

Summer 2019

Decisions Based on Perception: Perceptions of STEM Teacher Leader Job Satisfaction in Rural, High Poverty Schools

Jodi G. Zeis

Follow this and additional works at: <https://scholarcommons.sc.edu/etd>



Part of the [Education Commons](#)

Recommended Citation

Zeis, J. G.(2019). *Decisions Based on Perception: Perceptions of STEM Teacher Leader Job Satisfaction in Rural, High Poverty Schools*. (Doctoral dissertation). Retrieved from <https://scholarcommons.sc.edu/etd/5452>

This Open Access Dissertation is brought to you by Scholar Commons. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of Scholar Commons. For more information, please contact dillarda@mailbox.sc.edu.

DECISIONS BASED ON PERCEPTION: PERCEPTIONS OF STEM TEACHER LEADER
JOB SATISFACTION IN RURAL, HIGH POVERTY SCHOOLS

by

Jodi G. Zeis

Bachelor of Science
Millersville University, 1996

Master of Science
Old Dominion University, 1999

Education Specialist
University of Virginia, 2006

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in

Teaching and Learning

College of Education

University of South Carolina

2019

Accepted by:

Christine Lotter, Major Professor

Jan Yow, Committee Member

Stephen Thompson, Committee Member

Leigh D'Amico, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

© Copyright by Jodi G. Zeis, 2019
All Rights Reserved

DEDICATION

Thanks to my parents, especially my mom, for dreaming big dreams for me and guiding me to see my own personal gifts. Thank you to my husband for cooking or doing the dishes when there was something for me to study or write. To my children, Noah, Logan, Morgan, and Austyn, thank you for your patience and understanding when this took so much time. I hope that you see all that you dream is possible and that the best is yet to be. No matter what the mountain, keep moving forward. To my dogs, Annie, Charlotte, Beckett, Bumble, and Dash, thank you for sitting by me on late nights long after everyone else was asleep.

ACKNOWLEDGEMENTS

I would like to acknowledge some of my classmates, Paul Duggan, Stevie Rodis, James Byrum, Kathy Weatherhead, and Ayan Mitra, an unofficial cohort, who offered advice, a sounding board, and collaboration. Secondly, my committee members, each of whom has provided important insight and a drive to research more deeply. I would like to acknowledge the honest and raw feedback from my co-chairs, Dr. Christine Lotter, and Dr. Jan Yow. Their patience and high expectations helped me to drive research that one day may promote positive change in high poverty, rural schools. Thank you all for your unwavering support.

ABSTRACT

High poverty rural schools face teacher turnover at a rate higher than average schools. Perceptions drive decisions. Workplace circumstance affect what drives the leadership of STEM teacher leaders in high poverty rural schools. Therefore, when STEM teacher leaders leave, they take their unique skill sets with them. Research shows that engagement and self-efficacy, along with professional appreciation lead to a higher retention rate of teachers. Often that is achieved through distributed leadership. This study aimed to determine how leadership experiences shape the professional perceptions of STEM teacher leaders in high poverty, rural schools. Building on previous research this study asked: In what ways do administrators at high poverty, rural, schools perceive they are utilizing STEM teacher leaders; How do STEM teacher leaders perceive that they are utilized to provide and support professional development of other teachers; What administrative factors and teaching conditions promote STEM teacher leadership in high poverty, rural districts?

In this research, the term STEM teacher leader was defined as an educator whose primary responsibility is teaching students in either science, technology, engineering, or mathematics, but works formally and or informally to continue to support other teachers on an on-going basis (Wenner & Campbell, 2017). This research included surveys and interviews of administrators of STEM teacher leaders and STEM teacher leaders. Analysis of their responses showed that turnover of not only STEM teacher leaders, but of administrators, affected the perception of engagement in leadership roles of those

STEM teacher leaders. The research also showed that teacher leaders with high personal efficacy participated in roles of supporting and this encouraged the teachers to continue leading. On this basis, it is recommended that districts actively engage in the development and facilitation of on-boarding processes for schools when new principals arrive. It is suggested that such a process allows for the stability of on-site teacher leadership to continue for an introductory period of time by establishing procedures that allow for some consistency during transition years when new principals arrive. It is also recommended that all teachers receive responsibilities through the practice of distributed leadership, to increase their agency and to allow teacher leaders more time to provide professional development support.

