions of their Zone of Proximal Development (ZPD), the Zone of Promoted Action (ZPA) of their university-based teacher induction program, and the Zone of Free Movement (ZFM) in their school?
 - b. Across both programs, how does the ZPA of university-based induction programs interact with the existing ZPA of the teacher's school?

CHAPTER 3: METHODS

Utilizing a holistic comparative case study approach, I explored how two university-based teacher induction programs support beginning teacher development within their school context (Yin, 2018). To understand both programs fully, I utilized quantitative and qualitative methods. Using quantitative methods, I identified if there were differences in beginning teacher beliefs (von Oppell & Aldridge, 2021) and self-efficacy (Tschannen-Moran & Hoy, 2001) based on university-based teacher induction program, to better understand the ZPA of each program. The survey also illuminated aspects of teacher ZPD since the elements of the survey include beliefs, content knowledge, education, and years of experience (Goos, 2013). Responses to those questions influenced the questions which were asked in the interviews. The survey results provided me with demographic information about the teachers so I could select who to interview for the qualitative element of my study, which investigated the role university-based teacher induction programs and school context played in supporting beginning teacher development. With respect to my qualitative analysis, I utilized zone theory (Goos, 2008a; 2008b; 2013) as a framework for identifying how university-based teacher induction programs promoted actions which did, or did not, align with teacher ZPD and ZFM (Goos, 2014). Through interviews and survey results, I was able to understand the ways the two contrasting programs impacted beginning mathematics teacher development.

Overview of Cases

I utilized a holistic multi-case study design (Yin, 2018). The two cases for this study were two university-based teacher induction programs, which are referred to as the

Oceanside Teacher Induction Program and the Desert Valley Teacher Induction Program. These two programs were selected because while they offered similar types of supports (i.e., mentors, professional development, communities of support), but the focus of their programs and the selection of teachers they are intended to serve were drastically different. Within each case, quantitative and qualitative data were collected from the beginning teachers in the induction programs. The findings of the study are reported holistically, meaning each teacher in the program is not their own case but instead contribute to the overall study of the case, the induction program. Research question 1a investigated the interaction of teacher zones based on the induction program, while question 1b examined the interaction of the promoted actions of the induction programs with the teachers' schools' promoted actions. This allowed for a comparison of how the two programs supported beginning teacher development in different ways.

Oceanside Teacher Induction Program

The Oceanside Teacher Induction Program is in the Southeast United States and partners with 10 universities to support over 1,000 beginning teachers in over 200 schools. While the program is implemented across multiple universities, it is run and operated out of one university. The program initially only worked with schools who were part of the Race to the Top funding (Bastian & Marks, 2017) but has since evolved to partner with school districts who are already partnering with local universities, have high teacher attrition, or are performing poorly on standardized tests. The goal of the program is to improve student achievement by increasing beginning teacher retention and effectiveness.

Any beginning teacher in a partner school district is allowed to participate in the Oceanside Teacher Induction Program, regardless of how they entered the teaching profession. More than half of the beginning teachers in the program entered the field through alternative pathways (e.g., Grossman & Loeb, 2008), instead of traditional university teacher education programs. The program supports all teachers grades K–12, regardless of content area, who are in their first three years of teaching. As the variety of teachers in the program is so vast the program designers created a curriculum that supported teachers at any grade level in any content area.

The program consists of three main elements to support beginning teachers: a summer conference, individual coaching, and professional development. The summer conference is for beginning teachers before their first year of teaching and lasts three days. The conference is organized in a traditional format, allowing teachers to choose the sessions they want to attend. These sessions cover various topics, including student engagement, classroom culture, instructional rigor, differentiated instruction, lesson planning, and assessment. The purpose of the conference is to provide beginning teachers with strategies they can implement in their classrooms immediately. These sessions are led by the coaches in the Oceanside Teacher Induction Program.

The second element of the program is individualized coaching for all teachers in the program. The coaches are assigned to each beginning teacher, and they focus on planning, instruction, and assessment. The coaches may observe the beginning teacher and give feedback, model teaching, co-teach a lesson, co-plan, resource-share, or provide other supports. The goal of the coaching is to increase teacher effectiveness and ultimately to improve student achievement. Coaches meet with teachers weekly to

discuss their instructional goals. This element of the induction program provides teachers with the most individualized supports. It is important to note that the coaches assigned to the teachers do not necessarily come from the same content knowledge background. This means the beginning mathematics teachers may not have coaches with mathematics teaching experience.

The third element of the induction program is regular professional development (PD). These PD opportunities happen throughout the year, with each school receiving a minimum of three PD sessions, for the teachers enrolled in the Oceanside program. Administrators in the district work with the Oceanside Teacher Induction Program to determine the content of the PD sessions from a list of options given to the administrators. However, if a school wants a specific focus for their PD, not already available in the list of options, the Oceanside Teacher Induction Program will work with the district to create something more tailored to the needs of the school and their beginning teaches.

Each of the elements work together to support beginning teachers in all grades, in all content areas, across the many universities that make up the Oceanside Teacher Induction Program. While this program is available to all teachers in the partner districts, that is not the case for the Desert Valley Teacher Induction Program.

Desert Valley Teacher Induction Program

The Desert Valley Teacher Induction Program is in the Southwest United States and is operated out of one university. The program works with approximately 35 beginning teachers every year who are in their first or second year of mathematics teaching. The teachers can sign-up to join the program and receive a small stipend for

participation. One key distinction between Desert Valley's program and Oceanside, is that Desert Valley only works with middle and secondary mathematics teachers. The program also works with teachers who are teaching mathematics for the first time, even if they have been a teacher for a long time. While all first-year teachers participate in the program, participation in the second year is optional. Therefore, many of the teachers in the program are currently in their first year of teaching middle or secondary mathematics.

According to the director of the program (personal communication, March 10, 2025) the main objectives of the program are:

1. Exploring mathematics topics to gain a deeper understanding and implement engaging activities that enhance their mathematical knowledge.
2. Discussing pedagogy and classroom culture to develop effective teaching strategies.
3. Creating a supportive professional community where teachers can share ideas and support each other.
4. Focusing on critical areas and the Mathematical Practices of the standards to guide lesson design and unit planning.

There is also a focus on helping teachers learn about research based best practices for teaching mathematics. One of those practices, which is highlighted heavily in both coaching and Saturday Sessions is *Building Thinking Classrooms (BTC)* (Liljedhal, 2020). *BTC* focuses on getting students up and moving during class, collaborating with peers, and sharing multiple solution strategies, which is similar to what Munter and colleagues (2015) would call dialogic instruction. One goal of the program is for teachers to become lifelong learners as well as remain in the profession long term.

The program consists of two main elements. The first element is monthly Saturday sessions, which typically last four hours and are on the campus of Desert Valley University. According to the director of Desert Valley (personal communication, March 10, 2025), “These workshops provide a platform for participants to share ideas, materials, and concerns. They also offer opportunities to deepen mathematical knowledge, model effective teaching practices, and foster a sense of collegiality among teachers.” The sessions are run by the instructional coaches who are employed by the university and are former middle and high school mathematics teachers. The content of the sessions are focused on the needs of the beginning teachers and grounded in research based best practices

The second element of the program is instructional coaching. The coaches meet with the beginning teachers multiple times throughout the semester where they help plan lessons, observe the beginning teachers, and collaborate with the teachers to work on classroom management, instructional strategies, motivation, assessment, and more (personal communication, March 10, 2025). The coach also focuses on beginning teacher concerns and tries to implement supports to help address them. There is also some focus on building relationships with students and parents to help the beginning teachers feel connected to their community.

Summary

The two programs demonstrate the range of supports and populations university-based induction programs can attend to. Oceanside provided a program to a large volume of teachers of all grades and content areas, while Desert Valley provided a program that was very specific in that it only worked with middle and secondary mathematics teachers

and was much smaller. These two contrasting cases, see table 1, allowed me to see how the focus of and type of program interacted with beginning teacher zones and how the different types of programs helped beginning teachers develop in different ways.

Table 1

Elements of Two Case Programs

	Oceanside Teacher Induction Program	Desert Valley Teacher Induction Program
Program length	<ul style="list-style-type: none"> • 3 years 	<ul style="list-style-type: none"> • 1 year required • 2nd year optional
Beginning teacher grade and content areas	<ul style="list-style-type: none"> • Any K–12 teacher • Any subject area 	<ul style="list-style-type: none"> • Any middle or high school teacher • Mathematics only
Beginning teacher years of experience	<ul style="list-style-type: none"> • 1-3 years of experience 	<ul style="list-style-type: none"> • 1-2 years of mathematics teaching experience
Program focus	<ul style="list-style-type: none"> • Classroom management • Lesson planning • Assessment • Differentiated instruction 	<ul style="list-style-type: none"> • Mathematics content • Mathematics pedagogy • Instructional practices
Program Elements	<ul style="list-style-type: none"> • Summer institute • instructional coaching • professional development 	<ul style="list-style-type: none"> • Monthly Saturday sessions • instructional coaching

Participants

Within each site I recruited beginning teachers into my study at two levels. The first was for my survey and the second was for my interviews. The teachers recruited for my study were all beginning teachers within their first three years of teaching, who were enrolled in either program. While the Desert Valley Teacher Induction Program does include teachers who are new to teaching mathematics but have teaching experience, I did not recruit them into my study for interviews because they were not new to the field

of teaching. The Desert Valley Teacher Induction program had approximately 35 beginning mathematics teachers whereas the Oceanside Teacher Induction Program had about 300 beginning mathematics teachers. To initially contact teachers to participate in the survey I asked the director of each induction program to send out an email to all the induction program teachers. Each director sent out two additional follow-up emails encouraging the teachers to participate in the survey. After a four-week waiting period, a total of 15 beginning teachers from Desert Valley had completed the survey and 14 from Oceanside had completed the survey, see table 2.

Table 2

Demographic Characteristics of Survey Participants (N=29)

Characteristic	Category	Desert Valley		Oceanside	
		N	Percent	N	Percent
Gender	Male	6	40	6	43
	Female	9	60	8	57
Race/Ethnicity	White	8	53	5	36
	Black or African American	0	0	6	43
	Hispanic or Latino	2	13	2	14
	Asian/Pacific Islander	1	7	1	7
	Multiple Ethnicity	4	27	0	0
Teaching Experience	1-2 years	9	60	7	50
	3-4 years	2	13	3	22
	5+ years	4	27	4	28
Teaching Certification	Traditional Certification	9	67	6	43
	Alternative Certification	6	33	8	57

When completing the survey, teachers were asked if they were willing to participate in a follow-up survey. Only one teacher from Oceanside did not consent to a follow-up interview. I emailed every teacher who had four or less years of experience and had consented to be contacted for an interview to ask them to participate in an interview

(N=20). If teachers did not respond after two weeks, I sent another email and again after two more weeks. A total of four teachers from Oceanside were interviewed, see table 3, and eight from Desert Valley, see table 4.

Table 3

Demographic Characteristics of Oceanside Interview Participants (N=4)

Pseudonym	Gender	Race/Ethnicity	Years Teaching	Teaching Certification	Current Grade Level
Isabel	Female	White	1	Alternative	8 th , 9 th
Jackie	Female	White	1	Alternative	6 th
Kenzie	Female	White	3	Traditional	9 th –12 th
Luis	Male	Hispanic	1	Alternative	9 th

NOTE: Traditional teacher certification meant that the teacher enrolled in and completed an undergraduate or master's level teacher education program that led to licensure. Alternative certification was any teacher who entered the teaching profession in a different way.

Table 4

Demographic Characteristics of Desert Valley Interview Participants (N=8)

Pseudonym	Gender	Race/Ethnicity	Years Teaching	Teaching Certification	Current Grade Level
Ana	Female	Multiple Ethnicity	1	Alternative	9 th , 10 th
Bonnie	Female	Hispanic	3	Alternative	6 th , 8 th
Charlie	Male	Multiple Ethnicity	1	Traditional	9 th
Danielle	Female	White	2	Alternative	7 th , 8 th
Eric	Male	White	2	Alternative	9 th , 10 th
Flora	Female	Hispanic	1	Traditional	10 th –12 th
Grace	Female	White	1	Traditional	7 th , 8 th , 9 th
Hannah	Female	White	4	Traditional	6 th

NOTE: Traditional teacher certification meant that the teacher enrolled in and completed an undergraduate or master's level teacher education program that led to licensure. Alternative certification was any teacher who entered the teaching profession in a different way.

Data Collection

I first administered a survey to the teachers in both programs to get a sense of their ZPDs (Goos, 2013) and identify potential interviewees. Then I conducted 60-90

minute interviews to make sense of how university-based teacher induction programs supported teacher development in alignment with their ZPD. A convenience sample was utilized as teachers were not required to complete the survey and thus any of the beginning teachers from either program could make up the sample. All teachers who had four or less years of teaching experience and consented to be interviewed were invited to an interview.

Survey

In the Spring of 2024, I sent out a survey to all teachers in both programs. The survey (see Appendix A) consisted of three parts: (1) teacher demographic information, (2) teacher beliefs (von Oppell & Aldridge, 2021), and (3) teacher efficacy (Tschannen-Moran & Hoy, 2001). The purpose of the survey was to understand teacher ZPD and the ways in which the induction program may have impacted teachers' sense of efficacy. Furthermore, the survey results influenced the questions teachers were asked during the interviews.

Demographics

The first part of the survey asked teachers questions about their race/ethnicity, teaching experience, teacher education program, certification, school, and induction program. These items set the stage for beginning to understand teacher ZPD. As a reminder, ZPD is the “possibilities for developing new teacher knowledge, beliefs, goals, practices” (Goos & Bennison, 2018, p. 408). ZPD is shaped by past teaching experiences and spaces where teachers learned about teaching (i.e., teacher education programs). This background information allowed me to begin to understand teacher past experiences, which ultimately informed their ZPD and goals for instruction.

Teacher Beliefs

The second part of the survey focused on teacher beliefs. Goos (2013) used a Mathematical Beliefs Questionnaire that was 40 Likert-scale items to get a sense of teacher beliefs as part of their ZPD. The beliefs survey focused on whether teachers saw mathematics as transmissive or student-centered (Goos, 2013), or what Munter and colleagues (2015) termed as direct versus dialogic instruction. However, the original survey utilized by Goos (2013) was unavailable.

To capture teacher beliefs, in a way similar to Goos (2013), I used von Oppell and Aldridge's (2021) beliefs survey, which was designed to understand if teachers had traditional or constructivist beliefs, which again are similar to dialogic and direct instruction. For example, one of the items in Goos' (2013) questionnaire was "There are often many different ways to solve a mathematics problem" (p. 525). A similar item on my survey is, "In my lessons students collaborate to decide how a task should be approached" (Appendix A). This item is similar because both imply that there are multiple solution strategies to a given mathematics problem, which can be approached in a variety of ways.

The beliefs section of the survey (von Oppell & Aldridge's, 2021) is composed of 25 Likert-scale items ranging from almost never (1) to almost always (5). Teachers were asked to report their actual practice and preferred practice with this direction, "The 'Actual' column is to be used to describe how often you use the stated practice. The 'Preferred' column is to be used to describe how often you would like this practice to take place (a wish list)." While the original survey was composed of six factors, in their own validation study von Oppell and Aldridge eliminated the assessment factor. The

instrument was validated with 182 Arabic teachers and their results supported criterion-related validity. Internal consistency results suggested moderate levels of reliability for the factors with Cronbach's alpha levels ranging from .71 to .83. Discriminant validity showed that the correlation between the subscales was below the generally accepted criteria of less than .8 (Rönkkö & Cho, 2022). Furthermore, a principal axis factor analysis was conducted and only items that had a factor loading of greater than .40 on their given subscale and less than .40 on a different subscale were included in the final survey. These findings suggest that the survey is an acceptable measure of teacher beliefs.

Within the beliefs portion of the survey von Oppell and Aldridge (2021) asked teachers how frequently they implemented a practice in comparison to how frequently they would prefer to implement that practice. The benefit is that asking teachers about their preferred practice begins to unpack their ZPD. Whereas, asking about their preferred and implemented practice highlights any potential misalignment between their ZPD and their ZFM/ZPA. For example, if a teacher said they almost never let students "collaborate to decide how a task should be approached" but they would prefer to do it almost always, this can tell me two things. One, it could convey there is a misalignment between ZPD and ZFM/ZPA; maybe they do not think their students are capable of collaborating (ZFM) or they are not encouraged to have students work collaboratively (ZPA). Second, it could convey that while this belief is part of the teachers ZPD they do not yet have the skills necessary to execute this type of collaborative environment. For instance, they might not have a high sense of self-efficacy for instructional strategies for student collaboration. This section of the survey helped me comprehend teacher ZPD in the

context of their beliefs, elucidating how these beliefs shaped their actual practice and pinpointing areas where teachers can develop new practices or knowledge. (Goos, 2013).

Teacher Self Efficacy

The third section of the survey was about teacher self-efficacy and utilized the Teacher Self-Efficacy Scale (TSES) from Tschannen-Moran and Hoy (2001). To grasp the concept of teacher ZPD I needed to understand what the developmental areas for knowledge, beliefs, goals, and practice (Goos, 2013) were for beginning teachers. One way to measure this was through teacher self-efficacy as self-efficacy is “a teacher’s judgement of his or her capabilities” (Tschannen-Moran & Hoy, 2001). This judgement of their ability reflected their own knowledge of teaching and content, as well as their current practice. Essentially, understanding teacher self-efficacy allowed me to understand what parts of their ZPD they felt confident about, and thus could enact in their practice (high efficacy), as well as what areas were in the part of their ZPD where they were still developing (low efficacy).

The efficacy section of the survey (Tschannen-Moran & Hoy, 2001) was composed of 12 Likert-scale items ranging from nothing (1) to a great deal (9). Teachers were asked how much control they had over the given statement. The Teacher Self Efficacy Scale (TSES) is composed of three factors, efficacy for instructional strategies, student engagement, and classroom management. Tschannen-Moran & Hoy (2001) stated, “the three dimensions of efficacy for instructional strategies, student engagement, and classroom management represent the richness of teachers’ work lives and the requirements of good teaching” (p. 801).

Tschannen-Moran and Hoy (2001) created and validated the TSES, using a sample of 410 inservice and preservice teachers. The researchers considered both their long-form (24-items) and short-form (12-items). For this study, I used the short form version of the instrument. This instrument consisted of three, four-item factors, instructional strategies, classroom management, and student engagement. Factor loadings for each item ranged from .61 to .83 (Tschannen-Moran & Hoy, 2001). Cronbach's alpha levels for each factor in the short-form ranged from .81 to .86, with the alpha level for the overall scale being $\alpha = .90$ (Tschannen-Moran & Hoy, 2001). Additional researchers have used this scale and found similar findings (e.g., Klassen et al., 2009; Wolters & Daugherty, 2007).

Mathematics Content Knowledge

One additional set of questions was added to the survey. Goos (2008a; 2013; 2014) identified both mathematical knowledge and pedagogical content knowledge as part of teacher ZPD. As zone theory (Goos, 2013) attends to teachers' perceptions of teacher environment, it followed they would report their perceptions of their mathematical understanding. Additionally, if beginning teachers thought they had strong content knowledge it would make sense that they would not actively seek support for developing this element of their ZPD. Thus, as a measure of teacher mathematics content knowledge I had them report their self-efficacy for mathematics content, as opposed to a mathematics assessment. Furthermore, the teachers taught in a range of grades from 6th to 12th grade so having one assessment that would measure their content knowledge across all those grades would be long and tedious for the teachers. This would be a lot of work

to make sense of only a small portion of teacher ZPD, which could much more easily be identified using a self-efficacy scale.

To measure beginning teacher content knowledge, I created a short eight item scale, using Bandura's (2006) *Guide for Constructing Self-Efficacy Scales* to ask teachers about their sense of self-efficacy for mathematics content they may teach. The item asked teachers, "please rate how confident you are in your ability to solve mathematics problems in the given mathematics domain. With 0 being you cannot solve any mathematics problems in that domain and 100 being you are highly confident that you could solve all problems in that domain." To select the domains, I referenced the domains from the Common Core State Standards (Common Core State Standards Initiative [CCSSI], 2010), which were Number and Quantity, Algebra, Functions, Geometry, Probability and Statistics, and Modeling. I also asked teachers about Trigonometry and Calculus as those domains are not part of the Common Core State Standards but are part of the high school curriculum.

Pilot

In preparing for using this survey, which is a combination of von Oppel and Aldridge's (2021) beliefs survey and Tschannen-Moran and Hoy's (2001) Teacher Self-Efficacy Scale I decided to pilot my survey with inservice teachers from across the country. My pilot sample consisted of 43 teachers ranging from 1 to 41 years of teaching with the average number of years being 12.50. The content areas of the teachers in my pilot study can be found in table 5. While this is not a perfect match for my sample of teachers in my study, this pilot does help me to check the factors in my survey with a similar population of teachers.

When examining the psychometric properties of the beliefs portion of the survey I chose to eliminate the physical environment factor as it was not part of teacher ZPD. Physical environment may be considered part of teacher ZFM as their classroom environment might allow for, or constrain, certain classroom practices; however, von Oppell and Aldridge (2021) focus mainly on ways student work gets displayed within the physical environment, which was not aligned with zone theory as closely. The four factors that were included in the beliefs section of the survey were role of the teacher, teacher's philosophy of learning, pedagogy – choice of delivery, and collaboration. A description of each can be found in table 6.

Table 5

Number of Teachers Per Content Area

Content Area	Frequency
Mathematics	16
Science	5
ELA	5
Social Studies	3
Elementary	7
Special Education	2
Other	5

Table 6

Description and Sample Item for Each Beliefs Survey Factor (von Oppell & Aldridge, 2021, pg. 148)

Factor	No of Items	Description	Sample Item
Role of the Teacher	6	To assess the beliefs teachers have of the expectations of them in their classrooms.	As the teacher it is my role to deliver factual information to students.
Teacher's philosophy of learning	6	To assess the teachers' philosophy as to what constitutes learning and how students acquire knowledge.	Students learn best when they all complete the same worksheet.

Pedagogy – choice of delivery	6	To assess teacher beliefs of delivery of teaching and learning in the classroom.	My lessons involve students working on different activities at the same time.
Collaboration	7	To assess the extent to which teachers believe collaborative activities constitute learning or whether learning is an individual activity only.	In my lessons students collaborate to decide how a task should be approached

Following von Oppell & Aldridge’s (2021) four factor structure a confirmatory factor analysis was conducted to check the level of fit of the factors, using the pilot data. R statistical software was used to check the fit indices using the Lavaan package. Results for both the preferred beliefs and actual beliefs measure can be found in table 7.

Table 7

Confirmatory Factor Analysis Results Pilot Study: Beliefs Survey

Fit Index	Actual Beliefs	Preferred Beliefs	Cited Benchmark
Chi-Square	424.172*	485.405*	NA
Standardized Root Mean Square Residual	.133	.128	<.08
Comparative Fit Index	.570	.632	>.95
Tucker-Lewis Index	.520	.589	>.95
Root Mean Square Error of Approximation	.114	.135	<.06

NOTE: n=43. Benchmarks are cited by Wood et al., (2008), NA = no benchmark cited, * p<.01

These fit indices indicate imperfect fit. While both the CFI and TLI are on a continuum from 0 to 1, with 1 indicating perfect fit both the actual and preferred beliefs show room for improvement of model fit. To explore the data further I conducted an exploratory factor analysis for the preferred beliefs, using R statistical software. Eigen values and a Scree plot indicated a two-factor structure. However, I ran the EFA with the four factors, as indicated by von Oppell and Aldridge (2021) with a varimax rotation.

When looking at the factor loadings it became apparent that the Pedagogy factor was loading on to the same factor as Collaboration. I ran the model again, after eliminating the Pedagogy factor and Eigen values indicated a three-factor structure that had strong (>.7) factor loadings on most items and in which the items aligned in the correct factors.

I also examined the reliability of the beliefs section of my survey for each factor, using the Psych package in R. Results can be found in table 8. The Cronbach's alpha for the entire 25 item instrument was .85(95%CI = [.78,.91]). Again, there is evidence that the pedagogy factor may need to be eliminated.

Table 8

Reliability for Beliefs Portion of the Pilot Survey

Factor	No of Items	Cronbach's alpha	95% Confidence Interval
Role of the Teacher	6	$\alpha = .73$	[.59, .85]
Teacher's philosophy of learning	6	$\alpha = .81$	[.71, .89]
Pedagogy – choice of delivery	6	$\alpha = .4$	[.14, .66]
Collaboration	7	$\alpha = .90$	[.85, .94]

NOTE: n=43.

When examining the psychometric properties of the efficacy portion of my survey I recognize that the three dimensions of self-efficacy (e.g., student engagement, instructional practice, and classroom management) did not cover every aspect of teaching (e.g., communication with parents, equity, etc.). However, they do cover a large portion of teacher practice during instruction and serve as a place where university-based teacher

induction programs could potentially support beginning teachers. Sample items from each factor can be found in table 9.

Following Tschannen-Moran & Hoy's (2001) three factor structure a confirmatory factor analysis was conducted to check the level of fit of the factors, using the pilot data. R statistical software was used to check the fit indices using the Lavaan package. Results for both the preferred beliefs and actual beliefs measure can be found in table 10.

Table 9

Sample Item for Each Efficacy Survey Factor (Tschannen-Moran & Hoy, 2001)

Factor	No of Items	Sample Item
Classroom Management	4	How much can you do to control disruptive behavior in the classroom?
Instructional Strategies	4	How well can you implement alternative strategies in your classroom?
Student Engagement	4	How much can you do to motivate students who show low interest in schoolwork?

Table 10

Confirmatory Factor Analysis Results: Efficacy Scale

Fit Index	Preferred Beliefs	Cited Benchmark
Chi-Square	96.528*	NA
Standardized Root Mean Square Residual	.084	<.08
Comparative Fit Index	.848	>.95
Tucker-Lewis Index	.803	>.95
Root Mean Square Error of Approximation	.142	<.06

NOTE: n=43. Benchmarks are cited by Wood et al., (2008), NA = no benchmark cited, * p<.01

While none of the values are within the cited benchmark for good fit, most values, aside from RMSEA, are near the conservative benchmarks. This indicates relatively good fit with the model. Furthermore, Tschannen-Moran & Hoy's (2001) original study was

done with preservice teachers, who will be more similar to beginning teachers than my pilot sample which contains more veteran teachers. That being said, as efficacy is my main outcome variable for analysis this CFA demonstrates adequate fit and was appropriate to use for this study.

I also examined the reliability of the self-efficacy section of the survey for each factor, using the Psych package in R. Results can be found in table 11. The Cronbach's alpha for the entire 12 item instrument was .90(95%CI = [.85, .94]). These alpha levels provide evidence to support reliability of the self-efficacy portion of the survey.

Table 11

Reliability for Self-Efficacy Portion of Pilot Survey

Factor	No of Items	Cronbach's alpha	95% Confidence Interval
Classroom Management	4	$\alpha = .73$	[.59, .85]
Instructional Strategies	4	$\alpha = .66$	[.47, .80]
Student Engagement	4	$\alpha = .88$	[.82, .93]

No analysis was conducted on the mathematics content knowledge scale as the sample of mathematics teachers (n=16) within the pilot study was too small.

Actual Sample

While the sample size of the data from this study (N = 29) was too small, less than thirty per group, to warrant a CFA for the belief or self-efficacy items, the analysis from the pilot study suggests that the instrument was appropriate to use with beginning teachers. However, reliability for both the teacher beliefs and self-efficacy scale was checked and is reported in table 12.

Table 12*Reliability for Beliefs and Self-Efficacy Portion of the Dissertation Survey*

	Factor	No of Items	Cronbach's alpha	95% Confidence Interval
Teacher Beliefs	Role of the Teacher	5	$\alpha = .69$	[.46, .84]
	Teacher's philosophy of learning	6	$\alpha = .77$	[.61, .88]
	Pedagogy – choice of delivery	6	$\alpha = .63$	[.37, .80]
	Collaboration	7	$\alpha = .85$	[.75, .92]
Teacher Self-Efficacy	Classroom Management	4	$\alpha = .93$	[.87, .96]
	Instructional Strategies	4	$\alpha = .72$	[.51, .86]
	Student Engagement	4	$\alpha = .65$	[.39, .82]
Mathematics Content Knowledge	N/A	8	$\alpha = .88$	[.81, .94]

Interview

I interviewed beginning teachers from both programs in the summer of 2024. Any teacher who had four or less years of teaching experience was contacted to participate in an interview. My semi-structured interview protocol (see Appendix B) focused on the four dimensions of self-efficacy from the survey: classroom management, student engagement, instructional strategies, and mathematics content knowledge. Within each dimension of self-efficacy, I asked teachers questions to illuminate each of their zones by asking questions about what they could and could not do in their classroom (ZFM), what

they wanted to do in their classroom (ZPD), and what others were encouraging them to do (ZPA).

Before meeting with each teacher for their interview I examined their survey results. Specifically, I tried to identify any misalignment between their preferred and actual practices. This pointed me to potential tension between their ZFM/ZPA and ZPD. For example, for one of the teachers they stated their actual practice for the statement, “In my lessons students work collaboratively on tasks” they marked *seldom* but for their preferred practice they marked *almost always*. This indicated to me that there was a potential tension for the teacher on this belief so I asked during the interview, “In the survey, you stated you wanted students to have more collaboration opportunities, can you tell me more about that?” This question allowed me to understand if the teacher was feeling tension between their ZPD, ZFM, and/or ZPA. Additionally, it helped me to identify why the teacher’s preferred practice was not being enacted as they had envisioned. I also examined their self-efficacy as a place where they had room in their ZPD for growth or needed support. I then added questions to my interview to ask teachers about the identified dimensions. For example, I asked a teacher, “In the survey you mentioned that you wanted your induction program to focus more on classroom management, what are you hoping they could teach you about classroom management?” I utilized the interviews to get a sense of how beginning teacher zones were interacting. Furthermore, I asked questions to understand the role that their university-based teacher induction program was playing in their development.

Data Analysis

Data analysis was conducted in two rounds. First, qualitative analysis of the interviews, which was done in two iterations: within-case analysis and cross-case analysis (Merriam & Tisdell, 2016; Miles, Huberman, & Saldaña, 2014). Utilizing zone theory as my framework, I analyzed the interview data using inductive and deductive codes (Saldaña, 2021). I coded each program separately and then found themes within each program. Finally, I looked across the two cases to identify themes that transcended the two programs. In my second round of analysis, I used R Statistical Software with a threshold of significance of .05 to analyze the survey data. As the final sample size for each program was less than 15 participants, I employed a non-parametric analysis to compare differences between the two programs. The main method for analysis was a Mann Whitney U test (Kloke, 2015). Further explanation of each round of data analysis can be found in the following sections. Additionally, the alignment of the research questions, data collection, and data analysis can be found in Table 13. As a reminder, the overarching research question is: What are beginning mathematics teachers' perceptions of how university-based teacher induction support their development within their school context?

Qualitative Analysis

Within-Case Analysis

Preliminary analysis. Teachers were interviewed for 60-90 minutes on zoom. While interviewing the teachers, I took notes about the teacher's responses to each of the interview questions. I made sure to identify any responses that related directly to the research questions. For example, on one teacher's interview notes I wrote, "assistant

principal is interested in *BTC* à alignment with ZPA.” Points such as this were scattered across all of the interview notes. These highlighted points allowed me to easily identify where the teacher had mentioned in their interview any tensions or alignments.

Table 13

Alignment of Research Questions, Data Collection, and Data Analysis

Research Question	Data Collection	Data Analysis
a. Within each case, what is the relationship between teacher’s perceptions of the Zone of Promoted Action (ZPA) of their university-based teacher induction program, their Zone of Proximal Development (ZPD), and their Zone of Free Movement (ZFM)?	<ul style="list-style-type: none"> ▪ Survey about beliefs & self-efficacy <ul style="list-style-type: none"> ▪ Identify ZPA of induction as influencing teacher beliefs and self-efficacy. ▪ Identify potential teacher zone tensions to ask during interview. ▪ Interview <ul style="list-style-type: none"> ▪ Ask about dimensions of teacher zones including classroom management, student engagement, and instructional strategies. ▪ Ask about impact of induction program. 	<ul style="list-style-type: none"> ▪ Wilcoxon Sign-Rank test to compare beliefs and efficacy of one program to the other as representative of induction program ZPA. ▪ Qualitative coding utilizing inductive codes from zone theory and deductive codes to make sense of the interaction of teacher zones within each program.
b. Across both programs, how does the ZPA of university-based induction programs interact with the existing ZPA of the teacher’s school?	<ul style="list-style-type: none"> ▪ Survey about beliefs & self-efficacy <ul style="list-style-type: none"> ▪ Identify potential teacher induction ZPA and school ZPA tensions. ▪ Interview <ul style="list-style-type: none"> ▪ Ask teachers about the promoted actions of their induction program and how they implement, or not, those actions. ▪ Ask teachers about the rules and promoted actions of their school district. 	<ul style="list-style-type: none"> ▪ Compare preferred and actual beliefs responses on survey and develop additional interview questions ▪ Qualitative coding utilizing inductive codes from zone theory and deductive codes to make sense of the interaction of induction and school ZPA.

After each interview, within 24-hours, I recorded an analytic memo (Saldaña, 2021). I made an audio recording of my initial thoughts about the interview. In the memo I began to identify the ways in which the teacher’s induction program was aligned, or not,

with their other zones. For example, in an interview with one Desert Valley teacher I wrote, “She states that if it had not been for her induction program she would not have been able to teach in ways which she took up. She stated that she mostly would have relied on more traditional instructional approaches.” I also discussed my initial perceptions of the teacher’s three zones, paying close attention to the teacher’s ZPD given their description of their content knowledge, teacher education, and teaching experiences. For example, I wrote about one Oceanside teacher who was feeling some tension:

She feels like there is alignment, but also, she does not. She talks about how she came in and she wanted to do more traditional instruction, but the school was strongly suggesting that she use interactive notebooks. At first, she did not want to do that, but then her mentor teacher started using them. Then she started using the interactive notebooks and I think it started to align with her ZFM because the students were more organized, and she could do more things in her classroom.

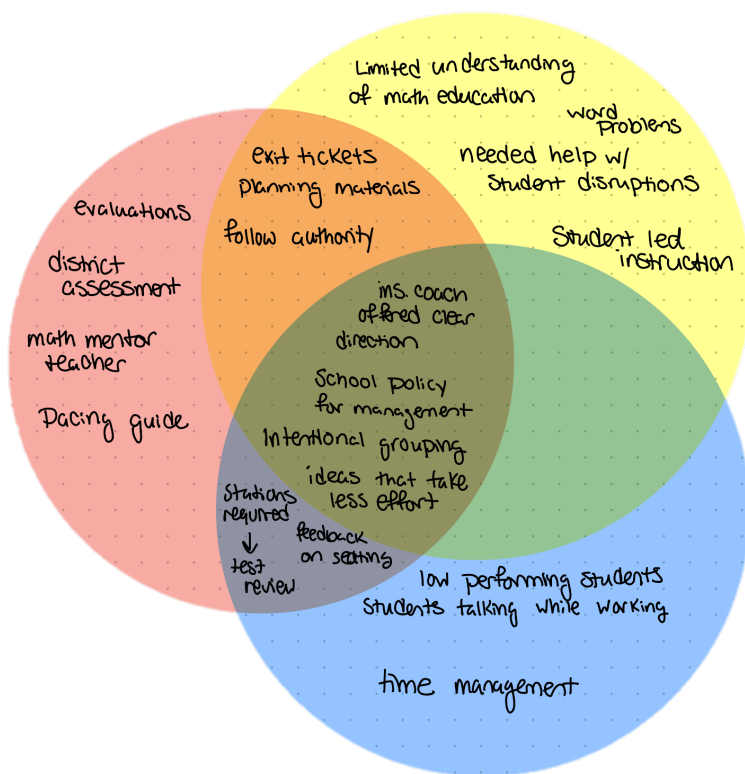
There was also a consideration of how the teacher’s perceptions of the ZPA of their induction program helped to build a picture of what the program was focused on promoting. For example, in one memo of a Desert Valley teacher I wrote, “There seems to be theme throughout the Desert Valley teachers that what they have learned about classroom management was related to their instruction. If I have good instruction, then my classroom will be managed, and my students will be engaged.” I ended each memo by describing how I pictured their zones as in alignment or tension.

After completing each analytic memo, I transcribed my audio recordings of the memo so that I could use them in my analysis. Drawing on the memos I had created after

each interview, I made a drawing of my perception of each of the teacher's zones and how they were aligned, or not. Within each drawing I included information from my notes from the interview and my analytic memos, see an example in figure 6. These were preliminary renderings and were further refined after a more thorough analysis of the interview data was complete. The drawings of the zones played a large part in identifying potential themes in the data as they visually represented tension, or alignment, the teachers were experiencing.

Figure 6

Initial Rendering of a Teacher's Zones



Interview coding. Before conducting any analysis, I transcribed each of my interviews. To code my interview data, I utilized the MAXQDA-22 software (VERBI Software, 2021). I initially started with a set of codes that were derived from my

theoretical framework (Goos, 2008a; 2013). The initial codes with an example of an interview segment that would be assigned the given code can be found in table 14. The original codes were created based on each of the zones of zone theory, the tensions and alignments of the zones, potential movement in the zones, and the role the school and induction program were playing in the teacher's development. Movement was coded because in prior research Goos (2013) had accounted for past, present, and future versions of the three zones for teachers. As I was only interviewing teachers at one point in time I added the code for movement to represent if a teacher said they had done something in the past but changed over time.

As I began coding, I relied on my initial coding framework. For example, if a teacher wanted to implement an exit ticket at the end of each lesson because they thought it was important for students to demonstrate their understanding of the lesson material, that was coded as *ZPD* because it highlights their vision of instruction as well as their goals for their classroom practice. If they mentioned that they wanted to try the new strategy because it was a new school policy that would be coded as *ZPA/ZFM*, as it provided evidence that the school was promoting them to implement the strategy (*ZPA*) but also it may be required (*ZFM*). Additionally, since the teacher already wanted to implement this strategy, and the school was promoting them to do it then it was coded as a *ZPA/ZPD alignment*.

Aside from coding for the different zones I also needed to identify if the promoted action was coming from the school or the induction program, to help answer research question 1b. If the teacher mentioned their school, or any member of their school district (e.g., principal, colleague, mentor) it was coded as *school*. If they mentioned their

induction program, or any aspect of the program (e.g., coach, professional development, peer), it was coded as *induction*. Going back to the previous example, this would also be coded as school because the promoted action was coming from the school. While these codes covered the big categories to make sense of the data and answer the research questions, I also created additional subcodes that were derived from the data (Yin, 2018). As I read through each interview transcript, I looked for dimensions of the codes listed in table 14 that were common across teachers. Under each of the headers I had multiple subcodes. For example, under the *ZFM* code I identified multiple elements that were part of the teachers ZFM. These were typically barriers that created tension between ZFM and the other zones. Some of the subcodes included *curriculum, student behavior, views of family, resources, time, appreciation, lack of effort, and student ability*. Similar subcategories were created under each zone. Under the tension and alignment codes I created subcodes about specific zone combinations (e.g., *ZFM/ZPD*). Finally, under the school and induction codes, subcodes included elements of the two spaces that influenced or provided support to teachers. Some examples of these subcodes included *instructional coach, mentor, professional development, resources, developing vision of instruction*. While many of these subcodes were added while coding the first transcript, some were added during later interviews.

To ensure all interviews had been coded using all of the codes I took a second pass at coding the interviews to see if any of the early interviews attended to the new codes. A subcode was added anytime a teacher mentioned something that was part of one of the zones but a subcode did not already exist. At the end of coding, any subcodes that had less than ten instances were condensed into another subcode, or left under the larger

header code (e.g., ZFM). The subcodes that were condensed into other codes were *feeling isolated*, *end of course exams*, and *pay*.

Identifying themes. As I coded the interviews, I wrote analytic memos at the end of each day of coding (Saldaña, 2021). When writing the memo, I started by acknowledging where in the coding process I was and then which of the two research questions I was attending to. As I was ready to make claims about each individual program I gathered my interview notes, teacher zone diagrams, interview memos, coding memos, and looked at my codes in MAXQDA. I started by trying to understand what each induction program was promoting the teachers to do/learn, from their perspectives. I needed to first understand teacher perceptions of the induction programs so that I could see how that was interacting with their various zones. As the first research question was about how teacher zones interacted in each program I looked to identify different configurations of teacher zones within each program. This helped me to see if there were any patterns. I then identified different quotes that helped explain the different configurations of zones in each program. In particular, I looked to identify how the ZPA of each induction program was in tension, or alignment, with the teachers' ZPDs and ZFM.

Table 14*Initial Coding Framework*

Code	Description	Example
Zone of Free Movement	Any mention of factors that limited or expanded what a teacher was able to do in their classroom including time, perceptions of students, resources, curriculum or assessment requirements, or school structure.	"I feel like our principal did a really good job at not like, micromanaging us." - Kenzie
Zone of Promoted Action	Any mention of ideas/practices that were suggested by others including professional development, interactions with colleagues, administration, or other mentors.	"Our principal had us read this one book called <i>Transform Your Teaching with Universal Design for Learning</i> by Jennifer Pusateri" - Bonnie
Zone of Proximal Development	Any mention of ideas/concepts that were part of the teachers possibilities for development including mathematics knowledge, pedagogical content knowledge, teaching skills and experience, or beliefs about mathematics, teaching, or learning.	"I wanted to relearn all the math, so I was doing that. I wanted to learn it before I started." - Ana
Zone Alignment	Any mention of agreement between different zones meaning the teacher referenced two or more zones and they discussed feeling like they could enact the practice/idea as a result of the two zones aligning.	"So I start with suggestions that seemed like they would take less effort to try out to see if they're going to work. So like the fist of five." – Isabel (ZPA/ZFM alignment)
Zone Tension	Any mention of disagreement between different zones meaning the teacher referenced two or more zones and they discussed feeling like they could not enact the practice/idea as a result of the two zones misaligning.	"So for the school, we always had a do now assignment... which was a pain to grade. So I've learned I'm not grading every do now assignment." – Jackie (ZPA/ZFM tension)
Zone Movement	Any mention of a zone at two periods of time where the idea/belief/practice shifted.	"I'm having to answer the same question...One day I was like, I know that she knows it really well. And I was like, 'can you go help this person?' And then from there, it just kind of turned into a thing." – Flora (ZPD/ZFM movement)
School	Any mention of a member or aspect of the school the teacher was employed in including their colleagues, administration, school rules and requirements, or others.	"Since my school coach visits weekly, which is a lot, you know, I like the support, but at the same time, I feel like it's micromanaging at the same time." - Charlie
Induction Program	Any mention of a member or aspect of their university-based teacher induction program including professional development, coaching, curriculum, or others.	"The new teacher induction program was good." - Eric

Cross-Case Analysis

After identifying the themes in each case, I again examined my data to look across the two programs. As my second research question attended to how the ideas of the induction programs interacted with the school ZPA, I looked to see if there were common themes across the two programs. I looked to see if I could group teachers, regardless of program, into different categories of each ZPA interaction. Utilizing my subcodes under tension and alignment of school/induction I looked to see if teachers perceived the promoted actions of their induction program as in tension or alignment with their school's promoted actions. I identified three categories of interactions and identified teacher quotes that supported the theme.

Quantitative Analysis

Descriptive Statistics

To start my analysis of the survey data I reported descriptive statistics about participant demographics including race, university-based teacher induction program, teaching experience, teacher education, and grade level and content area taught (see tables 2, 3, and 4). This allowed me to have a clear picture of who the participants were in my study, giving context to the analysis.

While it would be prudent to confirm the factor structure of my survey, similarly to the technique utilized for the pilot sample, given the small sample size ($n=29$) doing so would provide uninterpretable results. Thus, no CFA was conducted. I did however check the Cronbach's alpha for the factors to examine reliability, using the Alpha function in the Psych package. The alpha levels ranged from .63 to .93, indicating good fit (Table 13). Each subscale was examined to determine if dropping an item would increase

reliability. For the Role of Teacher subscale results indicated that dropping item six would improve reliability from .59 to .69 so the item was dropped. While both the CFA and measure of reliability indicate poor fit, the findings are unsurprising as the sample size is less than thirty. The limited sample size meant more robust quantitative analysis was not advised and thus nonparametric methods were utilized.

Nonparametric Analysis

While initially the plan was to run t-tests to compare the groups, given the small sample, assumptions for parametric analysis were violated when analysis indicated that data were not normally distributed. Thus, nonparametric analysis was used to interpret the survey results. Mainly I wanted to investigate if there were differences between the Oceanside and the Desert Valley teachers as this might indicate areas where the inductions programs are supporting teacher development (ZPA). To do this, I utilized a Mann Whitney U test (Kloke, 2015) in R. My independent variables of interest for this analysis were the university-based teacher induction programs. My dependent variables for this analysis included teacher self-efficacy and pedagogical beliefs.

I ran the `wilcox.test` function Mann Whitney U test for two independent samples. I also set `exact` to `FALSE` in the function because there were multiple tied rankings across the 29 participants. I ran the test for each factor of the beliefs survey and each dimension of the efficacy scale. The thought was, if teachers in one program had higher beliefs or efficacy in one of the dimensions it would provide evidence to support my assumptions about the focus of the program and what it was promoting. After running each test, I also created box plots to compare the two groups using the `boxplot` function in R. The boxplots created a visual representation of the data.

Assumptions. As I utilized a nonparametric analysis there were fewer assumption's that needed checked to warrant using the Mann Whitney U test. The first assumption was independence of observations. Since the data came from two different programs with no ties to each other the data were independent samples. The second assumption was ordinal or continuous data, as the survey had teachers give a score from 1 to 5 (beliefs) or 1 to 9 (efficacy) the data were ordinal and thus appropriate for using the nonparametric analysis.

CHAPTER 4: FINDINGS

In this chapter I organized the findings based on research question. In the first section, the within-case findings, I address research question 1a: *Within each case, what is the relationship between teachers' perceptions of the Zone of Promoted Action (ZPA) of their university-based teacher induction program, their Zone of Proximal Development (ZPD), and their Zone of Free Movement (ZFM)?* I share how the nature of the promoted actions for Desert Valley and Oceanside appeared to influence teachers ZPD and the ways it interacted with their ZFM. The interaction of teachers' zones was different within each program as the perceived goals of the programs were different. Additionally, I present a unique case of teachers with additional teaching experience, which influenced what they learned from their induction programs. The second section, the cross-case findings, address research question 1b: *Across both programs, how does the ZPA of university-based induction programs interact with the existing ZPA of the teacher's school?* I found that some teachers, from both programs, perceive two distinct sets of promoted actions (ZPAs), one from their school and one from their induction program. For these teachers, the additional ZPA had the potential to create unforeseen tensions which they must navigate.

Within Case Findings

To address research question 1a, I share the relationship between the teachers' perceptions of their induction ZPA, their ZPD, and their ZFM for each program individually. Findings suggest that the distinct differences in structure and content of each program, as described by the teachers, drastically influenced the way the induction programs promoted actions interacted with the teachers' other zones. For Desert Valley,

the teachers perceived a strong vision of mathematics instruction being promoted, which in some cases challenged them to expand their ZPD to align with the ZPA. Their ZFM had the potential to support them in expanding their ZPD, or, for some, created challenges which they struggled to overcome. For Oceanside, the teachers perceived that the promoted action of their induction program was closely aligned to their own instruction. Because of this, the expansion of their ZPD was limited. However, the personalized nature of the promoted actions did help the teachers to bring their multiple zones into alignment. Finally, I share a unique case of teachers who are in their 2nd, 3rd, or 4th year of teaching. For these teachers, their strong sense of autonomy and a unique view of their ZFM allowed them to more easily implement the promoted actions of their induction programs.

Desert Valley

Before outlining the main themes to address RQ1, I share some context about the ZPA of Desert Valley as described by the eight interview participants and reinforced by the 15 survey participants. According to the teachers, Desert Valley promoted a type of mathematics instruction that was aligned with dialogic (Munter et al., 2015) practices and was based on Liljedhal's (2020) *Building Thinking Classrooms (BTC)*. To address RQ1a I start by sharing the interaction of the ZPA of Desert Valley and the teachers' ZPDs. One theme emerged when examining this interaction; the way that the ZPA of Desert Valley were taken up by the beginning teachers happened in four distinct ways depending on if their ZPD was *loosely defined*, *clearly defined*, *all encompassing*, or *shifting*. The interactions of these zones influenced how teachers interacted with and implemented the ideas of Desert Valley and developed their ideas for how to teach mathematics. After

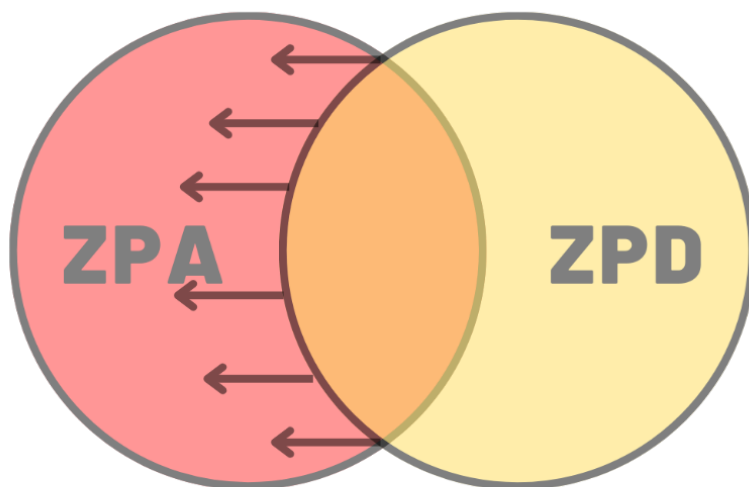
spending some time talking about the interaction of the teachers' ZPA and ZPD I then discuss the interaction with the third zone, ZFM. One theme emerged when examining the interaction of all three zones; teacher ZFM influenced how their ZPD shifted over the course of the program.