TABLE OF CONTENTS

| | |
|---------------------------------------------------------------|------|
| Dedication | iii |
| Acknowledgements | iv |
| Abstract | v |
| List of Tables | viii |
| List of Figures | ix |
| List of Abbreviations | x |
| Chapter I : Introduction..... | 1 |
| Chapter II: Literature Review..... | 18 |
| Chapter III: Methodology..... | 66 |
| Chapter IV: Results | 80 |
| Chapter V: Conclusions, Discussions, and Recommendations..... | 139 |
| References..... | 188 |
| Appendix A: Participation Letter | 216 |
| Appendix B: STEM Teacher Survey | 217 |
| Appendix C: Administrator Survey | 219 |
| Appendix D: STEM Teacher Leader Interview | 220 |
| Appendix E: Administrator Interview..... | 223 |

LIST OF TABLES

| | |
|-------------------------------------------------------------------------------------|-----|
| Table 4.1: Survey Results Sharing Teacher Perceptions of Administrator Support..... | 82 |
| Table 4.2: Number of Categories Teachers Perceive They Lead Based on Choices..... | 84 |
| Table 4.3: Teacher Perceptions of Time Spent on Leadership Duty | 85 |
| Table 4.4: Perceived Formal Professional Development in the Last Five Years | 112 |
| Table 4.5: Number of Formal Professional Development Roles of Teacher Leaders..... | 113 |
| Table 4.6: Description of Perceptions of Teacher Leaders and Support Received..... | 127 |
| Table 4.7: Teachers' Perceptions of Lack of Administrative Support..... | 130 |

LIST OF FIGURES

- Figure 5.1: Suggested roles to increase distributed leadership.....184
- Figure 5.2: Continuum of professional development support for teachers.....187

LIST OF ABBREVIATIONS

| | |
|------------|-----------------------------------------------|
| EOC..... | End of Course Test |
| PBL | Project-Based or Problem Based Learning |
| PLC | Professional Learning Community |
| STEAM..... | Science, Technology, Engineering, Arts, Math |
| STEM..... | Science, Technology, Engineering, Mathematics |

CHAPTER I

INTRODUCTION

Background and Significance

Introduction. Throughout the United States, teachers in rural areas work to meet the needs of diverse students in high poverty areas. Without a funding base, these schools and districts work off bare minimums while trying to best meet the needs of students (Biddle & Anazo, 2016). With a lack of funds, resources, and personnel, these rural schools struggle to prepare students for college and career due to lack of resources. Where larger, more affluent districts offer comprehensive professional development, content and grade band specific for teachers districtwide, high poverty rural school districts often need to rely on the training of a few educators (Howley & Howley, 2005).

Historically, studies regarding high poverty schools focused on urban schools (National Center for Education Statistics, 2013). As of 2011, one third of all schools served rural areas. These schools serve one quarter of the nation's students. (National Center for Education Statistics, 2013). Specifically, in South Carolina, approximately seventeen percent of the state's students attend rural schools. In fact, Showalter, Klein, Johnson, and Hartman (2017) state:

The majority of those students are minority students living in poverty. These 116,000 students face major challenges. Half of all rural students are students of

color, and 68.5 percent are from low-income families (one of the highest rates the nation). Spending on instruction is low and rural educator pay is below the national average. Achievement and graduation rates for rural students are among the nation's lowest. For example, only 80.6 percent of all rural students and 72.2 percent of rural students of color graduated in 2014, compared to the national averages of 87.3 percent and 77.4 percent, respectively (p.3).

South Carolina ranks as the fourth most critical in regard to rural education, based on factors such as graduation rate and poverty rate. Compared to other rural schools, their graduation rate is lower than many and their poverty rate is higher than most other rural schools, giving this state the overall ranking of fourth most critical in regard to the state of rural education. According to Showalter, et al. (2017), most notably, South Carolina's students rank in "urgent" in educational outcomes, using NAEP as a tool to measure such. The urgency shows in the data. According to Showalter, "80.6 percent of rural students and 72.2 percent of rural students of color graduated in 2014, compared to the national averages of 87.3 percent and 77.4 percent, respectively" (2014). Both science and mathematics performance by rural students in South Carolina rank in the bottom quartile (Showalter, et al., 2017). This means that students not only underperform in content such as mathematics and science, but that their access to quality STEM instructors is limited (Showalter, et al., 2017). They also rank urgent in College and Career readiness based on additional education outcomes such as low graduation rate and the low percentage of students taking AP courses (2017).