Desert Valley Promoted Dialogic Instruction

All participants articulated that Desert Valley promoted a vision of mathematics instruction that was focused on student-centered, inquiry-based practices, characterized by student group work and rich mathematical tasks. This was mainly prevalent through the attention to and use of *Building Thinking Classrooms (BTC)* (Liljedahl, 2020). Ana discussed her perception of the promoted action of the induction program, stating “We focus on *BTC*. So, putting students in groups, and specifically vertical non-permanent spaces, because we learned about the psychology of standing up and doing work on a non-permanent space that you can just erase, which will increase engagement.” Across all the participants the pedagogy of *BTC* was imbedded in their understanding of what ideas about mathematics teaching Desert Valley was promoting. Bonnie articulated a similar sentiment, “Well, most of [Desert Valley], we talk about mathematics skills, you know, that kind of stuff, but also, the *BTC*, those were the two.” The teachers reiterated they were provided the resources and materials necessary to align their instruction with *BTC*, Eric highlighted this idea, “The program really emphasized *BTC*, and they gave us all copies of the book. They gave us all a bunch of whiteboards to put up in our classes. So, they really pushed it.” In this way the teachers perceived that Desert Valley was promoting them to expand their ZPD to align with the ZPA they were promoting, see Figure 7.

Figure 7

Desert Valley Induction Program Focus



The teachers shared how they were encouraged to utilize some of the *BTC* mathematics tasks in their classrooms. To help the teachers expand their *ZPD* so they could use the tasks, they had an opportunity to experience the tasks first as students during their Saturday sessions. Charlie discussed what the experience was like at those Saturday sessions learning about mathematics tasks:

They actually have cool activities that we get to do every time. So that's something I always look forward to, being able to do my own collaboration with groups and they have us at the vertical whiteboard and try to attack these challenging math scenarios that are even a little bit challenging for teachers. We have to critically think about things, and there's not one right answer, but then we get to put our teacher hat back on and say, 'Well, how could it benefit students having an open-ended problem?' and 'How did you interact with each other?'

And then, ‘What are some things that we noticed?’ So that was cool that we got to experience it, and then we get to apply it to our own classroom.

Charlie shared not only his positive experience with the mathematical tasks but also how the tasks were aligned with *BTC* promoted in his induction program. The tasks were designed to be low floor, high ceiling, which was something Flora was learning to implement:

I guess one thing that I did not necessarily learn in terms of new things, but I got to practice, was the varying levels of entry points, like the low floor, high ceiling sort of thing, because that's something that I think I struggle with a lot.

These low floor, high ceiling activities were typically paired with a Notice and Wonder. Danielle discussed her experience, “I always have an opener. What they call a high ceiling, low floor, of getting kids to engage no matter what. Like, what do you see? What do you observe? What do you notice? What do you wonder?” Notice and Wonder was mentioned by every teacher in the Desert Valley program demonstrating the impact the routine had on the beginning teachers. Hannah said, “From the Notice and Wonders to the vertical whiteboards I have done that. For the more engaging lessons [the students] really enjoyed that, and the station activities, where they would go to each whiteboard and start writing on it.” The teachers found the Notice and Wonder activities easy to implement and the mathematical tasks engaging for all students.

The teachers also perceived that aside from a focus on mathematics tasks the program also promoted them to use social emotional learning strategies. Ana shared about social emotional learning [SEL] check-ins stating:

Doing SEL check-ins — having an opportunity to actually have personal conversations with students, like we learned a lot about that in the [Desert Valley] program. For example, you could ask your students, what are some routines they have in the morning, and that leads into a classroom activity.

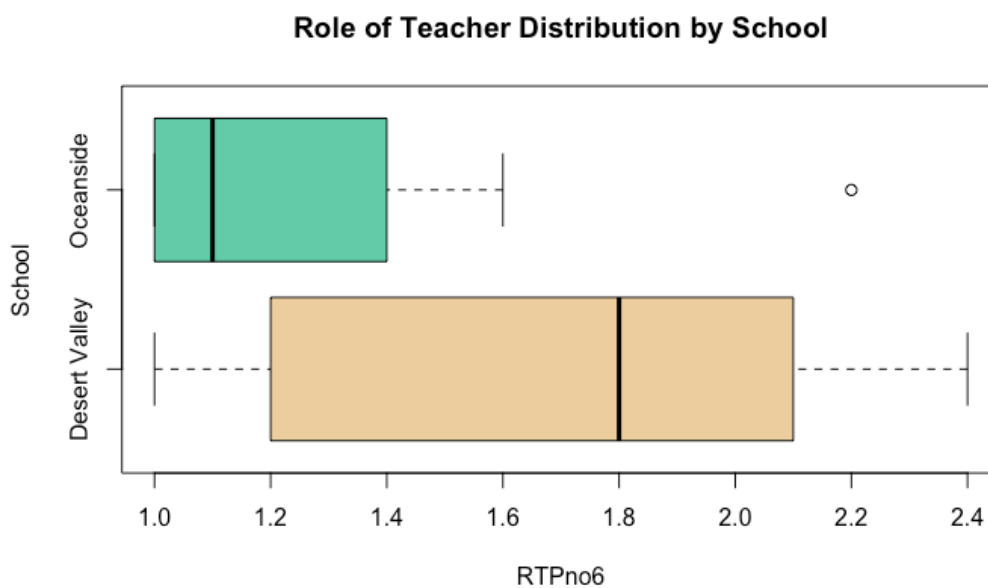
The teachers shared how these social-emotional learning strategies were designed to help them get to know their students on a more personal level. Across these examples it was apparent that the teachers perceived Desert Valley as promoting a clear vision of mathematics instruction. That vision was aligned with *BTC* by promoting mathematics tasks that were low floor, high ceiling, allowed for multiple strategies, and were completed in groups on non-permanent vertical spaces. While the teachers articulated this vision of instruction as part of their ZPA, their views were also supported by the survey data.

One dimension of the survey, which 15 teachers from Desert Valley participated in, was teacher beliefs about instruction (von Oppell & Aldridge, 2021). One of the factors of the survey was Role of the Teacher, this dimension measured if teachers had more constructivist orientations meaning “the teacher is expected to provide opportunities for students through suitable learning activities targeting specific learning outcomes, to be autonomous and to negotiate their understandings with other students” or traditional meaning, “students tend to be passive recipients in a process in which the teacher controls discipline, is viewed as the source of information and an autocratic decision maker” (von Oppell & Aldridge, 2021, p. 145). A higher score on this dimension meant a teacher had more constructivist orientations; the scale was from 1 to 5. Utilizing a Mann Whitney U test to compare the Desert Valley and Oceanside teachers, the results indicated that the

Desert Valley teachers had significantly higher constructivist orientation on the Role of Teacher dimension than the Oceanside teachers, $U = 161.5$, $p = 0.01$. This finding is further highlighted in Figure 8. What is interesting to note is that both programs had a median score of less than 2, meaning that while Desert Valley was more inclined to have more constructivist views, they were still many that had more traditional views of teaching. This is a unique finding as one would anticipate the at least one teacher to have a score above 3. Again, there was a small size so these findings should be further studied with a larger sample.

Figure 8

Box Plot Comparing Desert Valley and Oceanside Teachers beliefs about Role of the Teacher



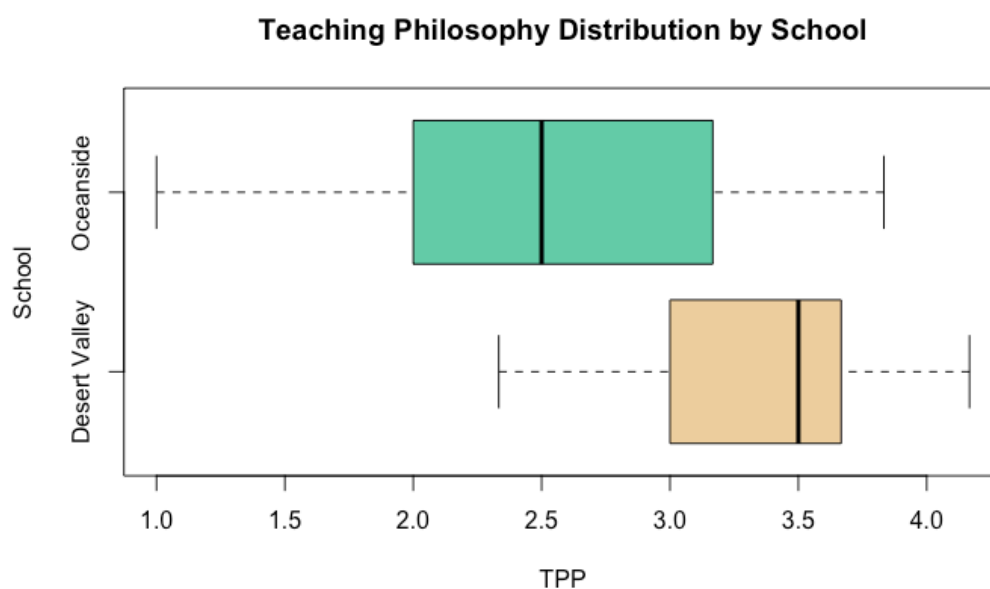
NOTE: $n=15$

Another dimension of the survey was Teaching Philosophy. For this dimension a teacher with a constructivist orientation, “views knowledge as being constructed through

active student participation, involving facilitation and guidance by teachers” as compared to a traditional orientation, which views knowledge in “the form of facts, is imparted by the teacher to the student who is expected to accept, memorize and replicate, unquestioningly, when required” (von Oppell and Aldridge, 2021, p. 145). Again, a higher score meant more constructivist views. The results of a Mann Whitney U test (n=15) indicated that the Desert Valley teachers had significantly higher constructivist views for Teaching Philosophy than the Oceanside teachers, $U = 176$, $p = 0.002$. This finding is further highlighted in Figure 9.

Figure 9

Box Plot Comparing Desert Valley and Oceanside Teachers beliefs about Teaching Philosophy



NOTE: n=15

For the other two dimensions of the beliefs survey, there were no significant differences between programs for the pedagogy factor $U = 124$, $p = 0.42$, or the collaboration factor $U = 121$, $p = 0.50$.

These survey findings provide additional evidence to support the claims from the interviewed teachers that Desert Valley promoted a vision of mathematics instruction that was dialogic, as dialogic and constructivist instructional strategies are similar. Furthermore, there were seven additional teachers from Desert Valley who participated in the survey meaning the constructivist views are not only applicable to the interviewed teachers. While these quantitative findings do not mean that the differences in teacher beliefs were solely due to the induction program, taken with the interviews, there is evidence to support that the ZPA of Desert Valley, as perceived by the teachers, was promoting dialogic instructional practices and beliefs. This clear ZPA being promoted by Desert Valley was taken up by the beginning teachers differently based on how it aligned with their ZPD and ZFM.

ZPA interacts with ZPD

While Desert Valley was promoting a specific type of instruction to the beginning mathematics teachers, that did not mean they would all be influenced by the ideas in the same way. Teacher ZPD including their vision of instruction, beliefs about mathematics, content knowledge, and pedagogical content knowledge influenced the way the teachers interacted with the ideas being promoted by Desert Valley. As the teachers described, Desert Valley pushed them to expand their ZPD to include ideas related to *BTC* (ZPA) (see Figure 1). Understanding how various teacher ZPDs interacted with their ZPA from Desert Valley was crucial. Across the eight teachers I found 4 distinct cases of how teacher ZPA of Desert Valley interacted with their ZPD. While the teachers shared similar perceptions of the promoted actions of Desert Valley their ZPDs were all quite different. The four distinct cases included the case of loosely defined ZPD, clearly

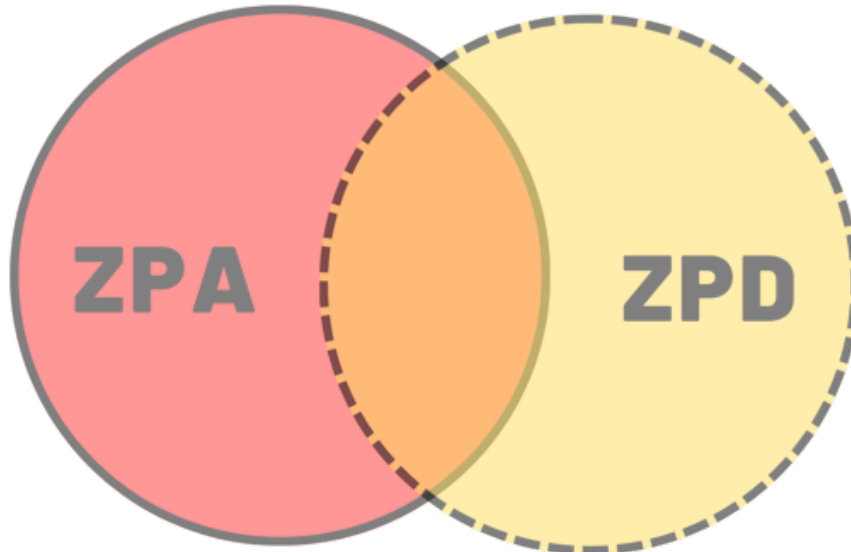
defined ZPD, all-encompassing ZPD, and changing ZPD. In the following sections I highlight each of the teachers that fall into these cases, articulate their ZPD and describe how it interacts with their perceptions of Desert Valley's ZPA.

The Case of Loosely Defined ZPD

Ana was the only teacher to fall into the category of loosely defined ZPD (Figure 10). During her interview Ana regularly stated that she was not sure what to do in her classroom and had an unclear vision for mathematics teaching. This was partially due to her limited experience learning about teaching mathematics and limited mathematics content knowledge. This loosely defined ZPD made it challenging for Ana to make instructional decisions so she would arbitrarily pick something that someone suggested. She said, "I would just pick a couple [activities] and try it. There really was no system to what I tried." Ana struggled to decide what ideas to take up from her ZPA, both school and induction program, and appeared not to consider how those ideas were aligned with her ZPD. She said:

I had all these notes, but it was too much information, hard to pick through, what I want to try, because I know everything probably would have worked had I given it a chance. So, it's just — I don't know if you heard that saying in life, but when you have too many choices, it makes your life more difficult.

All of these ideas became frustrating for her to manage. Despite this frustration, Ana still valued some of the ideas that Desert Valley was suggesting.

Figure 10*Loosely Defined ZPD*

Ana knew she wanted her teaching to look different than a traditional classroom; “Teaching nowadays needs to be different. You can't teach the way you did 20 years ago. Yeah, all these teachers teaching for 20 years, they've got to switch it up. That's really what I loved about [Desert Valley].” However, she was not always implementing practices that aligned with her ZPD. At one point she shared how another teacher had recommended that she try a memorization technique to help her students remember a concept. She took up this idea sharing, “So I would give [the students], certain things. I'd be like, Alright, guys, bell work today is you're writing $y=mx+b$, m is slope, b is y -intercept, 10 times.” Ana did not appear to recognize that this idea was in dissonance with her belief that teaching nowadays needed to be different from in the past. Ana's loosely defined ZPD did not allow her to fully implement the ideas of Desert Valley. However, the program did begin to shift her beliefs about teaching, which overtime could

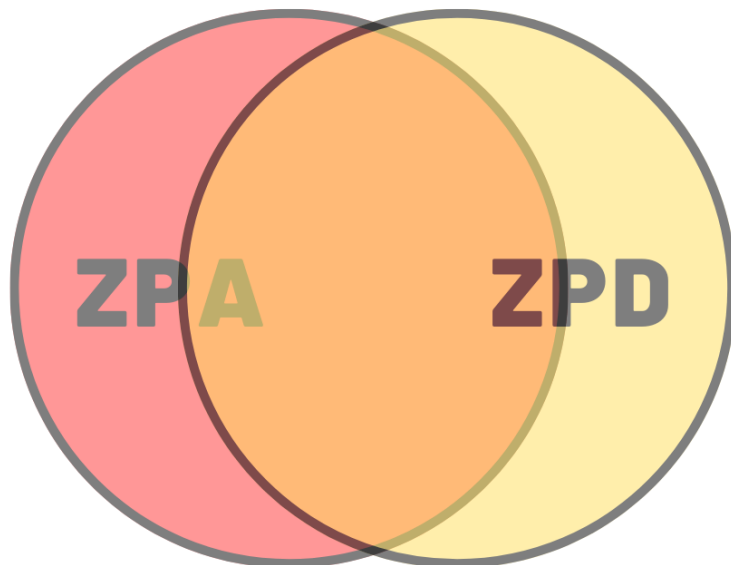
have long-term impacts. She talked about how originally her instruction was notes then practice but that was not working. She pivoted to only doing practice and just explaining as she went but she said, “It always changed, it was always different.” So, while Ana articulated the vision of instruction, which aligned with Desert Valley, it was not reflected in her description of her practice.

The Case of Clearly Defined ZPD

Across the eight teachers, half of them, Bonnie, Charlie, Grace, and Hannah, entered teaching with a strong sense of what they wanted their classrooms to look like, and content and pedagogical knowledge to support them in implementing that vision. Furthermore, all of the teachers stated wanting a mathematics classroom which looked similar to the *BTC* ideas that were promoted by Desert Valley, see Figure 11. As the teachers learned more from Desert Valley, they articulated being excited learning about and implementing the ideas.

Figure 11

Clearly Defined ZPD



Before the teachers entered the program, or the teaching profession, many already had taken time to develop a strong sense of what they wanted their classroom to look like (ZPD). When Grace started her first year of teaching, she was coming from a traditional teacher education program where she had already learned about *BTC*, she stated, “the whiteboards definitely come from my college prep stuff that pulls from *BTC*.” Her teacher education experience was similar to Charlie, he shared “From my university, we did a lot with IBL, inquiry-based learning, so it was pretty much standard.” While Charlie did not explicitly learn about *BTC* before joining Desert Valley, inquiry-based learning was well aligned with the ZPA promoted by Desert Valley.

Not all the teachers in this group were drawing on their teacher education experiences. Hannah had already been a teacher for three years, so she started the Desert Valley program with prior experience which shaped her ZPD. Specifically, she talked about how she could draw on those experiences to create lessons. Hannah articulated, “So if I didn't have this workbook, I would probably just look into what I did from a couple of years ago to set up, you know, some ideas.” Hannah relied heavily on her prior experience, but Bonnie had neither preservice teacher education nor teaching experience to draw on so she had to find alternative means for teacher development. Bonnie, who is alternatively certified, shared about all the books she had read to implement in her classroom related to classroom management (Wong & Wong, 2014), ethnomathematics, and Universal Design for Learning. She stated,

Okay, so, of course, the classroom management book by Wong and Wong, okay, and I literally go through the page and highlight each thing I need to do. So that's

that. I had to read this book *Transform your Teaching with Universal Design for Learning*. So I just have read a bunch of UDL books.

This statement by Bonnie explains how she was focused on improving her instruction and developing her vision of instruction. She went on to state this vision:

Well, to me, it would be that students are more in charge of their own learning, and that needs to ultimately happen. And that hasn't happened this year again, but that's what I need to get better at, and once I do that, I'm sure I'll see a whole different set of progress.

The vision of instruction Bonnie articulated was well aligned with the ideas being promoted by Desert Valley. Furthermore, it highlights how ZPD, though well defined, encompasses the future direction a teacher wants to move in. While Bonnie had a clear vision of instruction, she was still working on how to implement it in her classroom.

Across all four of the teachers, two ideas were clear 1) all the teachers articulated coming in with a clear vision of mathematics instruction which was shaped by a variety of experiences and 2) their perception of Desert Valley's ZPA was aligned with their vision of instruction (ZPD).

The already clearly defined ZPD further developed as the teachers engaged in the elements of the Desert Valley induction program including individualized coaching, a community of new teachers, and the Saturday sessions. These elements not only helped the beginning teachers refine their vision of instruction, grow their knowledge of mathematics content and pedagogy, but also helped bring their ZPD into closer alignment with their induction program ZPA.

One of the elements that most of the teachers mentioned extensively as shaping their ZPD were the Saturday sessions. Bonnie shared about how her time in the Saturday sessions helped her to develop her pedagogical skills, which aligned with her vision of instruction,

If I didn't have [Desert Valley] I would have been parroting out what I was listening to, learning how to teach. There would be no application. I wouldn't have known how. How do you know? Unless you go learn how to do it, right? Literally, by the time we would be there four hours and you almost wanted to keep it going, even though you're so exhausted, you wanted to put your head on the table and die, but you just wanted to keep learning, because everybody around you was so beautiful and wanted you to learn, and I was encouraged in there.

Not only did Bonnie express having a clear vision of the type of classroom she wanted to have, but she recognized she needed help trying to implement this vision. During the Saturday sessions the teachers would have an opportunity to engage in mathematics tasks that they could potentially use in their classrooms. Multiple teachers verbalized how engaging in those tasks not only helped them to develop their mathematics content knowledge but also helped them to think about utilizing those tasks in their future classroom. Grace shared:

We knew we weren't just there to do math tasks, we were there to learn from [the instructors at Desert Valley]. So, while we were doing the task, or at least while I was doing the tasks, I wondered, what are they doing as, the instructor, the teacher, in this setting.

Grace recognized that she was not only there to learn the mathematics but also to learn how to implement dialogic instruction. Charlie had a similar experience; “They always had us as teachers, be the students working out the vertical white boards. And then we get to have discussions on, ‘well, what did you do this time?’ Or, ‘how did we have you extend on this?’” The teachers shared that these experiences, where they navigated being the student and the teacher, helped them to identify how to implement these tasks in their own classrooms. Furthermore, their time at Desert Valley expanded their ZPD by influencing what they considered as best practice in mathematics. Hannah articulated this idea clearly, “I think [Desert Valley] helped me to realize that mathematics doesn't have to be taught so robotically... we can have more of these project-based learning types of lessons, or more engaging lessons.” As the teachers continued to refine their ZPD, and it started to align more with their perceptions of Desert Valley’s ZPA, they stated beginning to implement the ideas into their instruction.

All four teachers mentioned explicitly utilizing the tasks that were shared during the Saturday sessions at Desert Valley, or by their coaches. As Charlie’s ZPD expanded to align more with his ZPA from Desert Valley he began to implement more of the promoted practices. He articulated:

So, the beginning of the year before I had the vertical whiteboards that my induction program gave me, which I really like by the way, it was mainly just talk with your tables, it's more teacher centered. So, as I got through the induction program, getting to know some of the activities I could do with the vertical boards, I started doing those.

In this excerpt Charlie articulated how his vision of instruction shifted from more traditional to more dialogic, with students working together, talking with each other, and solving problems. With this shift in ZPD, Charlie tried out some of the tasks he learned about in his induction program, he shared, “I learned a lot of cool activities... I did try them out near the end of the year near finals, when we just need a break. And they loved them, so I'm definitely going to use them next year.” Charlie was not the only teacher to try out the tasks in their classroom, Bonnie shared, “I got all [the tasks] from [Desert Valley]. They just started teaching us right away, and I would just pull stuff up and try it. I've done a whole bunch of exercises that I pulled from there.”

While his initial vision of instruction was already clear, partly from his student teaching experience, it was only further clarified as it became more aligned with his ZPA from his induction program. Hannah tried out some of the mathematics tasks as well, stating, “I mean, all the engaging tasks I did for this year, I thought that they were really helpful.” The teachers all articulated the value of learning about different tasks and routines they could utilize in their classrooms. Grace employed the Notice and Wonder routine, she said, “Notice and Wonder, I did do those this year. I would like to do them more.” All of the teachers with a clearly defined ZPD not only shared internalizing the ideas from Desert Valley but also put those practices into action. This demonstrated an alignment of their ZPD and their induction ZPA.

All four teachers came into teaching with a strong sense of what they wanted their mathematics instruction to look like, while coming from different background experiences. Bonnie entered the field of teaching late in life, after working as a social worker, and emersed herself in educational research and best practice through books,

professional development, and collaboration with colleagues. On the other hand, Charlie and Grace came from traditional teacher education backgrounds and this shaped their vision of instruction. Hannah drew on her previous teaching experience, which shaped her knowledge and vision for mathematics instruction. Regardless, all teachers articulated wanting to learn how to teach in ways that were dialogic, which aligned with their ZPAs from their induction programs. This alignment led them to implement the ideas from their induction program and they were excited to do so.

The Case of All-Encompassing ZPD

Two teachers stood out as having a relatively unique experiences with the Desert Valley induction program, Eric and Flora, Figure 12. These two teachers were similar to the others who had clearly defined ZPD in that they entered their teaching career with a clear sense of what they wanted their classrooms to look like and the knowledge to make it happen. Eric shared, “So I'm super into [BTC]...there's also a blooming, culturally relevant mathematics program in the district, which I'm also into, and I've collaborated with the district person for that quite a few times.” He went on to talk about the type of instruction he, and his colleagues, were doing in their classrooms, “I mean, so a lot of the things that we're doing, it's student centered. Like, it's student led. There's inquiry.” Flora also entered the teaching profession with a clearly defined ZPD, which stemmed from her teacher education program where she learned about, “Shifting authority and shifting power and how our identities play into our mathematics identities, and how who gets called on and who answers questions, and who volunteers, and when we're picking groups like, it is a conversation about power.” She entered the teaching profession

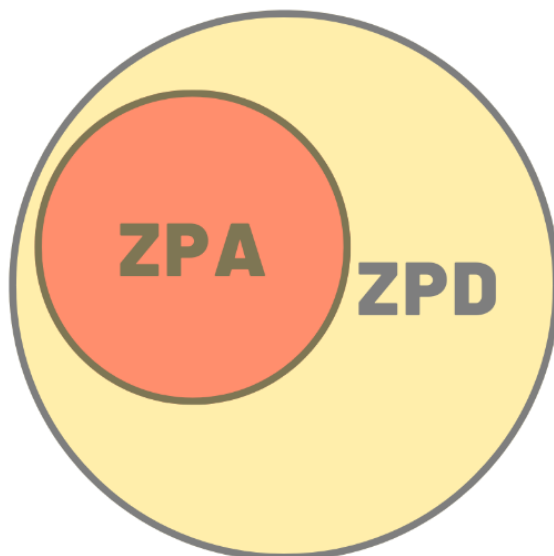
wanting to share authority with her students. One way that Flora was sharing authority with her students was through the use of rubrics for grading:

And so my goal at the end was to have [the students] self-assessing, so they would assess at the beginning and at the end of a rubric period. Then having them engage with it throughout the week as well. But I think for next year, my biggest goal is to start to mess around with more of cocreating the rubrics and having my students go through the process of creating those rubrics. I also started dabbling into cocreating success criteria and how that can play into creating these rubrics.