Why is this relevant to teacher leadership and professional development? South Carolina holds one of the highest rates of poverty, 68.5%, in rural areas (Showalter, et al.,

2017). Teachers serve as the most direct change agents for student learning (Elmore, 2002), especially in STEM subjects. However, in rural areas, STEM subjects experience a shortage of teachers six times or more of English Language Arts (Showalter, et al., 2017). As education moves to a model for college and career readiness, many of those skills are based on pedagogic skills possessed most often by teachers of STEM. The endeavor to move to STEM and STEM-like models requires not traditional lecture based models, but rather the type of pedagogy provided by successful STEM teachers (Dancy, Smith & Henderson, 2008). Such skills include the need, cross-curricularly, to collect and analyze data, ask questions, collaborate, and inquire (Hoachlander, 2014-15). One of the most effective ways to ensure quality instruction is to provide students with qualified staff (Darling-Hammond & Berry, 2006).

STEM education. STEM education includes the subjects of science, technology, engineering, and math (STEM), or any combination of those skills. Additionally, STEM education includes solving problems by applying knowledge of those areas to collaborate, analyze and discuss through data analysis (Vilorio, 2014). STEM is more than simply the content but rather, it is also the processes used to learn, inquire, analyze, discover, communicate, and invent (Partnership for 21st Century Learning, 2014). STEM includes a multidisciplinary instructional approach that connects one content area to inform another (Peters-Burton, 2014). In order to comprehensively prepare students for future careers in these areas, teachers need to continue to grow their skills and understanding of STEM as it pertains to societal and community needs now and in the future. As such, on-going professional development is essential to continuously best prepare students for such careers. In his report from the Department of Labor and Statistics, Vilorio (2014) outlined

professions for varying levels of talent and education in STEM fields with growing potential. On average, STEM jobs offer a higher salary than those considered non-STEM. If students fail to receive best practices in STEM education, those students face a lower income earning potential for the area of greatest job growth in the United States (Fayer, Lacey, & Watson, 2017). Therefore, it is essential to ensure that teachers who work in STEM education receive on-going professional development and support.

Professional development. Annually, schools develop complex professional development plans in order to introduce new content, strategies, and research to educators. Teachers typically receive the instruction at professional development sessions at the start of the school year, prior to the arrival of students, on other designated professional development days, or during monthly faculty meetings. In between, teachers receive the expectation to implement new information and strategies, and on many occasions, teachers receive little to no follow up training to support the initial learning. Professional development is an essential piece for teaching and learning excellence which potentially leads to the change needed in teaching and learning to prepare students for college and career readiness (Supovitz & Turner, 2000). Most effectively, professional development occurs as a career-long, content or group specific journey, based on standards and goals and based on a teacher's individual growth, with a goal of student learning and achievement (National Council for Teachers of Mathematics, 2010).

At its best, professional development provides collaboration in which peers and education leaders offer support and reflection (Schlager and Fusco, 2003). However, most districts continue to know little about teacher learning that inherently occurs through such development (Fishman, Marx, Best & Tal, 2003). To create effective

professional development programs, districts and schools need to build a solid and comprehensive knowledge-base which includes diverse and differentiated approaches, sustained by teacher leaders, via an on-going support process, in order to create professional development. By using teacher leaders within the school or school system, schools already struggling to find money for all their needs, eliminate or reduce otherwise significant costs incurred by providing outside professional development.

Because funding and time prevent high poverty, rural districts from sustaining hired professional development for all teachers throughout the year, it is essential for those identified as teacher leaders to share their new learning and support other teachers through the process of learning and implementing new best practices and content (Ghaith & Yaghi, 1997; Williams, 2012). Teacher leaders' primary responsibilities include teaching students but, they work formally and or informally to continue to support other teachers on an on-going basis (Wenner & Campbell, 2017). As STEM teachers, they not only teach science, technology, engineering, or math, but STEM actions such as "anticipating outcomes based on background knowledge, making sense of what is observed" (Peters-Burton, 2014 p. 100). These skills are necessary in schools where college and career readiness are now the norm.