From this quote, Flora clearly explained how shared authority with her students was a key element of her ZPD. Both Eric and Flora articulated visions of instruction that were well aligned with dialogic instruction. Furthermore, these teachers each have a degree in mathematics, which supported their content knowledge to implement their visions of instruction. While these teachers appeared similar to the clearly defined ZPD teachers, what set them apart was how they took up the ideas of the Desert Valley induction program.

When Eric and Flora attended the Saturday sessions at Desert Valley, they did not always find them to be useful because they were already very familiar with many of the ideas being promoted. In this way, their ZPD was encompassing the ZPA promoted by Desert Valley (Figure 4). Eric shared explicitly how he felt like he was not learning anything he did not already know:

I think there probably are people that got more out of that program than I did that were like, Whoa. All these new ideas are — you know, just seeing [BTC], how to do it. Because I had been actually doing this.

Figure 12*All-encompassing ZPD*

Eric entered Desert Valley already having spent a lot of time utilizing *BTC* in his classroom. Therefore, when they spent time discussing *BTC* with the beginning teachers on a Saturday, he did not feel like he was learning anything new. Flora had a similar feeling of repetitiveness from Desert Valley and her teacher education program, she shared, “[Desert Valley] felt like a book study on *BTC*, which is what my final year of my degree program was...So, I don't know that I necessarily took a lot away.” Both teachers articulated feeling like they were not learning anything new from the program, which was most likely due to the fact that they already had the content and pedagogical knowledge to implement a dialogic approach to mathematics instruction.

While both teachers did not take a lot away from the program, they still thought the ideas being shared were important and recognized that not all of the teachers came from the same background. Flora explicitly stated this idea:

From what I understood not everybody in the induction program went through a teacher prep program, like I did. A lot of them went through Pathways or an alternative certification programs. And so, I think a lot of the induction program felt like my teacher prep program, like I was just going through the program again. There weren't a lot of new ideas that I got to hear. They were sort of the same things that I had already learned in my education classes overall.

Flora reiterated her lack of learning from Desert Valley but recognized why other teachers, who were alternatively certified, might need the supports. Eric even shared how he acted as a resource to those new teachers who were learning how to use *BTC* for the first time, "I don't mind being a student in the class that was a little bit more knowledgeable than some classmates and just respectfully sharing the knowledge with classmates." In this way Eric's ZPD became part of his peers ZPA, in that he was actively promoting the *BTC* vision and was helping his peers gain the knowledge to implement the pedagogy. This became a common theme for both teachers with all-encompassing ZPD.

Their clearly defined ZPD that was completely encompassing their induction ZPA in some ways reaffirmed their commitment to their pedagogical practices, which allowed them to share their ideas with their colleagues in their local districts. Eric was asked to provide professional development for peers on *BTC*, he shared, "I was really lucky, to get paid to put on a PD for the district on *BTC*. And a lot of teachers came to it." Not only did Eric get to help teachers in his district learn about *BTC* in a formal setting but his principal would regularly send his colleagues to his classroom to observe his practice, he shared, "[My principal] would also, to his credit, he would send other mathematics

teachers. He was like, ‘Hey, go check out [Eric’s] class. Like, you should really go check it out.’ I said, you know, please just pop into my class.” Flora also had a principal that was encouraging others to learn from her classroom, she stated, “[My assistant principal] was bringing people in from the district to come in and view my classroom a lot, and they were like, wow. [My classroom] got walked quite a few times.” Flora even went on to share how this promotion of her instruction by her principal reaffirmed her commitment to her ZPD, saying, “So, I think that’s when I started to feel more confident, is when I saw the very obvious and explicit support from my administration.” Both teacher’s ZPDs started to become the ZPA for their colleagues, not just in the induction program, but also in their schools.

Overall, Eric and Flora articulated feeling they were not gaining new insight from their induction program mainly because it was reiterating the ideas they had already learned about. Furthermore, they were already implementing instruction that was aligned with the ideas promoted by Desert Valley. This encapsulating alignment between their ZPD and ZPA led to a lack of growth. As there were no new ideas being promoted by Desert Valley, it did not provide them opportunities to expand their ZPD or learn any new ideas. In this way, complete alignment of zones may not be the goal of induction programs, as it can lead to stagnation. However, both teachers still found value in Desert Valley as they saw the potential for their colleagues. They even went so far as to help promote the ideas of Desert Valley in their own schools and supported their colleagues to implement dialogic instruction. In this way, the ZPD of Eric and Flora became the ZPA of their colleagues.

The Case of Changing ZPD

The last case was a combination of the first and the second. Danielle initially entered teaching with a less focused vision of instruction, and one that was not mathematics forward. Unlike the clearly defined ZPD group, Danielle did not have preservice teacher education, teaching experience, or readings to draw on and develop her ZPD. As an alternatively certified teacher, she had limited knowledge of teaching, both content and pedagogy, to draw on. Danielle discussed her experience with the mathematics content saying, “Sometimes I'm just trying to teach myself the content as I'm preparing to teach it too.” Not only was the content part of her ZPD still developing her vision for instruction was also unclear, she shared, “I was still figuring out my teaching style.” As Danielle entered the teaching profession her ZPD was loosely defined and still in the process of development. This was similar to how Ana was experiencing teaching in that they both were unclear on what they wanted their classrooms to look like.

As the year went on many people, at school and at Desert Valley, provided Danielle with suggestions. Similarly to Ana, Danielle discussed feeling overwhelmed by the promoted ideas for instruction stating, “It's like as a new teacher they [school and induction] offer all sorts of resources, and it's always coming at you really fast. I'm trying to figure out which ones to pick up and be able to actually implement them.” As her ZPD was still developing it became difficult for her to decide what ideas to take up; “I mean, as someone who just jumped right into education, I would have no pedagogical theory or ideas of, like, worksheets versus projects. I'm like, whatever you want.” In this way, Danielle was similar to Ana in that she was willing to try any and all ideas being suggested to her, but this mentality shifted as Danielle's ZPD expanded over the course of the year.

At the beginning of the year Danielle was not quick to internalize or implement the ideas being promoted by Desert Valley. Danielle felt uneasy about the suggestions of her induction program as her ZPD was not fully aligned with her induction ZPA. She shared, “At first, it took me a while because [Desert Valley] would recommend stuff, and I was like feeling cringy.” She went on to talk about a specific practice Desert Valley was promoting, Notice and Wonder, she shared:

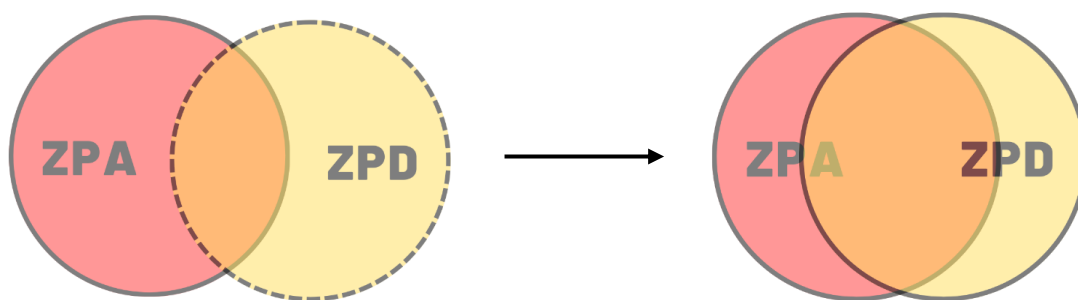
It felt cheesy. I would be like, what do you notice? And [the instructors at Desert Valley] would be like, well kids could say they noticed blue, they can notice this arc, the circle. I just felt like it was so basic that my kids would be like, ‘This is dumb.’ And I was thinking it was dumb. And then, some of the emotional check-ins. Some of it just felt like cheesy educator stuff that I was like, as a kid, I would think this is stupid. As an adult, I think this is stupid.

Danielle articulated that a few of the activities, mainly the Notice and Wonder and Social-Emotional Learning (SEL) practices, made her feel “cheesy” or “cringey.” She did not clarify what about these practices made her feel uneasy but she shared a hesitance to use the practices, even if her school would like her to use them as well. One example of this was when she discussed the SEL check-ins; “I just didn't like emotional check ins. My school probably would really promote it...and my mind may change, but I just have not bought into the emotional check ins. I don't think it's bad, but I cringe a little bit.” At the beginning of the year, as Danielle’s ZPD was still loosely defined, these promoted actions by Desert Valley were not aligned with her ZPD at all. She was resistant to implement them, and she articulated her hesitancy to even consider them as part of her

practice. However, as the year went on Danielle's ZPD began to shift and align more with her ZPA from Desert Valley, Figure 13.

Figure 13

Danielle's Zones Over Time



While Danielle's ZPD started out similarly to Ana, as loosely defined, she began to reflect on the ideas being promoted by Desert Valley, and her school, which caused her ZPD to become more well defined. Danielle stated:

I kind of was reflecting on it, that it was about halfway through the program that it finally clicked, of like, oh, now this is starting to make sense. And I now can imagine me using some of the stuff in my classroom. Because at first, I was like, doing it and going this just doesn't feel like me, and this initial thing doesn't feel great. I think in the middle of the year, I was like, Oh, wait. I could start imagining some things I could do in the classroom.

Danielle articulated the expansion of her ZPD as the year progressed, Figure 7. With each new idea shared by Desert Valley she started to think differently about mathematics teaching. Her vision of instruction became more well defined and shifted to align with her ZPA, which allowed her to decide what ideas she wanted to implement in her classroom. Danielle explained this shift in thinking:

As the induction program went on, I could pick out certain things I'm going to love or certain things I'm just never going to do that. And I think the longer I was in the induction program, I found more things that I did like, and just kind of understood that there's going to be certain things that would just not jive with how I wanted to teach. Not that there was anything wrong with it. It's just like style, right?

As Danielle explained, what it came down to was if an idea aligned with how she wanted to teach (ZPD). It was not that any of the ideas Desert Valley was promoting were bad ideas, but they did not align with her vision of instruction. She started to prioritize student voice and agency saying, "Student voice in math and student agency. I didn't really realize that's what I wanted until I experienced that [students could] do it. I was like, oh, we should do more of this." She also shared that students needed to have opportunities to problem solve; "I want them to be excited to come to math and actually say I want to try this problem. Math is more about problem solving than it is just, we're here to memorize equations." How Danielle began to describe her instructional goals was closely aligned to the dialogic vision of instruction being promoted by Desert Valley. Furthermore, Danielle attributed this shift to Desert Valley.

Not only did Desert Valley help Danielle to refine her vision of instruction, they also helped her to develop her content knowledge of mathematics, another key aspect of her ZPD. She shared how the Saturday sessions, where they did mathematical tasks, helped her learn the mathematics content saying, "And it was good catching up on some of the math, especially the eighth-grade math you're preparing them for, like Algebra." These opportunities to practice the mathematics helped Danielle feel more confident in

her instruction as she was more familiar with the content and ways to teach it, like using a double number line. She talked about learning from her peers at Desert Valley about using a double number line, she said, “We needed to use these, chips to create a double negative or double zero. I was like, I have no clue what you're talking about. And I really liked that. I was like this double number line is super helpful.” Not only was Desert Valley helping Danielle refine her vision of instruction, but she recognized how they were supporting her development of mathematical and pedagogical content knowledge. All of these supports helped her to have a more well defined ZPD.

Throughout the year what she wanted her classroom to look like became clearer. She discussed learning more about teaching, which was in stark contrast to the beginning of the year. Furthermore, her induction program at Desert Valley helped her to more clearly define her ZPD, which demonstrated her growth as a teacher. She shared that while she was initially hesitant to try out some of the suggestions from Desert Valley after trying them, she began to envision herself using those practices in her classroom. As her ZPD changed it became more aligned with her induction ZPA.

Summary

The teachers participating in the Desert Valley induction program experienced the program in unique ways, which mainly related to their own ZPD. Teachers who had clearly defined ZPD articulated being more likely to internalize and implement the ideas of Desert Valley. Teachers like Charlie and Grace shared regularly engaging their students in practices like Notice and Wonder or utilizing the mathematical tasks provided by Desert Valley. These teachers did not share any feelings of tension between what they wanted their classrooms to look like and what Desert Valley was promoting them to do.

Their own experience and knowledge gave them the resources needed to implement their vision of instruction. On the other hand, both Ana and Danielle entered the teaching profession with an unclear vision of instruction and limited content and pedagogical knowledge to draw on. This loosely defined ZPD made it challenging for them to engage with the ideas of Desert Valley and they began to implement any and all ideas at random. After time Ana's vision of instruction began to shift to align with Desert Valley but she was unable to implement this vision of instruction, which is explained further in the next section. On the other hand, Danielle was able to align her vision with the ZPA of Desert Valley and as time passed, she began to implement the promoted pedagogies in her classroom. Finally, Flora and Eric shared feeling as though they did not get much out of the Desert Valley induction program mainly because they were not learning anything new. While they found value in the ideas promoted by Desert Valley, they stated not learning anything they did not already know. However, the close alignment of their Desert Valley ZPA and their own ZPD did encourage them to share their ideas with their peers and colleagues, which made their own ZPD the ZPA of their colleagues. These findings suggest that while a strong alignment of ZPA and ZPD can be beneficial for teachers and allow them to implement their vision of instruction, complete overlap in zones may lead to limited growth.

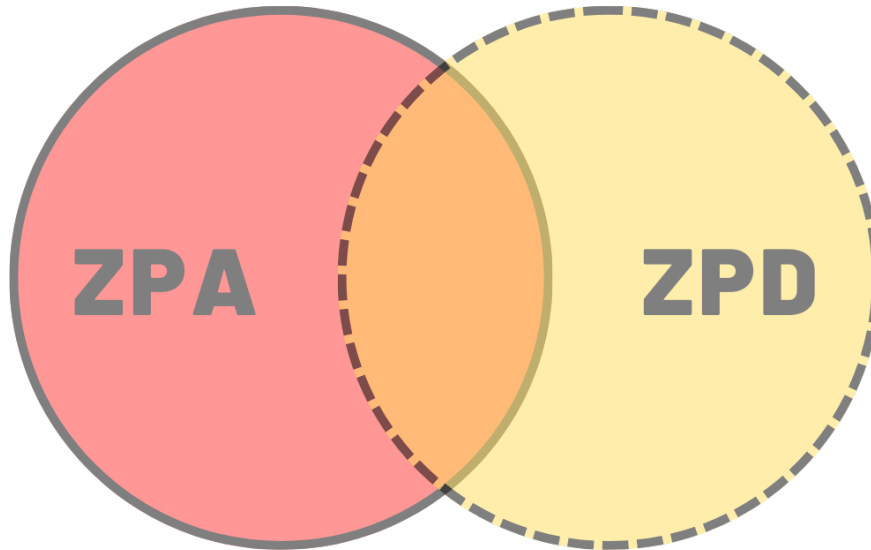
The Interaction of ZFM, ZPD, and ZPA

To further address RQ1a I examined the interaction of all three zones. To best highlight the way ZFM interacts with teacher ZPD and induction ZPA, I focus on a comparison of Danielle and Ana, who started with similar ZPDs but ended in very different places. What separated the two teachers was how they made sense of their ZFM.

Ana took a deficit view of students whereas Danielle did not; their perceptions of students played a drastic role in what they thought they could do in their classrooms. I shared this case to illustrate the potential role ZFM can play in determining whether teachers' ZPD expands to include the ZPA of their induction program. I start by recapping the ZPD of both Danielle and Ana and then I discuss the role ZFM played in expanding Danielle's but not Ana's ZPD.

The Case of Danielle and Ana

When comparing Danielle to Ana, at first glance they appeared to have started in the same place, with loosely defined ZPD (Figure 14). However, overtime Danielle's ZPD became more clearly defined and shifted into alignment with Desert Valley's ZPA. Although their ZPA and ZPD alignment appeared similar at the start of the year, their ZFM showed notable differences. How they perceived their environment, what they were allowed to do in their classroom, and most importantly what they thought their students were capable of doing greatly influenced their ZPD and ultimately their classroom practice. The difference in ZFM for the two teachers led one to take up the ideas of Desert Valley and shift her practice while the other decided to leave teaching at the end of the year. Thus, ZFM can have consequential impacts on beginning teacher learning and instruction.

Figure 14*Ana and Danielle's Beginning Zones*

Both Danielle and Ana initially felt overwhelmed by all the ideas shared with them. Danielle shared, “I think the job's so overwhelming that you're just like, I don't even know how any of this fits.” Ana was feeling similarly stating, “So it's just It was very stressful, big workload.” The two teachers started from a place of feeling overwhelmed and stressed by their new job. Furthermore, their induction program and their colleagues were sharing ideas with them left and right, their loosely defined ZPD led them to try any idea being shared. Ana talked about all the ideas beings shared saying, “I had all of these notes, but it was like too much information, and hard to pick through, what I want to try.” Danielle even specifically named that the reason it was hard for her to pick an idea was because she did not have the knowledge to draw on to make a decision. In this way both of the teachers started the year in a similar space of loosely defined ZPD that was not completely aligned with their ZPA and trying any and every idea. However, over time the gap between the two teachers started to widen as Danielle's

ZPD came into focus and shifted to align with her ZPA. On the other hand, Ana continued to try various ideas, that were often in conflict with each other.

As mentioned above, Ana's vision of instruction started to shift overtime. She shared how Desert Valley was positively influencing what she wanted her classroom to look like and even shared that with her principal saying:

Teaching nowadays needs to be different. You can't teach the way you did 20 years ago. Yeah, all these teachers teaching for 20 years, they've got to switch it up. That's what I really loved about [Desert Valley]. I would go to my principal and I'd be like, 'Oh, my God, you have to implement this. You need to read [BTC]. You need to have your teachers go to this program if they can, if they're first or second years. You need to look at these things. They're talking about vertical, non-permanent spaces, and the psychology behind it, the non-permanent groups, the non-curricular group activities.' There's so much more to it. And I was so enthusiastic about it and trying to promote it.

Ana was really excited about the ideas coming from Desert Valley and she wanted her classroom to look like this. She shared how she enjoyed the activities in the Saturday sessions, "I really loved the, What do you see, What do you wonder?" In many ways this enjoyment of the ideas from the induction program were similar to how Danielle's ideas started to shift. Her goals for her students even shifted, she shared, "I want [my students] to be excited to come to math and actually see that math is more about problem solving than it is we're going to memorize equations." In a lot of ways this statement from Danielle was similar to Ana's idea that mathematics instruction needs to be different than it was 20 years ago. However, Danielle really started to implement these ideas in her

classroom and Ana was still trying out ideas that contradicted her beliefs. Ana shared how she was struggling with her students, and another teacher gave her an idea how to help:

I was chatting with a middle school teacher at a fundraiser, and she was like, oh, because I was telling her how these students won't remember anything. She's like, 'Oh, you should try the memorization technique where you have them write something over and over and over and over again.' So, I would give them certain things. I'd be like, 'Alright, guys, bell work today is you're writing $y=mx+b$, m is slope, b is y -intercept, 10 times.'

This teaching technique that Ana implemented in her classroom was in direct conflict with her idea that teaching needs to be different. Furthermore, it was not aligned with the ideas from *BTC*. While Ana's loosely defined ZPD played a role in her not being able to recognize the dissonance of ideas, she articulated an issue in her ZFM saying, "these students won't remember anything." As a reminder, included in a teacher's ZFM is their perceptions of students as this could be limiting to their ability to implement ideas from their ZPD. This place of seeing the abilities of her students as limited led her to make the decision to try this more traditional pedagogical strategy. The role Ana's ZFM played in her actions, and development, ultimately led her to not use the strategies shared by Desert Valley, which is stark contrast to Danielle's experience.

While Danielle and Ana's ZPA and ZPD looked similar, when accounting for their ZFM, the zones looked significantly different. As shown in Figure 15, Danielle articulated having alignment with her ZFM, meaning she felt she had autonomy to do what she wanted in her classroom, the resources to implement her vision of instruction,

and the perception that her students were capable of engaging in the activities as outlined by Desert Valley. On the other hand, Ana articulated a tension with her ZFM mainly because she did not perceive her students as being able to engage in the type of instruction Desert Valley was promoting. This tension led her to implement a variety of instructional strategies, as highlighted above, and potentially kept her from feeling alignment between her ZPD and ZPA.

Upon entering the teaching profession Ana articulated a recognition that working in public schools came with rules and regulations that she needed to attend to:

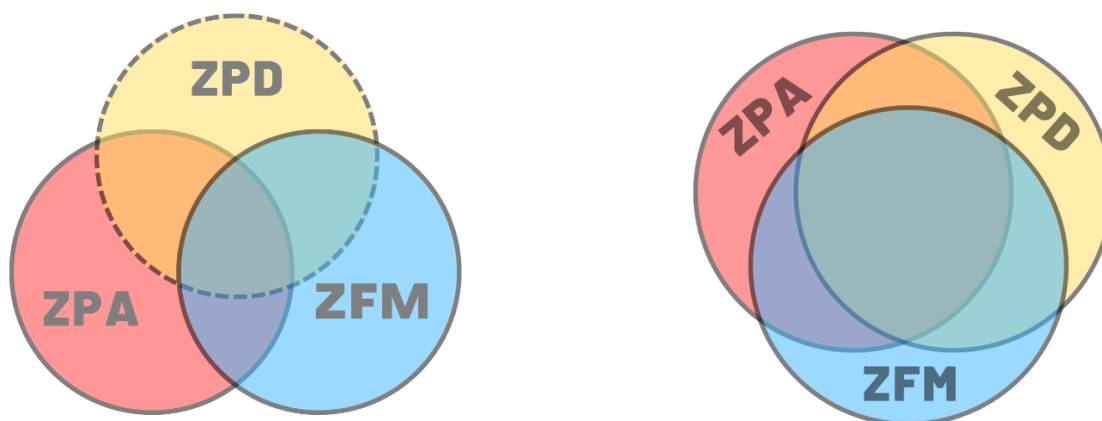
In public school in general, across the nation, there's just so many rules. You have to teach current grade standards, so I was not allowed to spend two weeks teaching them sixth grade math. I just wasn't allowed to do it. So, it was very frustrating from a teacher standpoint, like, I really wanted to help these kids, and I really wasn't allowed to.

This frustration Ana articulated was an example of how her ZFM was causing tension with her other zones. Especially when she shared that she really wanted to help the students but felt she was not allowed to. Ana continued to voice this feeling of being overwhelmed by all of the things she was being asked to do as part of her ZPA. She said, “You have to grade lesson plans, you have to stand around at lunch for 30 minutes and do lunch duty. I just got to a point where I was like, I am tired of putting in all this extra work.” All of the promoted actions Ana was supposed to be attending to felt misaligned with her ZPD and her ZFM. They were misaligned with her ZPD because this was not what she thought teaching was supposed to be about. However, they were also misaligned with her ZFM because she said, “I don't have the time for that” when talking

about all of the extra things she was supposed to be doing. On the other hand Danielle did not mention any of these perceived tensions. In this way Danielle had less tension with her ZFM to implement the type of instruction she wanted to.

Figure 15

Ana and Danielle's Zones



The biggest distinction between both teachers' ZFM's were in their perceptions of students. As a reminder, perceptions of students are part of the ZFM because if a teacher thinks students are unable to complete a task, then they perceive that task as something they are not able to do, thus not in their ZFM. There were two distinct views of students that influenced teacher ZFM: perceptions of student engagement and perceptions of student ability.

When discussing the students in their classes, Ana often adopted a deficit perspective towards students, while Danielle maintained a more asset-based approach. This was clear when Ana discussed student engagement in her classroom. Ana shared a lot of the struggles she was experiencing trying to get students motivated in her classroom; "there was zero engagement... They're literally not listening. They're chatting,

they're talking. I have like, two students paying attention the whole period.” Ana articulated her frustrations with the students’ lack of engagement saying, “If they're not going to put in the effort, it's going to take four days to get through an objective that I wanted them to learn. So, I had to move on even if they weren't there.” Her perceived lack of motivation and engagement from students made it difficult for Ana to try and implement some of the ideas shared by Desert Valley. One of the ideas Desert Valley shared was getting students up at the board and working but Ana had an issue with that saying, “If I send them up to the board, it's going to take an extra 20 minutes to get through one problem.” While Ana was articulating wanting to implement the ideas from Desert Valley (i.e., part of her ZPD), she did not interpret these practices as practical in her classroom. Ana also tried out the idea of having students work in groups, another *BTC* practice, but that did not go how she was hoping it would, so she stopped that practice as well:

And then at the end of the year, I had it to where I was doing groups of three. That was their assigned seat, and the person in the middle was very good at math. So, the person in the middle is going to help the two on the outside of them... But I would have a couple of those students just not help the person next to them. And then you have the other smarty pants that were just were like, ‘No, I'm good. I just want to do this.’ So it's like they didn't even have the motivation to do more. They were just satisfied doing the bare minimum, because for them, that was enough.”

While Ana tried out one of the practices, her perceptions of what was possible to do in her classroom, which she perceived as having low student engagement, led her to discontinue the practice.

A second area where Ana and Danielle's ZFMs differed was related to their perceptions of student mathematical ability. Ana articulated concerns about what students were able to do in her classroom and was worried that current technology, and the prior Covid-19 pandemic, were impeding students' ability to learn mathematics deeply:

These students don't read, they don't know how to write. They use Chat-GPT for everything. They were having a hard time with mathematical expressions, like three plus an unknown or three added by an unknown number. It's supposed to be three plus x . They can't do that. They are at a sixth-grade math level and reading level, and they haven't learned anything these last couple years [due to Covid] because they haven't had to put in the effort. This was the first year that was time to hold them accountable. And, of course, me, a first-year teacher, they're like, I don't have to do anything.

Ana's perceptions of her student abilities impeded her from being able to take up the ideas presented by Desert Valley. Charlie had shared that one of the ideas he learned from Desert Valley was a type of instruction called you, y'all, we, which is closely aligned with a dialogic approach to instruction. On the other end of the spectrum Ana was using a more traditional approach called "I do, we do, you do." [explain this] Ana explained the strategy saying, "I knew that I shouldn't be doing something called I do, you do, we do. That's not good, because when you do that, they are just mimicking, and they're not thinking and they're not learning." She voiced knowing that the practice was contradicting the ZPA of Desert Valley, but she felt stuck using the strategy because of her perceived ZFM. Ana explained, "It's really hard to find alternatives to that, because, like I said, the students just don't know how to think. You really have to hold their hand

the entire way. So, it's just almost impossible not to lecture.” Ana’s perception of her students’ abilities led her to implement strategies that were in tension with the ZPA of Desert Valley. Similarly, she shared, “These kids don't know how to think, because they haven't had to think for three years... I just don't know how I could have gotten them to learn these math subjects without me being up at the board lecturing.” Given Ana’s perception of her ZFM, it follows that her ZPD did not become more clearly defined because her ZPA and ZFM were always in tension. Furthermore, her ZFM stunted her ability to expand her ZPD to be more aligned with the ideas being promoted by Desert Valley. This made it challenging for her to implement the ideas shared by Desert Valley and thus her vision of instruction only started to shift but her actual practice remained traditional. This was not the case for Danielle.

Across the entire interview with Danielle, she only mentioned student effort once to say, “There's always one or two [students] that really don't want to do work, and they do better with the one-on-one, and they need to buy into you as a teacher.” Danielle recognized that while some students may not want to do the work, there were ways to work with those students to help them be successful. Furthermore, she expressed responsibility to get buy-in from students. Since Danielle experienced little tension with her ZFM, she was able to try out the different pedagogical strategies suggested by Desert Valley:

In our February session we did a demo of a Socratic seminar, and they were talking about how in math voice and choice feels really hard to bring in. [The Desert Valley instructors] did a demo of a Socratic seminar with math problems, and I was like, ‘oh, this is really cool.’ It didn't go phenomenal in my classroom,

but it's something that I can see, that I would want to keep bringing up, because it's usually seen as a very English class type of thing. But I had certain students that just loved it, who also hate worksheets, you know? So, the kids that really struggled in math seem to really like that.

Danielle shared trying out one of the strategies promoted by Desert Valley, a Socratic seminar, and even though it did not go exactly how she had planned it, she still saw value in the activity. Furthermore, Danielle recognized that some of the students who struggle in mathematics class might benefit from this approach. This was in contrast to Ana who had tried to give students an opportunity to talk with each other but they would not share so we quit the practice all together. ZFM continued to be a barrier for Ana, one that Danielle did not experience.

Summary

In addressing RQ1a, I found that ZFM can play in teacher development in that it has the potential to limit teacher ZPD expansion and can create tension with induction ZPA. While both of the teachers started in the same place, with loosely defined ZPD that was only partially aligned with their ZPA, they ended in quite different places. Ana continued to feel tension for the rest of the year, across all of her zones, and ultimately decided to leave the profession. Danielle, on the other hand, shared feeling more confident at the end of the year, had more alignment across her zones, and was looking forward to the next year. These two cases demonstrate the effect ZFM can have on the ideas teachers internalize and ultimately implement in their classroom. While Ana was excited about the ideas presented by Desert Valley, she very rarely implemented them in her classroom. Danielle was initially hesitant about the ideas from Desert Valley but

began trying them out and eventually incorporated them into her regular practice. Since Danielle did not share feeling limited by her environment, she was more willing and able to try out the promoted actions. This was not the case for Ana who said she felt constricted by her environment and could not use the practices she had learned about. In this way, ZFM has the potential to make or break the impact of inductions programs on teacher development.

Oceanside

The Oceanside program provided teachers with a uniquely different experience, when compared to Desert Valley. I start by sharing an overview of the ZPA promoted by Oceanside as described by the teachers, which was more content neutral and not mathematics specific. To address RQ1a, I describe how the ZPA of Oceanside interacted with the teachers' ZFM, ZPA, and ZPD. The teachers at Oceanside articulated how the program provided them individualized instructional supports, which attended to their ZPD and ZFM. Across the interviews a few themes emerged: (1) the content of the supports (ZPA) were created for and promoted to teachers in an attempt to address their needs whether that be in their ZFM or ZPD, and (2) the induction programs promoted actions worked as a mechanism for helping the beginning teachers bring their zones into alignment.

Oceanside Promotes Content Neutral Techniques

Unlike Desert Valley, which promoted mathematics instruction well aligned to a specific, well-defined vision of dialogic instruction, Oceanside was challenged to find supports that aligned with all teachers as their program was available to any beginning teacher in grades K-12, teaching any content area. The teachers shared how Oceanside

promoted actions that were more general and typically related to classroom management strategies as part of the teachers ZPAs. Luis mentioned how his coach specifically shared a lot of content neutral strategies because she was not a mathematics teacher herself, “I have a teaching coach and she comes and tells me information and teaching methodologies that people use, and different topics and different games and different tools that they use. So, she shows me that content neutral stuff.” Isabel discussed the general nature of the suggestions from Oceanside, stating, “[Oceanside] didn’t do much on the [math] content, it has been based on general instruction, different activities we can try, no matter if we’re teaching math or English or whatever. It is more generalized, like classroom management kinds of things.” The teachers learned a lot of content neutral ideas alongside their peers who were teaching things like English, science, social studies, and even physical education.

The teachers across the board shared an appreciation for the varying perspectives they heard from during professional development sessions at Oceanside. Hearing from different content and grade level teachers gave them interesting insights into teaching. Luis highlighted these interactions, sharing:

[Oceanside] also does [PD] for beginning teachers as part of the induction program. They have a new topic every time, and they group us together as new teachers, rather than by subject. I’ll have a PE teacher, and we’ll talk about the experiences we have, and then we’ll talk about how our peers’ experiences apply to our method, our topic, or our content. The gym coaches have a lot in common with the math teachers. It’s all about consistency and repetition. You know, we

don't necessarily understand each other's content, but the way we present it to the kids, the way we talk to them about it all that is very, very similar.

The sentiment, of learning from other content areas, was echoed by all the teachers, with Kenzie stating, "We see what maybe English teachers are doing, or the social studies teachers are doing, because it might be a little bit different. And maybe you see an idea that you like, and you would use it." While Oceanside was providing the teachers with more general pedagogical knowledge, the teachers were receptive to the ideas and appreciated the perspectives of teachers from other content areas.

One of the main content neutral ideas that was shared, both by coaches and in professional development sessions, was classroom management strategies. All four of the Oceanside teachers made mention in their interviews of classroom management suggestions they had received from Oceanside. As three of the Oceanside teachers came from alternative certification pathways, many referenced their lack of knowledge about teaching practice, and thus their induction program provided them supports in these areas. For example, Jackie shared, "[my Oceanside coach] helped me set the classroom expectations the very first week of school. I asked, what do you think my classroom expectations could be? Because I don't know what rules to give these kids." Jackie acknowledged where she needed more support, as part of her ZPD, and also the actions her induction program was promoting, as part of her ZPA. Isabel was also concerned about classroom management at the beginning of the year, she said:

So the biggest suggestion [from my coach] was to be strategic with the seating chart and where certain students are placed, so that that helps a huge deal. He also

suggested brain breaks, so you're still doing math, but now it's in the form of a game, so it's not as boring.

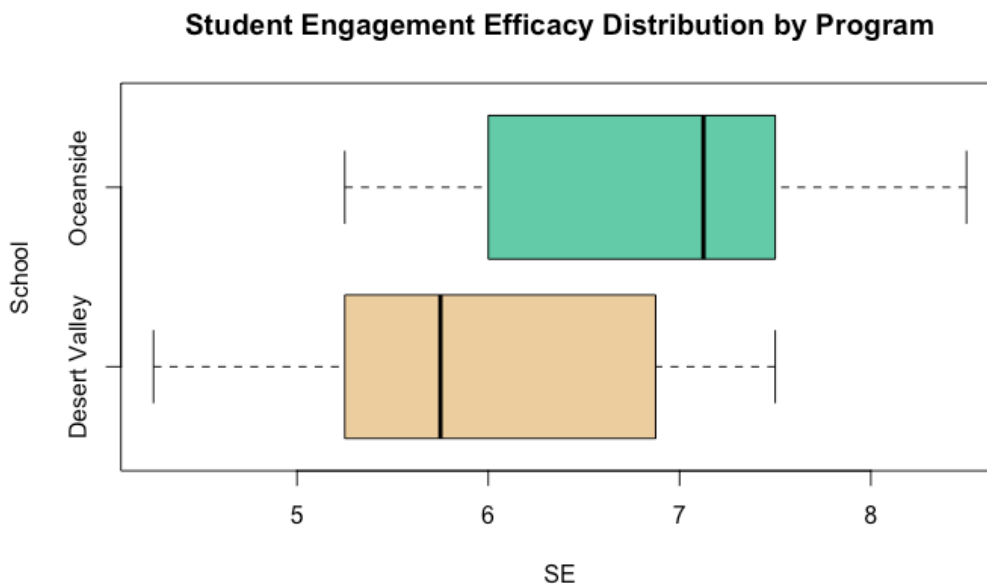
The classroom management strategies the teachers talked about were common among professional development and coaching sessions. Furthermore, they were aligned with what the teachers articulated needing help with. While the teachers articulated the general pedagogical ideas as part of their ZPA from Oceanside, their views were also supported by the survey data.

One dimension of the survey was teacher self-efficacy related to student engagement. Student engagement is a content neutral topic as it refers to getting students to engage in the topics, think critically, and be creative (Tschannen-Moran & Hoy, 2001). Utilizing a Mann Whitney U (n=14) test to compare the Desert Valley and Oceanside teachers, the results indicated that the Oceanside teachers had significantly higher self-efficacy about student engagement than the Desert Valley teachers, $U = 55.5, p = 0.03$. This finding is further highlighted in Figure 16. This finding supports the idea that Oceanside may have been a source of efficacy for the beginning teachers as it relates to student engagement.

For the other three dimensions of the self-efficacy survey (n=14), there were no significant differences between programs for the classroom management factor $U = 79, p = 0.26$, the instructional strategies factor $U = 99, p = 0.81$, or the mathematics content factor $U = 95.5, p = 0.69$.

Figure 16

Box Plot Comparing Desert Valley and Oceanside Teachers Self-Efficacy for Student Engagement



NOTE: n=14

There were other content neutral techniques promoted by the program, but these strategies were more specific to the individual teacher's needs. Unlike Desert Valley, which was promoting one method for teaching mathematics, Oceanside provided general pedagogical suggestions during professional development but then more specific suggestions during coaching interactions. These suggestions were based on the wants (ZPD) and needs (ZFM) of the teachers the coaches were working with.

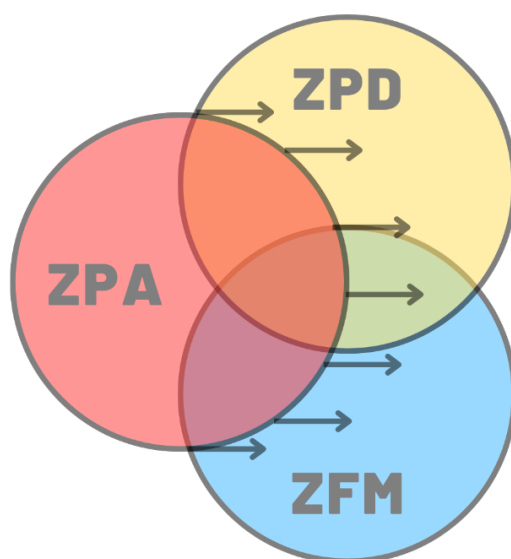
Oceanside Aligns Itself to Teachers Needs

Oceanside provided teachers with lots of supports through suggesting resources to reduce teacher workload, co-teaching lessons to demonstrate techniques, or through professional developments. The content of these resources was dictated by each teachers

individual ZFM or ZPDs. So unlike Desert Valley which was helping teachers expand their ZPD to align with their ZPA (Figure 1), Oceanside took an opposite approach of aligning their ZPA to the teacher ZPD and ZFM, Figure 17. In this section I share how Oceanside provided individualized promoted actions that were aligned to teacher wants (ZPD) and needs (ZFM). These interactions between the teachers' three zones were unique for each teacher and help to answer RQ1a. The alignment of the promoted actions of Oceanside to individual teacher ZPD and ZPA worked as a mechanism to bring the teachers' zones into alignment.

Figure 17

Perceived Oceanside Induction Program Focus



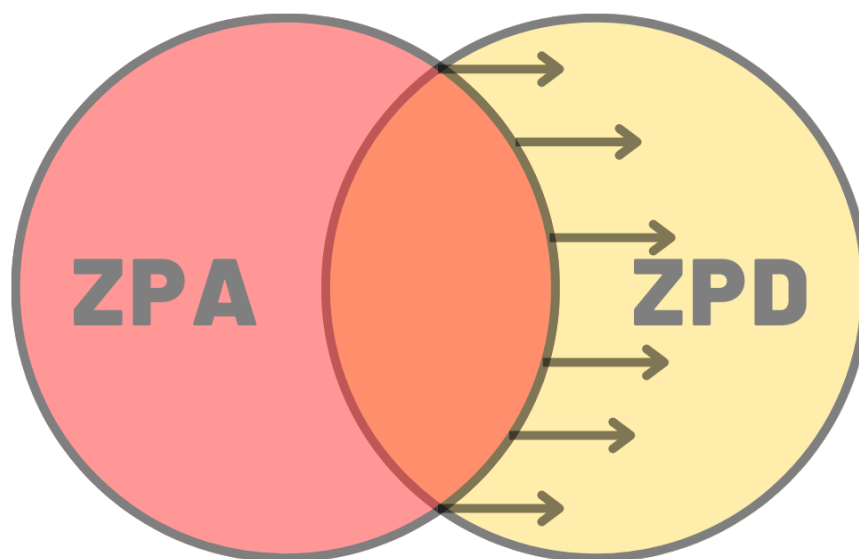
Aligning ZPA to ZPD

Unlike Desert Valley, which helped all teachers implement instruction that was similar to *BTC*, Oceanside did not promote a single type of mathematics instruction, according to the teachers. Instead, the PD teachers received was more general and the specific strategies teachers learned about from their coaches were aligned to their own

ZPD (Figure 18). All of the teachers at Oceanside described having similar visions of instruction to their colleagues at their specific schools, thus the resources provided by the coaches helped them implement these various instructional strategies.

Figure 18

Aligning ZPA to Mathematics Teacher ZPD



For example, when Isabel started the year, she was open to trying different instructional strategies. She shared, “I tried to incorporate a lot of group work, to get them up and moving so that we were not just sitting for an hour or so in the desk.” While this practice is more dialogic Isabel also used some traditional instructional practices:

So, most of time, it's like a PowerPoint slide that I have up on the board, and then I would put a timer up of how long they have to complete [the bell ringers] before the timer is up. Then we'll quickly review it and move on to the new topic. Then it usually gets followed by notes, whole instruction material. And then I would do a couple problems as a whole class, and that's when I would do like the popsicle sticks to try to check to see if they're understanding it. And then for the remainder

of class it would be either independent work or group work on finishing the remaining problems from the notes.

In this way, Isabel's ZPD was more loosely defined, which is why she may have been more willing to utilize the interactive notebooks that the other teachers in her building were using. She shared how the lead teacher helped her with the interactive notebooks, "So then it became all right, on this day, we're doing this page and these practice problems, and it helped me stay on task, and with the pacing of the material, and not getting too far behind her." As she worked more with the interactive notebooks, she was more excited about using them:

I really enjoyed the notebooks, especially with the keeping the materials organized and knowing exactly on this day we're doing page five and page six.

The next day, we're doing seven and eight and then just sprinkling in those task cards or sprinkling in the escape room.

There was a sense of organization that came with using the interactive notebooks that Isabel really enjoyed but then she could also try some additional engaging activities. The other activities that Isabel wanted to incorporate she got from her Oceanside coach, she stated "with the coaching and stuff I learned different tasks I could use." While the other teachers in her building were giving Isabel ideas about what her instruction could and should look like, school ZPA, she was getting other ideas about her instruction from her induction coach. The Oceanside induction program provided supports that aligned with her ZPD. This was similar for all of the teachers at Oceanside.

It was clear from the interviews that the coaches started from a place of trying to understand what the beginning teachers needed and wanted help with. By identifying

where the teachers needed help or what parts of their instruction they wanted to develop, the coaches were able to align their promoted actions with the teachers' ZPD. Jackie's ZPD was similar to Isabel's in that it was more traditional, meaning her instruction typically consisted of a warm-up, notes, and then individual practice problems. However, Jackie was really focused on students understanding why they were doing what they did in math. She shared, "I'm a why person. Why do I have to do it this way? So, I always explain the why to the math. If you understand the why, then you'll remember how to do it." This vision of instruction was important to Jackie, and her coach helped her to enact it. Jackie shared how this interaction worked:

Sometimes [my coach] would give me ideas, and I would try it, and I would tell her, this didn't work, so what did I do wrong? And then she would say, I tell you what. Let me come in and coteach with you. She would coteach with me. I'd have to give her my lesson ahead of time so that she could plan accordingly. And the coteaching was a matter of, I would still teach the material, but she would come up with ideas of how to assess them and how to keep them engaged. And I would watch her like she was very strategic with what she did, and I would watch her, and then I would try it with the next group.

Jackie articulated wanting to try and implement the ideas from her coach but was struggled to keep students engaged and assess their understanding. The coach identified that need and then provided the support to help Jackie be successful in implementing the ideas. However, most of the ideas coming from her coach were more content neutral, mainly related to student engagement or assessment. The Oceanside coach was able to make adjustments to align the Jackie's ZPA with her ZPD. For example, the idea for the

popsicle sticks came from Jackie's Oceanside coach, which became part of her typical instruction.

Kenzie was also getting content neutral supports from her Oceanside coach, which helped her to implement her vision of instruction. Kenzie's instruction was similar to the rest of the Oceanside teachers in that the main activity was notes, "I'm a math teacher, I don't know if I ever said that. There's notes, basically every single day, almost every day there's notes." However, she found that the students would come in and just grab the notes and do nothing at the beginning of class. She articulated this concern saying, "Because sometimes my kids would come in and just not do anything. They would just grab the notes and then just sit around talking too much and not getting into work right away." In this way, Kenzie wanted to include some more activities that would get the students engaged in mathematics right at the beginning of class. She had seen other teachers using warm-ups at the beginning of their lessons; "But I also noticed that a lot of other teachers, they'll do warm-ups." So, she shared this idea with her coach:

[My coach] had this PowerPoint slide, which she would put different things in the PowerPoint. It would be like, what are some things that you want to work on? And then I would respond in the PowerPoint. And then she would add different things or add different resources for me to use. I asked her about ... I wanted to include more warmups or exit tickets. She showed me different ways to incorporate it or different outlines to use if I wanted to do that.

Kenzie articulated that she wanted to work on warmups and exit tickets and then her coach provided those resources. While providing those resources did save Kenzie time,

part of her ZFM, the goal here was to help provide resources that were aligned to Kenzie's vision of instruction, her ZPD.

Luis also had a similar structure to his mathematics classroom, but he really wanted to focus on differentiated instruction. He shared, "I want to get better at differentiated instruction... the goal is to have different versions of the same assignment for varying skill levels." He shared that his ideas about best teaching practices were heavily influenced by his colleagues, "I saw other teachers doing similar things in my school." He also had a chance to talk with his colleagues about their instructional practices during their PLC meetings. However, to do this type of differentiation Luis had to find a way to organize students by ability, which required some data collection. He stated, "one of the challenges I had was not gathering enough data when I was doing quizzes and things like that to see which kids were where and where some of the struggles were." However, as data collection was a content neutral topic, his Oceanside coach was able to help him with this. He shared, "So the induction program taught me about how to collect and present data, how to use games, how to use different tools, how to use AI, how to generate tests, those type of things, but not content specific." These resources helped Luis implement his vision of instruction, which was centered around within class ability grouping.

Across all four of the Oceanside teachers there was a similar vision of instruction that was more traditional in nature. That vision, which consisted typically of a warm-up, notes, and practice was not very mathematics specific. Furthermore, throughout the interviews, the Oceanside teachers rarely mentioned mathematics except for when being asked about their mathematics instruction specifically. This was in stark contrast to the

Desert Valley teachers who mentioned mathematics even when discussing classroom management or student engagement. This could be a reflection of the content neutral nature of the promoted actions from Oceanside. In this way, the teachers ZPD was more content neutral as well. They were teachers first and mathematics was just their content area.

Aligning ZPA to ZFM

All teachers discussed their struggles with both student behavior and ability, both elements of teacher ZFM. Luis highlighted this idea, “I would say the two biggest challenges I faced this year were behaviors and the kids did not have adequate middle school level learning.” When compared to the Desert Valley teachers, the Oceanside teachers were more likely to mention these limitations to their instructional practice based on student ability or student behavior. Throughout all of the Oceanside interviews many teachers referenced their students developing mathematical abilities. Jackie shared, “my kids could not multiply. So, I would do one-minute, two-minute, three-minute multiplication drills, and then it got to where I had division in there. I'd have adding, subtracting and multiplying in there.” This sentiment echoed what Luis shared about missing middle grade skills. Students developing abilities were also connected to motivation, Isabel shared “I had several students that had no motivation. They would sit in class, play on their phones and computers. I had a few that had averages of 10, and I didn't know you could score that low.” The Oceanside teachers shared similar concerns about lack of motivation from the students. Luis said, “I find that some of the kids are extremely hard to engage, either because I don't relate to them, or because they have no interest, or because they've given up altogether.” A combination of lack of motivation

and developing mathematical ability made it, from participants' perspectives, challenging for the teachers to engage students in mathematics.

The beginning teachers at Oceanside were also learning how to navigate behavioral concerns. The issues seemed to arise when students were given independent time to work, as was the case for Kenzie, "some of [the students] get a little too comfortable in that homework time, and they start to move around, and then they're talking to their friends. And I'm like, just do your work, please." Jackie had a similar issue with free time, "As soon as you gave them free time, you've lost them. It was a matter of, how can I keep them engaged but not put so much stuff on the board under the agenda that it overwhelms them?" The balance between keeping students engaged but not overwhelming them with the workload was a challenge for the Oceanside teachers. These struggles to address student ability and behavior were rich areas for Oceanside to support the teachers. Many of them could have potentially felt a lot of tension between their ZPD and ZFM but Oceanside provided resources and strategies to help bring these zones into alignment.

For example, coaches would visit the classroom and ask teachers what they needed to be successful. Jackie shared how this interaction would happen in her classroom:

[My coach] would come in, and for her, it was more of, what are you struggling with this week? What are you struggling on? ... One of the things that she taught me was I had tables at the beginning of the year, so I let my kids work in groups. [She said] all the tables had to go. They had to go. So she suggested I get desk,

and that's what I did. And then I started having less behavioral problems there too, because they couldn't touch each other.

Jackie shared that she was struggling with the students not focusing during class because they were always messing with each other at their seats. Once she communicated this struggle to her coach they provided her with the necessary supports, which she found to be successful in her classroom. In this way, the actions promoted by Oceanside, getting desks, aligned with Jackie's ZFM and furthermore brought her ZFM into alignment with her ZPD. Jackie was then able to do the type of instruction she wanted to do in her classroom without feeling tension from her ZFM. Isabel was similarly trying to figure out how to help her students focus, especially as they returned back to class after lunch. Her coach provided her with an interesting suggestion, she shared, "[My coach] suggested games to do after lunch so that they're not really doing homework, they're not really doing notes, but if it's a game and it's fun, then they'll want to get back to class to play." These suggestions helped the teachers address their concerns with student engagement and behavior and brought their zones into alignment.