Utilizing teacher leaders for professional growth allows for less district spending on professional development. Additionally, using teacher leaders allows for continuity from year to year as teacher leaders share with the plethora of new staff in such rural schools. Teacher leaders also can provide for on-going support and follow through for teachers after initial professional development training (Shearby & Shaddix, 2008).

Unfortunately, many teacher leaders feel as if they never receive the opportunity to lead

colleagues in professional growth. Such support has the potential to serve as a major influence on aligning instruction with effective learning in STEM (Banilower, Heck & Weiss, 2007) by helping other teachers align instruction with effective STEM learning practices as emphasized in current reform documents.

Theoretical Frameworks

Professional growth frameworks. Howley and Howley's (2005) *High-Quality Teaching: Providing for Rural Teachers' Professional Development* provides a framework that contributes to professional growth. They suggest that situated learning for teachers contributes to the most purposeful experiences which leads to more effective teaching (Lave & Wenger, 1991; Wenger, 1998; Howley & Howley, 2005). Researchers suggest that educator learning must be relevant and connected to the needs and situation of the teacher, educators need to receive ample opportunities to communicate about new learning and discuss struggles and successes, and educators need the opportunity to put new learning and ideas into practice (Choo, 1998; Howley & Howley, 2005; Senge, 1994; Wenger, 1998). Situated leadership provides teacher leader support based on each teacher's situation and needs by designing professional development around those needs (Howley & Howley, 2005). Essentially, this reflects that when teachers share their learning experiences with other professionals, both informally and formally, and those experiences connect to relevant needs for those teachers, then change occurs through implementation of shared learning. Howley and Howley also express that effective professional development requires on-going dialogue (2005; Senge, 1994). Additionally, effective professional development requires reflection upon data (Howley & Howley, 2005; Choo, 1998)

Likewise, Senge's (1994) *The Fifth Discipline: The Art and Practice of the Learning Organization* provides a framework that leads to effective professional growth. Senge suggests that in order for professional growth to occur, a shared vision needs to focus the energy of learning (1994). When a teacher leader and other staff share a goal, learning accelerates. This shared goal allows commitment to occur over the long-term. Creating a shared vision among teachers, including teaching leaders, forms a team. (Senge 1994). As such, when teacher leaders are utilized, they can provide ongoing conversations and drive the initiative to continue professional growth through analyzing and discussing the issues.

Distributed leadership. These ideologies coincide with the shared leadership framework (Scribner, Sawyer, Watson, & Myers, 2007). Distributed leadership encompasses the practices of multiple individuals, including teachers, and occurs through relationships and interactions among a variety of school employees. (Crow, Hausman, & Scribner, 2002; Spillane, Halverson, & Diamond, 2001). Schools, especially in high poverty, rural areas, need to rely on more than just the principal to meet the needs within a school. This is due to lower funding and less personnel to fulfill necessary operations for adequate teaching and learning to occur. Contrary to distributed leadership, leading with just the administrators causes a loss of momentum and consistency when the administrators leave (Lambert, 2002). Shared instructional leadership, through the use of teacher leaders, conveys the belief that others in the school have the right, responsibility, and ability to be a leader (Lambert, 2002). Knowledgeable participation, a shared vision, using data to collaborate and act, and reflecting to create synergistic plans leads to empowerment of teacher leaders. In other words, teacher leaders bring skill and support

to teachers who share an interest to grow but need support. Because administrators often struggle to meet the needs of all teachers, utilizing teacher leaders familiar with content and pedagogy needs allows for a collaboration of learning and growth. This in turn results in a greater level of self-efficacy by teacher leaders and willingness to continue leading to help other professionals learn. Research on teacher leadership suggests that collaboration among educators, self-efficacy, and shared interests are essential to sustained professional development leading to student success (DuFour & Eaker, 1998; Lambert, 2002; Newmann & Wehlage, 1995; Schmoker, 1996; Spillane, Halverson, & Diamond, 2001).