Kenzie also mentioned how the resources provided by her coach saved her time, which she felt she did not have (part of her ZFM), to address student mathematical ability:

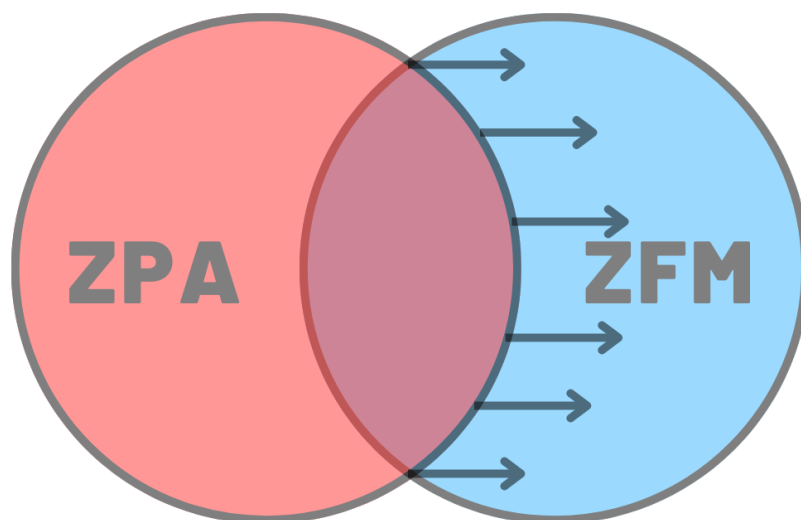
[My coach] was always a good person for resources, especially when I didn't want to find the time to look for something, I'd be like, 'hey, I want to do more exit tickets.' ... Then [my coach] would be like 'here, use this as your exit ticket.'

Again, the promoted actions by Oceanside, exit tickets, were well aligned with what the teacher felt they could do in their classroom. The time the coach spent finding the exit

tickets also reduced any tension Kenzie felt with her time restriction in her ZFM. The coaches continued to provide resources for teachers that addressed tensions they were feeling with their ZFM. In this way, the ZPA was aligned to the teacher's ZFM, Figure 19. The coaches at Oceanside were not working with the teachers to implement a certain type of classroom management strategy but instead were providing teachers with resources that aligned with their specific wants and needs according to their ZFM.

Figure 19

Aligning ZPA to Match Teacher ZFM



Summary

Unlike Desert Valley which was helping teachers expand their ZPD to align their perception of the Desert Valley ZPA, Oceanside was doing the opposite in aligning their ZPA to teacher ZPD and ZFM. The Oceanside teachers articulated feeling tension with their ZFM in relation to time to create lessons, student behavior, and mathematical ability. The coaches provided teachers with resources and ideas that helped mitigate some of those tensions and were individualized to each teacher. Additionally, teachers needed

support with implementing their vision of instruction, which was closely aligned to that of their colleagues, Oceanside coaches again provided resources and other supports that helped the teachers bring their vision to life in their classrooms. In these ways the Oceanside program was not trying to get teachers to align to them but instead provided supports that were closely aligned with teacher existing practice, at the intersection of their ZPD and ZFM. This meant that the teacher's ZPD was not expanding to include new ideas promoted by Oceanside but instead their ZPA was expanding to encompass the teacher's ZPD.

The Oceanside Program: Serving as a Mechanism to Align Zones

Across all four teachers from Oceanside there was more alignment of teacher zones, when compared to the Desert Valley teachers, and the mechanism through which Oceanside promoted teacher actions could be the reason for this alignment. The Oceanside teachers communicated to their coaches what they wanted to do in their classroom and what they were struggling to implement. They shared their concerns mainly because they were struggling to enact their desired instructional practice (ZPD). Said another way, because there was a lack of alignment between their ZPD and their ZFM, they struggled to enact their vision of instruction. As they reached out to their coaches for support, their ZPA and ZFM became more aligned allowing them to implement their vision of instruction.

For example, Jackie was struggling to keep her students focused during her lesson so she found it difficult to make any progress during her class. In this manner, her ZPD, which involved completing notes as part of her instructional vision, was not aligned with her ZFM because her students were unable to complete the notes due to distractions.

Jackie brought this challenge up to her Oceanside coach who suggested she switch up her classroom layout and use desks instead of tables. When Jackie implemented this change, she found she was able to complete the lesson with less distractions. She said, “So she suggested I get desk, and that's what I did. And then I started having fewer behavioral problems there too, because they couldn't touch each other.” This suggestion from Jackie’s coach brought her ZPD and ZFM into alignment so she was able to implement her vision of mathematics instruction.

Similarly, Katie was struggling to keep her students engaged for the entirety of the class period. Her vision of instruction included engaging students for the entire class period (ZPD) but her students were easily getting off task and so the end and beginning of class were usually more chaotic. Again, there was a tension between her ZPD and ZFM. Katie turned to her coach for help with keeping students engaged the whole lesson and her coach suggested warm-ups and exit tickets. Katie tried these strategies, “But I definitely included like, more warm-ups, or like, more exit tickets. That way they had something to do first thing when they came in, or something to do at the very end of class.” This suggestion from her instructional coach brought her ZPD and ZFM into alignment so that she was able to enact her vision of instruction.

Summary

These examples highlight, and build on the previous findings, to suggest that because of the tailored nature of the ZPA from Oceanside, teachers were able to bring their ZPD and ZFM into alignment. With each suggestion from the Oceanside program teachers were addressing areas of their ZPD or ZFM that were not in alignment with their other zones. As the area of zone overlap is the type of instruction most teachers enact,

any tension the teachers felt meant that they were less likely to implement their instructional vision. As they implemented the promoted actions from Oceanside this began to reduce the tension they were feeling, which ultimately allowed them to implement their vision of instruction.

Teachers With More Experience

For a final with-in case analysis I examined the four teachers with more than one year of teaching experience. When trying to answer RQ1a, I noticed that this group of teachers had a unique interaction between all three of their zones in that their ZFM was typically more aligned with their other zones than some of the first-year teachers. A typical example of this zone alignment can be found in Figure 20. These teachers seemed to interpret their ZFM in ways that were not limiting to their ability to enact the type of instruction they wanted to. This meant they were more likely to understand elements of their ZFM, that typically would hinder them from various instructional practices, as manageable.

Student behavior was a typical reason teachers listed as interfering with their ability to implement their vision of instruction. However, for the more experienced teachers, student behavior seemed to be less of a deterrent. For example, Hannah talked about post Covid behaviors of students being easily distracted but she was quick to recognize that blaming student behaviors on something that happened four years ago was not an excuse, she pointed out, “when's the point where we have to say, ‘you know, it's too far away to blame it on covid anymore.’ You know, what part of it is the parents? What part of it is the teachers or the school?” The point she made was, Covid cannot be an excuse for student behavior and that teachers need to address the concerns head on.

She went on to share that students being distracted and easily off task could be managed by clarifying for students that they will have opportunities to get up and talk with their peers. Hannah shared, “You can’t talk to [your friend] right now, they’re too far away [on the other side of the room]. There will be a time where you can get up and move around, absolutely, but now is not the time.” What could have been viewed as a reason to not allow students to engage in some of the *BTC* activities, Hannah viewed as a way of managing typical distracting behaviors in her classroom. This can be seen as overlap between her ZPA and ZFM. Providing students with opportunities to engage in *BTC* gave students an outlet for their energy and a chance to be social during class. Eric also used his instruction as a way to mitigate potentially disruptive behavior. He shared, “I want to frame it as a privilege to participate and learn, you know? So, it’s like a punishment to be like ‘you don’t get to participate, you don’t get to learn math.’” Again, not only was there alignment between his ZPA, ZPD, and ZFM but because of his views of mathematics and mathematics instruction it helped him align with his ZFM more closely.

While more experienced teachers had alignment with their ZPA and ZFM, the way they responded to student behavior also represented more zone alignment. For example, Kenzie shared:

In math, a lot of the kids don’t want to participate at all, because they’re afraid of getting it wrong when really, they know how to do it. They’re just a little nervous.

Yeah, and they probably just haven’t talked much in their previous math class.

Instead of interpreting student lack of participation as disrespectful or a lack of caring, Kenzie understood that a student’s absence of participation stemmed from nervousness or a lack of experiences to share in the mathematics classroom. This shift in perspective

allowed Kenzie to feel more alignment between her ZPD and ZFM and in turn lead to a different interaction with the student. This sentiment is similar to Eric:

There are kids that kind of just stand in their group and don't really say much and are scared to say something. Then there's the talkers, but not about math. Those kids, interestingly, when I ask them then to think about [the math problem], they're willing to go think about it.

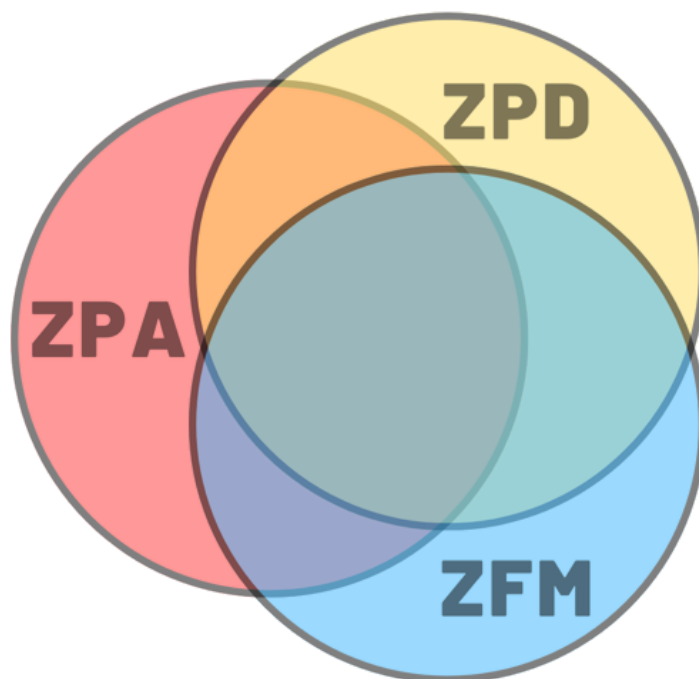
Again, the teacher's perceptions of the students [ZFM] combined with their own knowledge about students and teaching [ZPD] lead to a different response to student behavior.

Teachers with additional years of teaching experience also felt they had more autonomy to take up the ideas of others, or not. Danielle was clear about this autonomy, "There's a lot of, like, freedom as a teacher you have." This sentiment was common across all four teachers. Eric even took it a step further to share how this autonomy allowed him to implement more ambitious mathematics instruction, "I get good results and because they [administration], from the beginning, really liked me, they pretty much leave me alone in the classroom." This understanding of how the school operates and what is required to ensure his autonomy allowed Eric to implement the pedagogical practices which most aligned with his ZPD. Hannah had the same understanding, she said, "Ultimately it is our decision, we decide what the kids need as far as the pacing of what they are doing." There was a sense of doing what was best for students and the teachers shared feeling they knew what was best for their students. Kenzie went even further to share how this sense of autonomy mitigated any potential tension she might have felt with her ZFM:

I mean, at the end of the day, it's your classroom, so you can do whatever you want with your students, with your classroom in general, as long as you're willing to try different things and just see what works and what doesn't work. There's always going to be somebody who's doing something different than you. You might be teaching the same topic, but maybe one teacher goes faster, and one teacher goes slower, it just is what it is. Every classroom is going to be different. But knowing that that's okay at the end of the day, you're still teaching, you're still doing what you're supposed to be doing. I don't really feel like myself there's tension. I just go with my gut, and if it feels right for you, and you're doing what you're supposed to be doing, then don't think too much about it.

Figure 20

Typical Alignment between ZFM and Other Zones for 2+ Year Teachers



What was common across all of the more experienced teachers was a strong sense of autonomy. This strong sense of autonomy in turn expanded their ZFM to allow for more of their ZPD to be realized in their practice. This is represented by the larger intersection of ZPD and ZFM in Figure 20. They did not sense as much tension with their ZFM because they felt free to take up the ideas they wanted to and leave the ones they did not want to utilize in their classrooms. While they did collaborate with their peers, they did not feel obligated to use materials exactly as provided by their districts or through their collaborations. Eric shared a unique example of how he navigated this autonomy and collaboration while recognizing that he only had two years of experience as compared to some of his colleagues:

I hate IXL. And, you know, the kids hate IXL. And, you know, everyone hates IXL, except for the older teachers. But I really wasn't coming at it from a place of judgment, which I've been very conscious of now. Older teachers that have been doing it for a while, which I have a lot of respect for — if you've been a teacher for more than 10 years, respect off the bat, but they feel like, 'oh, all these youngsters are coming in here with these new ways of doing things.' You know, I understand, like, I got my routine right, like, I got my way of doing it. I understand, not everyone's going to get on board, and that's okay. I think I was doing it as a model, and then people are like, 'Who's this? Wow, this newbie who doesn't even have a degree in education is having really great results, right?' And I'm like, well, here's why. It's not because I'm like, born a good teacher. It's just because there's this cool way of doing things that I learned, and it's working for me.

Eric had to navigate his autonomy, to not use IXL and instead implement more ambitious practices, while also recognizing that he had the least amount of experience in his department and wanted to be respectful of his more veteran colleagues. What was clear from the excerpt was that he still felt a sense of agency within his ZFM; he could implement dialogic pedagogies. While all the slightly more experienced teachers articulated feeling a sense of autonomy, they were cognizant of their lack of experience when compared to their colleagues.

The lack of tension the more experienced teachers felt with their ZFM seemed to be a trend across the four relatively more experienced participants. This stemmed from their sense of autonomy and views of student behavior. It could be that their additional years of experience helped them to better understand students and their behaviors. Additionally, having even one more year in a school allowed teachers to understand the school culture and climate in a way that helped them better navigate their peers and administration. While there is evidence to support this claim, from the existing data, additional data would need to be collected with a larger sample to confirm this finding.

A Cross-Case Analysis

To address research question 1b, I examined how the promoted actions of the induction programs interacted with the promoted actions of the teachers' schools. While the teachers from Desert Valley and Oceanside shared having vastly different experiences, the presence of an induction program that existed outside of the school context, was similar for all teachers in the study. Two themes emerged when looking at the interaction of the teachers' perceptions of their induction and school ZPAs. First, some teachers interpreted the promoted actions by their induction program as a separate

ZPA from their school. Within this group of teachers, some found these two ZPAs to be in tension while others experienced them as aligned. Second, some teachers articulated feeling they had one large ZPA which encompassed all the promoted actions from their school and induction program. In the following sections I share how these differing views of their induction ZPA influenced the ideas they incorporated into their ZPD.

Multiple ZPAs

Across the 12 teachers in both programs, nine of them articulated recognizing a difference between what was being promoted by their induction program and their school. The ways in which they discussed the distinct sets of promoted actions from both their school and induction program made it clear that the teachers were perceiving those actions as in tension or alignment with each other. For these teachers two distinct ZPAs were created to represent one for their induction program and one for their school. As the induction programs exist outside of the school environment it makes sense that teachers would perceive it as separate from their school ZPA.

The teachers articulated how they were receiving supports from so many different people. Bonnie shared about how the promoted actions from Desert Valley were different from some of the work her school was doing with West Ed. West Ed is a research, development, and professional learning provider that works with schools, and other agencies, to help provide high-quality learning experiences for all teachers and students (WestEd.org). Bonnie shared about her experience with Desert Valley and WestEd:

So that was different than what [Desert Valley] provided on *BTC* and math, because these are more task oriented and are truly applicable in hands on teaching and math. Whereas WestEd focused more on an engagement perspective. How

are you engaging kids in the classroom? Are we doing enough student to student?
Are we doing enough teacher to student?

Bonnie articulated understanding that what Desert Valley was asking her to do was different from what WestEd, and her school, were asking of her. In this way Bonnie had two ZPAs. Charlie felt this same distinction of two different forms of promoted actions, one from his induction coach and one from his school assigned coach. He said, “I had my on-site coach, but then there's also the induction program coach.” The teachers shared feeling as though they had so many different support systems. Isabel shared having a mentor teacher at her school, an instructional coach from the district, and her coach from Oceanside. This was common among the Oceanside teachers to have multiple coaches from their district and school. As the teachers navigated their two ZPAs some experienced alignment but some experienced tension.

School and Induction ZPA Alignment

Of the 9 teachers with two ZPAs, Danielle, Eric, Flora, and Grace experienced alignment of these zones, Figure 21. In this way they perceived what their school was promoting them to do and what their induction program was promoting as well aligned. It is of note that all five of these teachers were in the Desert Valley program. Furthermore, all four teachers shared feeling a strong sense of autonomy and agency, which may have contributed to their sense of ZPA alignment.

As all of the teachers who had ZPA alignment were from the Desert Valley induction program, they perceived their induction ZPA as implementing dialogic instruction aligned with *BTC*. However, each teacher had different promoted actions coming from their school. Danielle shared, “So the sixth, seventh and eighth grade, we

have an emphasis on project based learning and personal competency-based learning.” At Eric’s school the focus was on culturally relevant pedagogy. He shared, “there’s also a blooming, culturally relevant mathematics program in the district.” Flora shared how her school was using standards-based rubrics for grading, “So all the Geometry teachers, all the Algebra 1 teachers we had rubrics for projects.” For these three teachers there was clearly a promoted action that was coming from their school. On the other hand, Grace was in a situation where the teachers were all kind of doing their own thing, she stated:

It’s pretty traditional teaching in most of the other mathematics classrooms. There were six of us this year, so, I’d say about three of those six, it’s pretty traditional teaching. Two of them are a little bit more on the self-paced. One of them is all self-paced. One of them is a little bit more self-paced, a little bit project based.

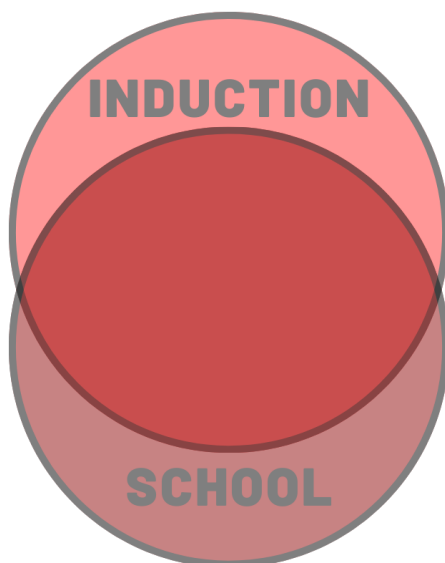
Grace did not have one clear promoted action coming from her school but instead was hearing different voices promoting different pedagogical practices. Regardless of what was being promoted by the school, each of the four teachers felt alignment with those school ideas and the pedagogical practice promoted by Desert Valley. Even Grace, because her school was promoting a lot of teacher autonomy, did not share feeling tension between her induction program and school. Instead, she stated feeling she was being promoted to implement the type of instruction that she thought was best for her and her students.

For Danielle and Eric, the push from their school to do Project-Based Learning and culturally relevant pedagogy was well aligned with the ideas of Desert Valley. When asked specifically if she felt tension or alignment between her school and Desert Valley, Danielle shared, “[Desert Valley] definitely is aligned to what I want to do, and definitely

what my school wants me to do.” Danielle shared feeling no tension between her school and her induction program, which was also what Eric articulated. Eric said, “I was encouraged to do *BTC* and culturally relevant pedagogy. So I felt very supported at that school in pursuing that style of teaching.” In this way both teachers were in schools that were already encouraging practices that aligned with Desert Valley.

Figure 21

School and Induction ZPAs in Alignment



Flora and Grace shared experiencing the alignment in a different way. In their interviews, both teachers stated that they had different people in each ZPA that were supportive of their ideas. Understanding this helped them to feel alignment between their two zones. Grace shared how she experienced her different mentors:

We have an instructional specialist at our school, and her job is basically new teachers. I go to her if it's something that's more school specific, or maybe that's not necessarily solely math based. If it's something that it's a math question that I

have, then I go to other math teachers that I know, or to my [Desert Valley] people.

Grace said she found value in both groups of mentors but in different areas of her instruction. Keeping these mentor practices separate kept Grace from feeling tension.

Flora had a slightly different experience. She shared:

I would say overall, my admin and my [Desert Valley] coach were pretty aligned. I would say that the math teachers were where I saw the most contradiction. But that's also something that I was spoken to about at the beginning of the school year. The math lead was talking to me about their goals for the Math Department, which were to move away from what has always been done. Because that's what they were seeing... And so, I think that although I was facing a lot of pushback from my fellow teachers, I was also getting a lot of support in trying to do new things.

Flora, like Grace, was able to find people in her support network who could provide her support and encouraged her to do the practices promoted by Desert Valley. Furthermore, she stated her administration, Desert Valley coach, and mathematics department chair were well aligned. These two teachers found alignment of their multiple ZPAs through picking and choosing who in their ZPAs to engage with and listen to.

All four teachers had a strong sense of agency and autonomy in their schools, which could have contributed to why they felt alignment. If they felt they were allowed to do what they wanted in their classroom, and not forced to do practices they did not want, it was easier for them to feel alignment of their ZPAs. Danielle recognized that she had this autonomy when she said, "There's a lot of freedom as a teacher you have." Flora had

a similar sentiment and was explicit about the role her autonomy played in her satisfaction as a teacher, she shared “I've always said I felt like I have a lot of autonomy with what I get to teach. I think if I didn't, it would be very difficult.” Eric’s description of his autonomy built on the ideas of Danielle and Flora because he connected this autonomy to how he was able to implement his dialogic instructional practices:

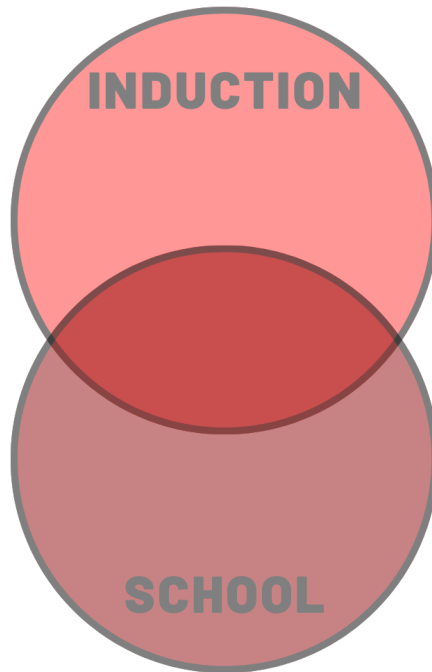
There's very little oversight, for better or for worse, because [my school] is so big. So, I have a lot of freedom. A lot of teachers have a lot of freedom to do what they want. As long as the kids and parents are happy, [the administration] is not going to bother you too much about what you do, which I have really liked and benefited from, because I can implement more progressive pedagogies with math.

Eric’s sense of autonomy allowed him to implement the type of instruction being promoted by Desert Valley and also kept him from feeling any tension with the ZPA from his school. In this way, the autonomy the four teachers shared feeling helped them feel alignment between their school and induction ZPAs.

School and Induction ZPA Tension

Five teachers, Bonnie, Charlie, Hannah, Jackie, and Kenzie, shared sensing tension between their school and induction programs, Figure 22. This made it challenging for them to determine what practices to use in their classrooms. Ultimately the teachers had to make decisions about which ideas from both ZPAs they would adopt in their ZPD. All five teachers did not make the same decisions about which ZPA to more closely attend to. Like the other teachers, these teachers also had many mentors and supports coming from their induction program and school.

All of the teachers, in both Oceanside and Desert Valley, had an induction program coach who provided them with different promoted actions. However, they also had other coaches, administrators, and professional developers promoting other actions. Charlie said, “I had my on-site coach, but then there's also the induction program coach.” He was not alone in having multiple coaches; Kenzie shared, “I could always go to like my actual mentor, that was in the school as well.” On top of her school mentor Kenzie also had a district level mathematics instructional coach, “Our district did have a math specific person where we had to go to professional developments with them.” Bonnie similarly had other professional development opportunities as her school was partnered with West Ed. She spoke about West Ed, “So we had West Ed in here last year and the year before.” Across all of the teachers, each one mentioned at least one other mentor, coach, administrator, or colleague in their school ZPA. Each of these people promoted different actions in their classrooms.

Figure 22*School and Induction ZPAs in Tension*

For these teachers what was being promoted by their induction program and what was being promoted by their school did not always align. Charlie shared his experience with this tension saying:

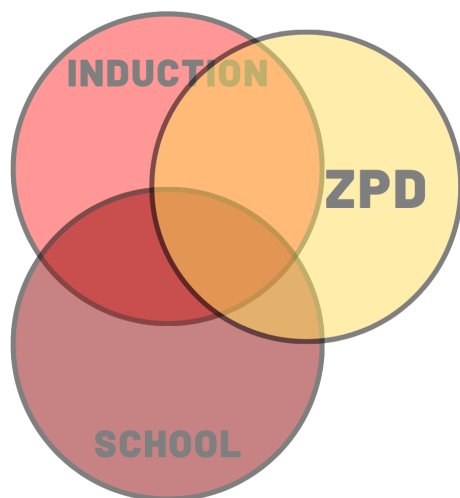
I mean, my school's pretty relaxed on their own teaching, because there are just some teachers who try to stick to more traditional routes, but then our induction program has more student-centered routes that they like to try and teach.

Charlie articulated how the focus of Desert Valley was on dialogic instruction but many of the teachers in his school were using traditional teaching approaches. Kenzie also articulated a concern that what she was learning at Oceanside did not match what was happening in her school, she said, “With the whole group discussion stuff, no other teacher at my school was doing that.” She was wrestling with the tension she was feeling

between her induction program ZPA and her school ZPA. Charlie and Kenzie's experiences were similar to Jackie's, except she had even more mentors, she stated, "My only complaint is when I have three different people, and I'm meeting with them every other week or every week, none of them were ever on the same page." All of the teachers felt tension between their multiple ZPAs. However, they each had to negotiate which ideas they would end up utilizing in their classrooms.

Figure 23

Alignment of ZPD and Induction ZPA



For Bonnie, Charlie, and Hannah this meant taking up the ideas of their induction program at the cost of alignment to their school ZPA, Figure 23. Bonnie said, "We had some stints of clashing [my school and Desert Valley], but again, I fell back on my Desert Valley stuff." While Bonnie was experiencing tension at the end of the day she decided to align her instruction with Desert Valley. This was similar to Charlie who said:

The [other teachers] stick with the district model to a T. I did get to see a few other teachers teach, which it's been pretty standard. Mine's a little bit different,

because I have a stronger emphasis on inquiry, rather than just doing the simple I do, we do, you do.

Charlie recognized that his dialogic instructional practices were different from his colleagues more traditional peers. This meant that while there was tension between his school ZPA and his Desert Valley ZPA he chose to align himself with Desert Valley.

Hannah clarified how she decided where to align her instruction to, stating:

I think it just depends on what I think the kids would benefit from, either the workbook or the engaging lesson. And I have chosen the engaging lesson over the workbook before, and it has worked out. It's just not all the time, because I think that the workbook has, like, specific things that the engaging lesson doesn't, or vice versa. Especially when it comes to getting them set up for success, as far as the benchmark testing, and like the verbiage of the question sort of thing. It's very similar to the verbiage of the book.

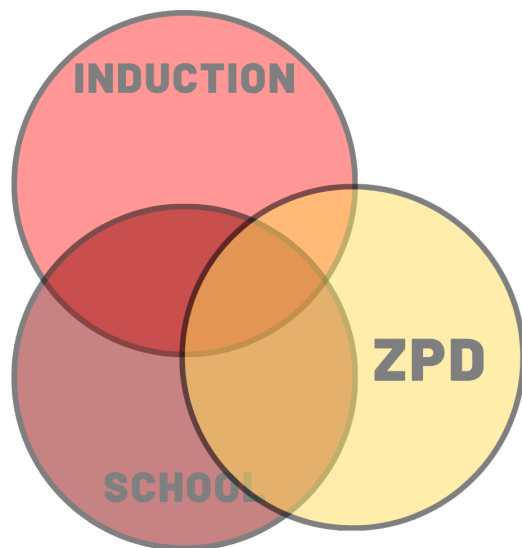
Hannah's decision to align herself with her induction program or her school ZPA depends on what the needs are of her students (ZFM). While the school and Desert Valley are promoting her to use drastically different instructional practices, she makes the ultimate decision of her practice based on her other zones.

Both Jackie and Kenzie typically tended to implement instructional practices that were more aligned with their school ZPA, Figure 24. Jackie was feeling a lot of tension from all of the members of her ZPAs, so she addressed them because they were not aligned. She said:

Whenever they kept coming at me with all these different ideas to do in the classroom, or different ways of doing my lesson plans, different ways of doing

things. I finally went to all of them, and I said, ‘Look, y'all need to start getting together and figuring out what is something we can work on monthly — things that you can have a topic for us to work on, like classroom management, and we try something every week. But all of y'all have got to be on the same page, because when I have four people coming at me, four different ideas that are different things, it's too much. If it's too much for me, what's going to happen with my kids?’

Jackie recognized the tension that was happening in her multiple ZPAs and asked the people promoting different instructional practices to make changes. Once they did, she felt some alignment but ultimately, she asked her induction coach to align their practice with her schools. For example, her Oceanside coach tried to provide her with a lesson plan template, and she said, “This doesn't work with what my school wants. My school's template was two pages.” In that moment Jackie made the decision to align her instruction with her schools ZPA. Kenzie also made this choice by utilizing all of the notes and other materials that her colleagues provided her. Kenzie shared, “I just relied on the other teacher who was teaching the same classes I was. I was really leaning on her, because I don't know what I'm doing.” In this way Kenzie was more likely to take up the ideas of her colleagues than she was potentially from her induction coach.

Figure 24*Alignment of ZPD and School ZPA*

Across the five teachers it was clear that 1) they recognized that there were two ZPAs, one from school and one from their induction program, and 2) those two zones were in tension with each other. As the teachers navigated the tension two chose to in someways disregard their school ZPA and only take up their induction ZPA, two did the opposite, and one alternated between the two as best fit her students' needs. While a tension between the two zones may not be ideal for teachers, it could actually be better than teachers instead perceiving that ZPA as one large zone encompassing both their school and induction program.

One Large ZPA

The last group of teachers, Ana, Isabel, and Luis, were different than the other teachers because they did not articulate perceiving two distinct ZPAs, from their school

and their induction program, instead they viewed it as one large ZPA that encompassed both sets of promoted actions. The teachers in this group were more likely than their peers to feel that they had to serve all the masters, meaning they felt pressure to try any and every idea that was suggested to them. They did not state prioritizing ideas or notice conflicts between what was being promoted by various people in their ZPA. The lack of awareness that ideas were contradictory pointed to the idea that teachers were not seeing two zones in tension or alignment, but instead one large ZPA.

Ana, who was part of Desert Valley, was being promoted to implement dialogic instructional practices and she was excited about those ideas, she said, “I was so enthusiastic about it and trying to promote it.” She wanted to use the different tasks like Notice and Wonder in her classroom and find different ways to engage students. Furthermore, she wanted her students to have the feeling of figuring out the mathematics on their own, another dialogic strategy:

It feels good when you kind of figure things out on your own. So, I can't imagine why they wouldn't like that feeling of, 'oh, I kind of figured something out without [the teacher] just spelling it out for me.'

While Ana heard those ideas being promoted at Desert Valley at the same time the other teachers in her school were using notes regularly, and so she fell in line with that practice, she said, “I started teaching, it was notes, then practice.” However, Ana never stated recognizing that these notes were in direct conflict with the ideas she was agreeing with from Desert Valley. Isabel had a similar experience. Isabel shared struggling with students who were not engaged in class and after talking with some other teachers they gave her an idea to get them involved. She shared:

[the students are] too afraid to ask for help, so I incognito tried to sneakily go over there and help them. So, I'm not making a big scene in front of the whole class that they don't know how to do it, because I don't want them to feel embarrassed or anything.

This strategy helped Isabel to get her students more engaged. However, her induction coach also suggested that she try another strategy to get students engaged, she shared, “popsicle sticks. I'd write the kids names on them for each class. Then to make sure that kids were paying attention, I would pull a random stick out and be like, ‘Okay what's my next step to solve this problem?’” Isabel shared feeling excited about both of these strategies but did not articulate that she saw them as conflicting. Both Ana and Isabel took up conflicting ideas that they did not think about as being in tension or alignment with each other.

The teachers who had one ZPA tried out many ideas from various sources. Luis discussed his experience of incorporating various ideas from different members of his ZPA.

So, I did talk to my other teachers, some of the older, experienced ones, some of the younger ones. I talked to the content coach about what their experiences were, about some of the challenges I was facing.

Luis indicated that he sought advice from various members of his ZPA, without considering any particular member's advice to be more significant or aligned than that of others. Just as he shared that he got advice from veteran teachers, he was also equally likely to get advice from novices. These many sources of ideas led the teachers to try any and all ideas. Ana characterized her willingness to try anything when she said, “I picked

from a list, because obviously they were telling me a lot, and I would just pick a couple and try it. There really was no system to what I tried.” Isabel shared a similar sentiment, “So with me I’m going to at least try it once to see how it works. If it’s a complete bust, then maybe I can modify it the next time and see if it’s a little bit better.” The teachers all articulated a willingness to try any idea that was shared with them. When Isabel shared that if something did not work, she would modify and try it again, it implied that anything could work in her classroom with small modifications. Teachers with one large ZPA were not considering how the ideas were interacting with other suggestions they had already implemented in their classrooms.

The three teachers with one large ZPA all shared that they had a lot of support from their induction program, school, and district. They articulated an appreciation for the support and were all eager to take up the ideas and suggestions of their colleagues and peers. However, they did not consider if all of those ideas were attending to the same goal, or conflicting goals. Furthermore, the teachers did not have a filter for picking and choosing what ideas to implement in their classrooms. The teachers shared how hearing from all of the different voices in their ZPA was overwhelming at times, and in some ways, this contributed to Ana leaving the field of teaching at the end of the year.

Summary

Across all twelve teachers there were three ways the promoted actions of their university-based induction program interacted with the existing promoted actions of their school. One group of teachers felt a strong alignment between their two ZPAs stating that what they were asked to do in their school was well aligned with what their induction program was asking. All of those teachers were part of the Desert Valley induction

program and were at schools where they perceived having the autonomy to implement the type of instruction they wanted. Another group of teachers felt tension between their school ZPA and their induction ZPA. These teachers recognized that they were being asked to do things that were contradictory and not always aligned with their other zones. When the teachers were faced with these conflicting promoted actions, they shared that they had to make decisions about which ideas to take up. Finally, the last group of teachers did not perceive any tension or alignment between the ZPA of their induction program and school because they did not appear to have a way of filtering which ideas might supersede others. These teachers felt obligated to try every suggested idea. Furthermore, they tried out different ideas that were contradictory. All the teachers, regardless of their induction program, fell into one of the three categories, suggesting that regardless of the induction program, it is the teachers own frame of reference, and potential ZPD, which influences how they navigate their multiple ZPAs.

CHAPTER 5: DISCUSSION AND IMPLICATIONS

In this final chapter, I discuss the main findings of the study and the connection to previous literature. I then address the implications of the findings when considering mathematics education research, teacher preparation, or future induction programs. Finally, I address the limitations of the study and draw a final conclusion.

Discussion

When examining the findings highlighted in the previous chapter, two main points of discussion became clear. First, there is a need to move beyond retention as a measure of induction program effectiveness. The findings of this study suggest that, while all but one teacher planned to remain in the teaching profession, teachers still experienced multiple tensions, some of which were exacerbated by their induction program. Thus, I recommend that research on induction programs consider additional means of determining program effectiveness. Second, different structures of professional development (i.e., ambitious vs incremental) have both strengths and weaknesses for supporting beginning mathematics teachers.

The findings from this study support and extend the work of Goos (2008b) suggesting that teachers may have multiple, interacting ZPAs. How those zones interact can have drastic impacts on what ideas teachers take up. The teachers who had aligned ZPAs shared that they had tried out many of the promoted actions in their classrooms. The teachers who had conflicting ZPAs had to navigate that tension by determining which promoted actions to internalize and implement. Teachers who did not have multiple ZPAs tended to feel overwhelmed as they tried to enact all of the promoted actions with no rhyme or reason.

Through the lens of zone theory (Goos, 2013) I was able to show how the promoted actions of two university-based teacher induction programs interacted with teacher school context (ZPA/ZFM). As others have found (Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; Hammerness & Matsko, 2012; Wang & Odell, 2007; Weschler et al., 2012; Wood & Stanulis, 2010) school culture and climate can have lasting impacts on the experiences of beginning teachers in induction programs. These findings suggest that providing an additional, external ZPA can be beneficial for teachers as the ideas may be more aligned to their own goals (e.g., Bonnie, Charlie, & Hannah). However, this additional ZPA has the potential to create unforeseen tension for beginning teachers, which can be challenging for teachers to navigate. For programs wanting to promote a specific type of instruction, understanding the ZPA of the school can help induction providers understand potential tensions and work to bring teacher zones into alignment.

Moving Beyond Retention

As discussed in chapters 1 and 2, teacher learning is an ongoing process, part of which involves teacher induction (Feiman-Nemser, 2010; Ingersoll & Strong, 2011; Stanulis et al., 2007). For beginning teachers, induction can increase retention (Allen, 2013; Ronfeldt & McQueen, 2017; Smith & Finch, 2010), help with socialization into the profession (Bickmore & Bickmore, 2010; Feiman-Nemser, 2010; März & Kelchtermans, 2020), and provide teachers support in learning to teach (Feiman-Nemser, 2010; Voss & Kunter, 2020; Wang et al., 2008). While findings from studies on the effectiveness of traditional teacher induction have found mixed results (e.g., Reeves et al., 2022; Weschler et al., 2012) studies of university-based teacher induction have mainly focused

on effectiveness as it relates to teacher retention (Bastian & Marks, 2017; Zugelder, 2019) or the content of the induction programs (Hammerness & Matsko, 2012; Maloch et al., 2022). The present study adds value to the current body of knowledge by providing a comprehensive analysis of university-based teacher induction programs from the viewpoint of novice mathematics teachers, which moves beyond retention. The utilization of zone theory (Goos, 2013) enabled an in-depth investigation into the ways these induction programs support novice mathematics educators within their given school context and suggested an adaptation of Goos' (2013) zone theory.

Previous studies have found mixed results related to the impact of induction (Reeves et al., 2022; Weschler et al., 2012). However, many studies of induction have focused on teacher retention as the main measure of effectiveness (Allen, 2013; Bastian & Marks, 2017; Guarino et al., 2006; Ingersoll & Stong, 2011; Keese et al., 2023; Ronfeldt & McQueen, 2017; Smith & Finch, 2010; Zugelder, 2019). This study suggests that looking beyond retention may point to additional areas of effectiveness or the need for increased support for teachers. Specifically for university-based teacher induction programs, the added ZPA these programs create for teachers requires additional support for teachers to navigate added pressures and tensions. Understanding how the teachers are experiencing the induction program can help to provide nuance to the impact of induction on beginning teacher learning.

University-Based Teacher Induction Programs in Context

One of the goals of this study was to investigate a new version of induction programs housed at universities rather than provided by schools. As mentioned in chapter 2, one of the limitations of traditional K–12 induction programs are that the school

culture can limit what beginning teachers learn and implement from their induction programs (Andrews & Quinn, 2005; Kelly, 2004; Kutsyuruba et al., 2019; Weschler et al., 2012). University-based teacher induction programs have the unique feature of existing simultaneously inside and outside of a given school culture. Thus, I hoped, when addressing RQ1b, to understand the interaction of the promoted actions of these induction programs (ZPA) with the given school culture (ZPA/ZFM). One main takeaway from this study is that some teachers perceived two ZPAs, one from their induction program and one from their school. These cases show how induction programs have the potential to create additional tension for beginning teachers as they navigate their two ZPAs.

The Problem with Two ZPAs

The premise that two ZPAs could potentially exist for teachers was suggested by Goos (2008b) who stated, “It is significant that prospective teachers develop under the influence of two ZPAs, one provided by the university program and the other by the supervising teacher(s) in the practicum school, which do not necessarily coincide” (p. 295). This study provides evidence to support that multiple ZPAs can, and do, exist for teachers. As the university-based teacher induction programs exist outside the school context they promote a unique set of actions that can differ from the promoted actions of the school. This point was most clear when Jackie discussed how she had four different mentors all promoting her to use different pedagogical strategies in her classroom. She was able to recognize that those actions were not all aligned, and she reported telling her mentors that they needed to find a way to align themselves so that she could manage implementing all of the promoted actions they were requesting.

For half of the teachers who experienced two distinct ZPAs, they described tension between their school and induction program ZPAs. These teachers conveyed a sense that they had to negotiate which promoted actions they wanted to internalize and implement. Both Jackie and Kenzie tended to lean towards promoted actions from their school ZPA, while Charlie and Bonnie took the opposite approach, and Hannah switched back and forth depending on ZFM. Had the induction program not introduced a conflicted set of promoted actions, the teachers would not have had to navigate these tensions.

Teachers who experienced tension could benefit from additional support in making decisions on what promoted actions to select or help in bringing their zones into alignment. Jackie had to advocate for herself to help reduce some of the tension she was feeling between her competing ZPAs, but not all teachers did this. Adding an additional ZPA has the potential to bring new tension into the experience of beginning teachers, and this is something that university-based induction programs, or other professional support providers, should consider as they decide on how to promote these actions.

Learning to Teach Mathematics

A second goal of this study was to understand the experiences of mathematics teachers as they transitioned from the university to the teaching profession. As mentioned in Chapter 2, the field of mathematics education has made a strong push for dialogic instructional practices to be utilized in classrooms (AMTE, 2017; NCTM, 1989; 2000; 2014). For this reason, many teacher induction programs have taken up this call and focused their methods courses on these practices (Alles et al., 2019; AMTE, 2017). Yet, little is understood about how those instructional practices continue to be utilized once

teachers enter the teaching profession. A few researchers (i.e., Jansen et al., 2017; Morris & Hiebert, 2017) have addressed this concern by investigating what teachers learn in their methods courses and how they continue to utilize those practices in their first few years of teaching. Prior research (Lewis, 2014; Nolan, 2016) has suggested that beginning mathematics teachers face challenges as they navigate these two-worlds: the university and their school context (Anagnostopoulos et al., 2007). I hypothesized that not only could university-based induction programs serve as a bridge from university to school but also that they could become a mechanism for helping beginning mathematics teachers implement dialogic mathematics instruction. In answering research question 1a I found that this, for a few of my participants, was in fact the case.

A Continuation of Teacher Education

For Charlie, Flora, Grace, and Hannah, the ideas of Desert Valley mirrored that of their university teacher education program. All four of the teachers shared that they entered the teaching profession with clear visions of their mathematics instruction, strong content knowledge, and an understanding of dialogic teaching practices (ZPD). As they participated in the Desert Valley induction program, they heard the same dialogic ideas about mathematics instruction reiterated. Furthermore, they shared how they implemented those strategies in their classrooms including using whiteboards for group work, Notice and Wonder routines, and other mathematical tasks that reflected dialogic principles.

Regardless of what their school was promoting, all four teachers aligned themselves with their Desert Valley ZPA. For Flora and Grace there was already alignment between their multiple ZPAs, so they articulated being able to easily

implement the dialogic instruction promoted by Desert Valley. For Charlie and Hannah, they described tension between what their school was promoting them to do and what they wanted to do. Yet, both of these teachers continued to align themselves with the practices promoted by Desert Valley, regardless of the promoted action of their school. This small sample demonstrates the potential for a university-based teacher induction program to support beginning mathematics teachers, bridging what they learned in their teacher education program and their first year of teaching. Furthermore, it demonstrates the potential for these programs to support beginning mathematics teachers in implementing dialogic instruction in their classrooms, regardless of, or even in spite of, their school environment.

Supporting All Teachers to Implement Dialogic Instruction

While one of the goals of this study was to understand how university-based teacher induction programs serve as a mechanism for supporting teachers in their transition to the classroom from teacher education, not all teachers enter the profession in this way. Furthermore, the focus on mathematics teachers was to understand how they might learn about and implement dialogic instruction in their mathematics classrooms when their colleagues may not be using these approaches.

For the rest of the Desert Valley teachers, they entered the profession through alternative certification pathways. As not all teachers who enter the teaching profession after participating in any sort of program or course work (Johnson & Birkeland, 2008), it is hard to know if the ideas Desert Valley promoted aligned with their prior experience; none of the teacher's mentioned that it did explicitly. Desert Valley was able to support the alternatively certified teachers to expand their ZPD to include the dialogic practices

promoted by the induction program. This is powerful because it provides some insight into ways that alternatively certified teachers can begin to learn about and implement research-based teaching practices in mathematics. All the alternatively certified teachers, except for Ana, shared that they were able to learn about and implement some of the dialogic practices suggested by Desert Valley. It is interesting to note that for Danielle and Eric there was no tension between their induction and school ZPAs, so they described feeling capable to implement the tasks, and other dialogic practices, suggested by Desert Valley. For Bonnie, there was tension, but like Charlie and Hannah, she chose to align her ZPD with that of her Desert Valley ZPA, instead of her school's. This small sample suggests the potential of these induction programs to support all teachers in implementing dialogic instructional practices.

However, for Ana, this was not the case and one of the driving factors in her struggle to expand her ZPD to include dialogic instruction came from her tensions with her ZFM. As Ana expressed a desire to take up the ideas of Desert Valley, she continued to articulate her students' inability to participate in and understand the tasks presented. Therefore, she chose to employ more traditional instructional practices. This suggests that while a clear dialogic vision for mathematics instruction promoted by an induction program (ZPA) can expand teacher ZPD and thus influence practice, tensions with teacher ZFM can have lasting effects on how many of those ideas are implemented in a teacher's instruction.

Professional Development for Mathematics Teachers

Moving beyond the research questions, this study provides a unique look at two different forms of professional development. According to the teachers in Desert Valley

there was a large focus on dialogic instructional practices, which was not the case for the Oceanside teachers. Additionally, the Desert Valley teachers articulated feeling tension as they tried to implement practices that they were not familiar with, which aligns with the findings of Nolan (2016) and Lewis (2014). For the teachers in the Oceanside program, they did not experience as many of these tensions mainly because their supports were more closely aligned to their own instruction and thus, they were not being asked to make drastic changes to their instruction. One lens through which to make sense of these two forms of professional development is what Otten and colleagues (2025) refer to as *transformational* and *incremental* professional development (PD).

Transformational PD (Otten et al., 2025) is characterized as having a clear goal or focus of the PD that is removed from current more traditional teaching practice. The promoted actions of transformational PD may be difficult to implement as it typically is dialogic in nature which requires strong content and pedagogical content knowledge. Incremental PD (Otten et al., 2025) on the other hand is more modest in its goals for teachers. Otten and colleagues (2025) outline a few models of incremental PD but for this discussion I focus solely on their *modest-goal-with-support* incremental approach, which I will refer to as incremental PD. This form of PD focuses on smaller goals for teachers that are more closely aligned with their existing practice and thus can be more traditional in nature. Both forms of PD require continued support for teachers in the PD as they learn about the ideas and begin to implement them in their classroom. In what follows I share how Desert Valley can be viewed as transformational PD whereas Oceanside provides an example of more incremental PD. I share some potential benefits and challenges of each approach through the lens of the small sample of participants in my study.

Desert Valley as an Example of Transformational Professional Development

In transformational *PD* (Otten et al., 2025) there is a clear vision of dialogic instruction that is promoted by the *PD*, in this case that vision was aligned to *BTC*. Teachers in the Desert Valley program initially learned about this vision from attending Saturday sessions where they shared engaging in mathematical tasks and learning about *BTC*. The teachers then had buy-in, which for some teachers, like Bonnie, Charlie, and Eric, was easy. On the other hand, it took Danielle almost half a year in the program before she finally took up the ideas. After buy-in comes sustaining the practices and spread, which was similar to how Eric and Flora shared their ideas with other teachers at their schools. Desert Valley provides a clear example of transformational *PD*, which show the potential benefits and challenges of this professional development approach.

For example, one benefit of transformational *PD* is it is well aligned with research based best practices for mathematics instruction and typically aligned with what beginning teachers are learning about in their preservice teacher education (Sowder, 2007). This was the case for the teachers in the Desert Valley induction program. The teachers shared how they learned about these dialogic instructional practices, such as having students work in groups on mathematical tasks. Furthermore, Flora experienced a clear connection between what Desert Valley was teaching her and what she learned from her teacher education program. Another benefit of transformational professional development as presented by Desert Valley, was that teachers were clear on what they were learning about. All of the teachers in the program were able to clearly articulate what they were learning from Desert Valley. Furthermore, they understood the goal and purpose of each of the elements of the program in supporting them to implement the

ideas from *BTC*. The teachers understood what they were getting from their induction program. The final benefit of transformational PD is that it can have big impacts on teacher practice. While some of the teachers, like Eric and Flora, were already implementing the practices they were learning about from Desert Valley, most of the teachers were learning the ideas for the first time. Many of the teachers, with the exception of Ana, were able to implement at least some of the practices into their typical instruction. The teachers were able to begin to implement some of these practices because the ZPA of Desert Valley was aligned with their ZPD. For Danielle, her time at Desert Valley had extensive impacts on her ZPD as it shifted over time to become more and more aligned with the ideas promoted by Desert Valley. In this way, transformational PD helps teachers to expand their ZPD by incorporating dialogic teaching practices. This shows that transformational PD has the potential to have significant and lasting impacts on teacher practice.

On the other hand, engaging teachers in transformational PD can be challenging for a number of reasons. First, as it is asking teachers to make substantial changes to their instruction, it takes a lot of time, effort, and energy. All of the Desert Valley teachers had to attend monthly, four-hour Saturday sessions to learn about *BTC*. While many of the teachers enjoyed this time, it did take a lot of time out of their schedule. Flora even shared that she would not have stayed in the program if she was not being paid to participate. For teachers like Ana, what was being asked of her was too much to sustain. Her principal had said to her, that she should not be working harder than her students. Ana believed in this idea and in her view implementing *BTC* in her classroom meant working harder than her students, so she did not implement it. As Goos (2008b) shared,

“For learning to occur, the ZPA must engage with the individual’s possibilities for development (ZPD) and must promote actions that the individual believes to be feasible within a given ZFM” (p. 296). For Ana, the ideas being promoted by Desert Valley were not feasible within her ZFM. Second, the ideas of transformational PD may not be well aligned with what is being promoted in the school. Three of the Desert Valley teachers felt tension between their induction ZPA and their school ZPA. For these teachers many of their colleagues were utilizing more traditional teaching practices, and this made it difficult for them to navigate. For example, Bonnie’s colleagues were using a typical notes system where students followed along and then did individual practice. She had to decide if she wanted to implement the dialogic instruction that Desert Valley was promoting, which aligned with her ZPD, at the risk of causing conflict with her colleagues, or do the opposite. Bonnie made the choice to ignore some of the more traditional promoted actions from her school in favor of the more dialogic approaches of her induction program. She also did not feel she had the support from her administration to implement dialogic instructional practices, similar to findings from Nolan (2016). One participant ultimately decided to move to a different school at the end of the year to alleviate some of the tension they were feeling, which is one path Goos (2013) hypothesized teachers would choose when their zones were in tension. These challenges with transformational PD are significant and have the potential to diminish the impacts of the PD.

Oceanside as an Example of Incremental Professional Development

Through the lens of Otten and colleagues (2025) Oceanside can be viewed as a case of incremental PD as many of the promoted practices were designed to be aligned

with teacher ZPD and ZFM. The suggestions were small in that they were practices teachers could take-up quickly, such as trying an exit ticket or rearranging desks in the classroom. As compared to Desert Valley, which was asking teachers to have students work in groups on mathematical tasks and then facilitate a whole class discussion. Furthermore, they were closely connected to teacher existing practice, as the coaches were asking teachers what they wanted to learn more about. Once teachers have experienced initial learning about the practices they have buy-in and continue to use them in their classroom, which was the case for the Oceanside teachers. Similarly to transformational PD, incremental PD has its own set of benefits and challenges.

There are a few notable advantages of an incremental approach to PD, which were highlighted by the teacher's engagement in the Oceanside induction program. First, the changes are modest in nature and thus easier for teachers to implement. Whereas the teachers in the Desert Valley induction program were asked to make substantial changes to their practice, many of the suggestions from Oceanside coaches were much smaller in nature. The benefit of incremental PD is that the modest nature of the PD focus makes it easier for teachers to implement. For Ana and Danielle, it was challenging to implement the big ideas shared from Desert Valley yet, none of the teachers from Oceanside articulated a similar concern. For example, Jackie was struggling with students focusing during class and her Oceanside coach suggested she switch from tables to desks. This change was not difficult for her to implement, and she was able to switch to desks in her classroom. A second benefit of incremental PD is that it is closely aligned to teacher existing practice. This was the case for Kenzie who shared wanting to implement exit tickets in her classroom, her Oceanside coach sought out different exit ticket options for

Kenzie to try out. This suggested practice was close to what she was already doing in her classroom and thus made it easy for her to take up. Isabel was using interactive notebooks, and her coach suggested some tasks that would fit nicely in her interactive notebooks. The small nature of the suggestions made it easy for teachers to internalize and implement. This was mainly because the promoted action of Oceanside was aligned with teacher ZPD and ZFM. As many of the suggestions were already aligned with these two other zones, the teachers felt like they were able to implement the suggested practices. Furthermore, as the incremental PD was closely aligned with teacher existing practice this meant it did not create new tension with the teacher's school ZPA. For two of the teachers, they did not articulate experiencing two different ZPAs, meaning the promoted actions of the induction program were so closely aligned with their school they did not see them as distinct.

While incremental PD can be beneficial in that it is closely related to teacher existing practice, a limitation may be that it does not push teachers to expand their ZPD as much. While many of the Desert Valley teachers talked about how the induction program shifted their vision of instruction this was less true for the Oceanside teachers. Many of them were mainly supported to implement practices that were already in their ZPD or very nearly aligned. This meant there were no large changes in their ZPD only small shifts. A second challenge of incremental PD is that since the suggestions are so closely related to teacher existing practice it is hard for them to recognize the impact the induction program is having on their practice. During the interviews the Oceanside teachers mainly referenced their induction program only when specifically asked about it. The teachers did not bring it up when talking about their practice or how their practice

has been shaped. In this way the impact of the program is harder to study and assess because the teachers do not identify it as distinct from either their own practice or the initiatives at their school. This could also explain why two of the Oceanside teachers only had one ZPA.

Summary

Desert Valley and Oceanside provide a unique comparison of transformational versus incremental PD (Otten et al., 2025). The findings from this study suggest that both methods of PD can help to support beginning teachers and help retain teachers in the profession. More transformational PD can have large impacts on teacher practice, which is more aligned with dialogic instruction. This can expand teacher ZPD and improve their content and pedagogical content knowledge. However, transformational PD can also create some additional tensions for teachers as it may not align with their ZPD or ZFM. Furthermore, it has the potential to create an additional ZPA which can then be in tension with a teacher's school ZPA. This tension makes it difficult for teachers to implement the ideas of the PD and can even cause them to feel overwhelmed, as was the case of Ana. On the other hand, more incremental PD can be closely aligned with teacher existing practice and thus easier for teachers to implement in their classrooms. The feeling of alignment between the ZPA of incremental PD and a teacher's other zones reduces the amount of tension they might feel, as was the case for the Oceanside teachers. This reduction of tension has the potential to have lasting impacts on teacher retention. However, this form of PD does not push teachers to try practices that expand their ZPD. There is limited opportunity for, what Goos (2008b) calls *productive tension* which pushes teachers to grow and learn new practices. Additionally, the impact of incremental

PD is hard to study as it is so close to teacher practice that the teachers even are less likely to articulate the impact of the PD on their own instruction. Overall, the two forms of PD were successful in helping the teachers feel supported in their first few years and both have room for improvement.

Implications

Given the discussion points highlighted above, there are many implications for research, teaching, and induction programs in general. In the following section I highlight the implications for each of these domains as well as address the limitations of this study and identify opportunities for future research.

Implications for Research

Previous studies of teacher induction have found school culture and climate to have significant impacts on teacher practice (Andrews & Quinn, 2005; Bickmore & Bickmore, 2010; Wang & Odell, 2007; Weschler et al., 2012; Wood & Stanulis, 2010). The results of this study support these findings as five teachers felt tension between the ZPA of their induction program and the ZPA of their school. This tension teachers experienced mainly stemmed from their school wanting them to engage in a different type of instructional practice than aligned with their ZPD or their induction ZPA. For example, many of the teachers at Bonnie's school were using traditional instructional practices, but Bonnie did not want to do this. For Bonnie, the support of her induction program helped her to push back against the traditional instruction of her school, but for Jackie and Kenzie this was not the case. While other studies of induction have focused on programs that exist inside of the school setting, university-based teacher induction programs exist outside of the school culture. It is for this reason that these induction

programs could be more effective at helping teachers to implement instructional practices that may not align with their school, like Charlie, Bonnie, and Hannah.

Second, from a theoretical lens, this study builds on the work of Goos (2008a, 2008b, 2013, 2014). In prior work Goos (2013; 2014) had presented ZPA as one zone which had the potential to encompass school culture, other colleagues, external sources, and teacher education. In one instance (Goos, 2008b) mentioned the potential for multiple ZPAs. This study builds on her work by finding evidence to support that teachers can perceive multiple ZPAs. For nine of the 12 teachers, the way they discussed their school and induction program suggested they experienced two ZPAs. Future studies might also work to identify if teachers are experiencing more than one ZPA, which could be in tension or alignment with their other zones. Understanding these multiple ZPAs can help researchers understand why teachers do, or do not, take up different promoted pedagogical practices. Furthermore, there was some initial evidence to suggest teachers may have multiple ZFMs. Jackie said, “For the most part, I would pick and choose some of the ideas they had would work in one class, but wouldn't work with my other classes.” Jackie is providing evidence to suggest that she perceives each of her classes as different ZFMs. While Jackie was the only teacher to mention this, it is worth further investigation.

Third, from a methodological perspective, I was able to utilize zone diagrams as a method of analysis. Goos (2014) included some diagrams to help represent two teachers in her case study, similarly I created diagrams for each of the teachers. However, I used the creation of the diagrams as part of my analysis. Looking across the many diagrams allowed me to identify potential themes and cases to analyze, which is different than how

Goos (2014) had utilized the diagrams previously. Drawing the zones for each teacher can help to characterize the experiences of the teacher in their given setting and clearly show significant tensions or alignments.

Implications for Mathematics Teacher Education

As the mathematics education community continues to push for dialogic instructional practices (AMTE, 2017; NCTM, 2014) and university teacher education programs prepare future mathematics teachers to implement these strategies (Bosica et al., 2021; Sowder, 2007) we need more research exploring how these ideas get taken up after PSTs graduate. Building on the work of Nolan (2016) and Lewis (2014), this study provided a deeper understanding of how beginning mathematics teachers can learn to adopt dialogic instructional practices. Furthermore, the findings suggest that with the type of support offered by Desert Valley, teachers who may not initially have a dialogic vision of instruction can expand their ZPD over time, like Danielle did. Furthermore, most studies have focused on beginning teachers coming out of traditional teacher education. Half of the teachers in this study came from alternative certification pathways. This suggests that university-based teacher induction supports for beginning teachers have the potential to help all teachers, not just traditionally certified, implement dialogic instructional practices.

Second, the results of this study highlight the importance of asset-based views of students, which teachers did not articulate as a goal of either program. A key factor in Danielle shifting her ZPD, while Ana did not, was the difference in how both teachers discussed their students. There were many times during Ana's interview where she mentioned deficits her students had related to their ability, knowledge, and behavior.

Danielle refrained from making such references. When discussing areas for student improvement, she took responsibility for student challenges and acknowledged the influence of external factors on student knowledge, ability, and behavior. The same was true for the teachers who had two or more years of experience. These teachers were more likely to not view student ability as a limiting factor in their ZFM. Teacher beliefs, especially about students, can have lasting impacts on their instruction (Boyd & Ash, 2018; Giboney Wall, 2018; Raymond, 1997). This study supports this claim as the teachers, like Ana, who had more deficit views of students, were less likely to implement more dialogic practices in their instruction because they thought the students were not able to complete the tasks. Teacher educators can play a key role in guiding beginning teachers and PSTs to develop asset-based views of students. It is worth considering whether Ana's experience and retention in the teaching profession would have been more positive if her perceptions of students were more asset-based. Had this been the case it would have reduced some of the tension she felt between her ZFM and her other zones. Future research might investigate how teacher educators help PSTs to develop asset-based views of students and if those views are sustained once teachers enter the teaching profession.

Implications for Induction Programs

While prior research has looked at the impact of university-based teacher induction on teacher retention (Bastian & Marks, 2017; Zugelder, 2019), the relationship between beginning teachers and their mentors (Maloch et al., 2022), or the design of university-based induction programs (Hammerness & Matsko, 2012; Stanulis et al., 2007), few have focused on the interaction between these programs and the school

context. Building on this prior work, this study provides additional insight into how university-based teacher induction programs support beginning teachers in their context. This investigation uncovered the potential of induction programs to create additional tension and pressure for beginning teachers. Additionally, looking beyond teacher retention allowed for an understanding of some of the challenges beginning teachers face such as navigating the constraints of school rules and procedures, supporting students of all abilities, and developing their vision of instruction. Further research is needed to understand the relationship between teacher, induction program, and school more closely. This study mainly utilized teacher self-reports and interviews; observations may uncover the impact of the induction program on teacher instruction more clearly.

Second, this study investigated two types of professional development transformational and incremental (Otten et al., 2025). The results from this study demonstrate the value and potential of each type of support for beginning teachers. When designing support for new teachers, induction programs should consider what outcomes they aim to achieve from participation in the program. If the goal is for all teachers to utilize dialogic instructional practices in their classrooms than a transformational PD approach is logical. On the other hand, if the goal is to help teachers feel success quickly, reduce tension they feel in their job, or make modest improvements to instruction than an incremental PD approach is more sensical. Both programs had similar retention rates so if that is the goal then either method of PD would be sufficient. Regardless of the approach induction providers need to ensure they are addressing potential challenges. For transformational PD, induction programs could find ways to mitigate the additional tension they may be creating as teachers navigate two ZPAs. One way they could do this

is by identifying what initiatives schools are already promoting and then finding ways to align their dialogic ideas with the school ideas. This would take the work off of the beginning teachers to find ways to merge the two sets of promoted actions. Additionally, they could prepare participants for how to navigate this tension. For incremental PD, induction programs could find ways to expand teacher ZPD by providing modest suggestions that are still pushing teachers to think about teaching mathematics differently. Just because a suggestion is small does not mean the idea has to be something a teacher is already doing. While there is extensive literature about transformational PD, more work needs to be done to understand the impacts of incremental PD. It is worth considering whether incremental PD can assist educators in achieving dialogic instructional practices over time.

Third, this study found that while too much tension between teacher ZPD and other zones can lead teachers to leave the field, like Ana, too little tension is also an issue. For Eric and Flora, their ZPD encompassed the ZPA of their induction program. Although one might assume that the optimal condition for zone alignment is complete overlap, the results of this study indicate otherwise. For Eric and Flora, the lack of any tension between their ZPD and their induction ZPA led to a lack of growth. As Goos (2008b) shares, productive tension is important for teacher growth and development. These two teachers experienced no tension and thus their growth was stunted. As induction programs provide supports and professional development for beginning teachers it is important they understand teacher ZPD so they can provide appropriate tension. This tension leads to growth, development, and engagement from the teachers.

Limitations

One of the main concerns with case study research is related to validity. Meriam and Tisdell (2016) recommend many strategies for establishing validity including reflexivity, triangulation, member checking, and peer review. While I initially set out to collect more rigorous quantitative data as an additional point of triangulation, I was unable to do so. Furthermore, I only collected two forms of data. While the interviews with teachers were long and addressed all my questions, an additional point of data collection such as collection of teacher resources or observations would have worked to further establish validity. This data could have helped me to better understand teacher ZPD not only as reflected through their words but also through their actions. Additionally, it would have helped me to identify more clearly what practices they were implementing in their classroom, a further reflection of the overlap, or tension, of their zones. I also did not have the time necessary for member checking. That being said, I did receive feedback on my work multiple times from my advisor and other colleagues in my office as an opportunity for peer review. Furthermore, I spent a lot of time reflecting on my work through my multiple rounds of memos and different analytic decisions.

A second limitation of my study was that I did not have equal size groups of teachers from each program. As is demonstrated by my individual case findings, chapter 4, I was able to write substantially more about the Desert Valley program as compared to Oceanside. While part of this is due to the nature of the programs and what teachers shared, had I interviewed more participants from Oceanside I believe the depth of the findings for the program would have been more robust. The same can be said for my quantitative analysis. Initially I had hoped to have more survey participants to run more

rigorous quantitative analysis, but I was unable to recruit additional participants. My limited response rate for both the survey and interviews could have limited my findings.

Conclusion

While induction has been a large part of the teacher education process for many years, universities-based teacher induction programs are relatively new. For mathematics teachers specifically, the findings of this study suggest that these induction programs can have substantial impacts on teacher practice, especially as it relates to dialogic practices. However, induction programs need to consider how they are helping teachers reduce tension they feel between their various zones and not adding to it, but in a way that does not eliminate all productive tension. As Goos (2008a) stated, “creating induction and mentoring programs that promote a sense of individual agency within the boundaries of the school environment” (p. 87) are critical for the success of induction programs. The findings of this study support this claim and serve as a call for future induction, and other PD programs, to consider how the ideas they are promoting are feasible within a teacher’s given school environment.

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Appendix A

Beginning Teacher Survey

First Name:

Last Name:

Which of the following best describes you?

- | | |
|---|--|
| <input type="checkbox"/> American Indian or Alaskan Native
<input type="checkbox"/> Asian/Pacific Islander
<input type="checkbox"/> Black or African American | <input type="checkbox"/> Hispanic
<input type="checkbox"/> White
<input type="checkbox"/> Multiple Ethnicity
<input type="checkbox"/> Other |
|---|--|

To which gender identity do you most identify?

- Male
 Female
 Non-Binary / Third Gender
 Prefer not to say

End of Block

Start of Block: Beliefs

This section of the questionnaire contains statements about your beliefs about teaching and learning. The ‘Actual’ column is to be used to describe how often you use the stated practice. The ‘Preferred’ column is to be used to describe how often you would like this practice to take place (a wish list).

Role of the Teacher										
	Actual Practice					Preferred Practice				
	Almost Never	Seldom	Sometimes	Mostly	Almost Always	Almost Never	Seldom	Sometimes	Mostly	Almost Always
As the teacher it is my role to deliver factual information to students.										
As the teacher it is my role to										

This section of the survey is designed to help us gain a better understanding of the kinds of things that create difficulties for teachers in their school activities. Please indicate your opinion about each of the statements below. Your answers are confidential.

	Nothing (1)	(2)	Very Little (3)	(4)	Some Influence (5)	(6)	Quite a Bit (7)	(8)	A Great Deal (9)
How much can you do to control disruptive behavior in your classroom?									
How much can you do to motivate students who show low interest in school work?									
How much can you do to get students to believe they can do well in school work?									
How much can you do to help your students value learning?									
To what extent can you craft good questions for your students?									
How much can you do to get children to follow classroom rules?									
How much can you do to calm a student who is disruptive or noisy?									
How well can you establish a classroom management system with each group of students?									
How much can you use a variety of assessment strategies?									
To what extent can you provide an alternative explanation or example when students are confused?									
How much can you assist families in helping their children do well in school?									
How well can you implement alternative strategies in your classroom?									

End of Block: Efficacy

Start of Block: Math Teacher Efficacy

Do you teach mathematics?

- Yes
 No

Skip To: End of Block If Do you teach mathematics? = No

This section of the survey is designed to get a sense of your confidence in your mathematical ability. For each item, please rate how confident you are in your ability to solve mathematics problems in the given mathematics domain. With 0 being you cannot

solve any mathematics problems in that domain and 100 being you are highly confident that you could solve all problems in that domain.

	0	10	20	30	40	50	60	70	80	90	100
Number and Quantity											
Algebra											
Functions											
Geometry											
Probability and Statistics											
Trigonometry											
Calculus											
Modeling											

End of Block: Math Teacher Efficacy

Start of Block: Current Teaching Assignment

Please provide the following information about your school.

State _____

County _____

District Name _____

Building Name _____

Including this year, how many years have you been teaching? _____

Select all the of the grades in which you currently teach students.

- | | |
|--|---|
| <input type="checkbox"/> Prekindergarten | <input type="checkbox"/> 6 th |
| <input type="checkbox"/> Kindergarten | <input type="checkbox"/> 7 th |
| <input type="checkbox"/> 1 st | <input type="checkbox"/> 8 th |
| <input type="checkbox"/> 2 nd | <input type="checkbox"/> 9 th |
| <input type="checkbox"/> 3 rd | <input type="checkbox"/> 10 th |
| <input type="checkbox"/> 4 th | <input type="checkbox"/> 11 th |
| <input type="checkbox"/> 5 th | <input type="checkbox"/> 12 th |

This school year, what is your main subject that you are teaching at your current job?

- | | |
|---|--|
| <input type="checkbox"/> Elementary Education | <input type="checkbox"/> Foreign Languages |
| <input type="checkbox"/> Middle School General | <input type="checkbox"/> Health Education |
| <input type="checkbox"/> Special Education | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Arts and/or Music | <input type="checkbox"/> Science |
| <input type="checkbox"/> English and Language Arts | <input type="checkbox"/> Social Studies and History |
| <input type="checkbox"/> English as a Second Language (ESL) | <input type="checkbox"/> Career or Technical Education |
| | <input type="checkbox"/> Other |

Which statement best describes the way YOUR classes at your current school are organized?

- You instruct several classes of different students most or all of the day in one or more subjects (sometimes called Departmentalized Instruction).
- You are an elementary school teacher who teaches only one subject to different classes of students (sometimes called an Elementary Subject Specialist).
- You instruct the same group of students all or most of the day in multiple subjects (sometimes called a Self-Contained Class).
- You are one of two or more teachers, in the same class, at the same time, and are jointly responsible for teaching the same group of students all or most of the day (sometimes called Team Teaching).
- You instruct a small number of selected students released from or in their regular classes in specific skills or to address specific needs (sometimes called a "Pull-Out" class or "Push-In" instruction).

End of Block: Current Teaching Assignment

Start of Block: Education and Training

Do you have a bachelor's degree?

- Yes
- No

Skip To: Q16 If Do you have a bachelor's degree? = No

What is the name of the college or university where you earned this degree? _____

Which of the following best describes your bachelor's degree?

- It was awarded by your school's College of Education, School of Education, or Department of Education.
- It was awarded by another college, school, or department, not in education.

Page Break _____

Do you have a master's degree?

- Yes
- No

Skip To: End of Block If Do you have a master's degree? = No

What is the name of the college or university where you earned this degree?

Which of the following best describes your master's degree?

- It was awarded by your school's College of Education, School of Education, or Department of Education.
- It was awarded by another college, school, or department, not in education.

End of Block: Education and Training

Start of Block: Certification

Did you enter teaching through an alternative route to certification program? (An alternative route to certification program is a program that was designed to expedite the transition of nonteachers to a teaching career, for example, a state, district, or university alternative route to certification program, like Teach for America.)

- Yes
- No

What is the grade range of your teaching certificate in your current state? (select all that apply)

- Early childhood, preschool, or at least one of grade K-5
- At least one of grades 6-8
- At least one of grades 9-12

What content area are you licensed to teach?

- Elementary Education
- Special Education
- Arts and Music
- English and Language Arts
- English as a Second Language (ESL)
- Foreign Languages
- Health Education
- Mathematics
- Science
- Social Studies and History
- Career or Technical Education
- Other
- None

End of Block: Certification

Appendix B

Beginning Teacher Semi-Structured Interview Protocol

For all these questions, I will start by asking the number question but then only ask the sub questions based on their response. For example, some teachers might attend to the sub questions when answering the numbered question, in which case I would not ask the sub question. Additionally, I will look at the teacher's survey responses prior to the interview and base my questions from that as well. For example, if a teacher feels confident about classroom management, then I might push more as to where that confidence is coming from.

Introduction: Pleasantries/Welcome/Thanks for agreeing to be in my study and for doing this interview with me today.

- 1) How is your school year going so far?
- 2) Can you tell me about your school? What is it like to work there?
- 3) What are your goals for this year?

Classroom Management: I'm now going to ask you some questions related to the survey you took earlier.

- 4) On the survey you were asked some questions about classroom management. Can you tell me about your classroom management practices?
 - a) Where did you learn these strategies for classroom management? (ZPA)
 - b) Are these practices similar to other teachers in your school? If not, what are other teachers doing? If so, are you expected to be doing what other teachers are doing? (ZFM)
 - c) Do you have any policy in your school about classroom management? If so, what is the policy or practice? (ZPA)

- d) How confident do you feel in your classroom management? Is there anything you wish you could change? (ZPD)
 - i) What has hindered you from changing your practice?
- e) Has your induction program taught you anything about classroom management?
 - i) Have you implemented these ideas into your classroom? Why or why not?
 - ii) Is there something related to classroom management you want to learn more about?

Student Engagement: Thank you for sharing that. I am now going to ask you a few questions related to student engagement.

- 5) How would you describe your students' engagement in your classroom?
 - a) What have you tried in your classroom to engage your students in your math lessons?
 - i) How did you come up with these ideas? (ZPA)
 - b) How satisfied are you with the level of student engagement in your classroom? (ZPD) What has led to this level of satisfaction?
 - c) If barriers are mentioned to student engagement: Can you tell me more about the barriers you see in your classroom that limit student engagement? (ZFM)
 - d) What has your induction program taught you anything about student engagement?
 - i) Have you implemented these ideas into your classroom? Why or why not?

Instructional Strategies: Thank you for sharing that. I am now going to ask you a few questions related to instructional strategies.

- 6) What does a typical lesson in your classroom look like?
 - a) How did you decide on this lesson format? (ZFM/ZPA)
 - b) Can you tell me about your lesson planning? (ZPA) Do you work with a team? Is this required? (ZFM)

- c) What policies does your school have about instruction? (ZPA)
- d) What about your instruction are you satisfied with? (ZPD)
- e) What about your instruction would you like to change? (ZPD)
- f) Where do you get most of your ideas about math instruction from? (ZPA)
- g) What has your induction program taught you anything about math instruction? (ZPA)
 - i) Have you implemented these ideas into your classroom? Why or why not?
- 7) How confident are you in your math content knowledge?
- 8) How does this confidence impact your instruction? (ZPD)
 - a) Has your induction program effected your confidence in your math ability? In what ways? (ZFM)

Induction Program: Thank you for talking about your math instruction. This next set of questions are focused specifically on your induction program.

- 9) Can you tell me about your induction program?
 - a) How has the program helped you learn how to teach mathematics? (ZPA)
 - b) What elements of the program (i.e., mentor, pd, summer institute) have been the most helpful for you? Why?
 - c) Are there any topics you wish your program would spend more time focusing on? (ZPD)
 - d) Do you think the ideas your program is promoting align with the culture of your school? Why or why not? (ZPA/ZFM)
- 10) Anything else you want me to know about your induction program?

Thank you so much for talking with me today. If I have any additional questions I may email you, if that is alright with you. I really appreciate your time and hope you have a wonderful day.

VITA

Maria Stewart grew up in Sandusky, Ohio, in a rural farm community. After graduating high school in 2012, she attended Bowling Green State University, where she earned a Bachelor of Science in Adolescence to Young Adult in Mathematics Education. After completing her degree, she stayed at BGSU for an additional year working alongside Dr. Jonathan Bostic to earn a Master of Education in Curriculum and Instruction degree.

From 2017 to 2020, Maria worked as a high school Algebra teacher in Findlay, Ohio. This time was critical for her as she learned about the challenges faced by new teachers as they try to implement dialogic mathematics instruction. In many ways, this time as a classroom teacher inspired Maria to go back to school and work to support new teachers. In the fall of 2020, at the height of the COVID-19 pandemic, Maria started her Ph.D. at the University of Missouri. She graduated in the summer of 2025.

Maria is currently as Assistant Professor of Mathematics Education at Oklahoma State University. She lives in Stillwater, Oklahoma with her husband, James, and their two cats.