Situated learning. A situated learning framework allows the exploration of learning based on the environment around the learner while allowing students to apply theoretical perspectives to engage in science through that natural environment (Sadler, 2009). In the instance of this proposed study, a situated learning framework provides a structure for both the professional learners and their needs, as well as an example to utilize in classroom teaching. The learners and facilitators apply ideas, tools, and resources to examine and support issues in the environment or context (Sadler, 2009). “This perspective suggests that knowing and learning cannot be abstracted from the environments in which they take place” (Sadler, 2009, p.2). This in turns promotes practical and realistic application to share and expand learning in a purposeful way.

Purpose of Study and Rationale

Recent research points out the importance of on-going quality professional development as an essential piece for changing teacher practices (Darling-Hammond, Hyler, Gardner & Espinonza, 2017), as well as the necessity for teachers to build self-

efficacy within their profession (Bray-Clark & Bates, 2003). More importantly, professional development literature primarily focuses on the change in professional practice of the teachers receiving the original professional development rather than the opportunities to share that new learning with colleagues in order to create a more extensive change in practice. To that end, this study examines the perceptions of teacher leaders regarding the opportunity to provide professional development versus the other tasks they are assigned and similarly, it will compare their administrators' perceptions regarding roles and responsibilities of teacher leaders and their impact on professional development.

A great need exists for high poverty, rural schools to improve the professional skills of teachers on an on-going basis, in a sustainable way (Mollenkopf, 2009). Rural teacher attrition often results in schools staffed with inexperienced teachers (Murphy & Angelski, 1997) unfamiliar with the culture and needs of the schools. Likewise, these schools need to build a culture of efficacy and collegiality that contributes to teachers desiring to stay committed to the school and communities where they work (Hulpia & DeVose, 2010). Additionally, job satisfaction of teachers is critical to school effectiveness and school improvement (Firestone & Pennell, 1993; Rosenholtz, 1989).

Although an extensive literature exists on professional development of teachers in high poverty areas, the majority of research available focuses on urban areas (Gutierrez, 2000; McKinney, Haberman, Stafford-Johnson, & Robinson, 2008) and not the professionally isolated, high poverty rural areas which struggle equally with meeting the needs of students. Less literature exists regarding the responsibilities of teacher leaders within the school system, beyond standard teaching duties, within high poverty

rural areas. Because of the high turnover and difficulty in recruiting the highest quality educators in high poverty rural areas, these schools continue to struggle to meet the needs of students (Monk, 2007). Currently, high poverty rural schools rely on general professional development that addresses the needs of the most teachers at one time which limits specific content pedagogy and content development (Jimmerson, 2004). However, many possible factors contribute to this problem. Darling-Hammond et al. (2017) explain:

Well-designed programs must also be implemented well to be effective. Even the best designed PD may fail to produce desired outcomes if it is poorly implemented due to barriers such as: inadequate resources, including needed curriculum materials; lack of shared vision about what high-quality instruction entails; lack of time for planning and implementing new instructional approaches; conflicting requirements, such as scripted curriculum or pacing guides; and lack of adequate foundational knowledge on the part of teachers (p. 20).

Schools, especially those in high poverty, rural areas, need to look inward to create an on-going process with dedicated procedures to ensure proper teacher support and professional development occurs. Therefore, support through STEM teacher leaders is needed in order to provide support necessary to assist with the success of implementing new skills learned in professional development.

This study contributes to the body of knowledge needed to address the obstacles preventing teacher leaders from implementing on-going professional development by examining teacher leadership opportunities and the obstacles that those leaders perceive to prevent them from professionally supporting and developing teachers. It further

examines what affects the ability of teacher leaders to support educators through formal and informal opportunities.

As schools struggle to meet growth and achievement requirements and prepare students as college and career ready upon graduation, teacher leaders hold the potential to help improve instructional learning and support that potentially results in the most effective teaching and learning practices (Senge, 1991). This study examines the responsibilities of identified teacher leaders and the responsibilities bestowed upon them in order to see if they truly receive opportunities to support professional learning. Especially in STEM fields, where content needs rapidly change, utilizing teacher leaders taps the most current information from teachers with the most relevant knowledge and skill (Goodpaster, Adedokun, & Weaver, 2012). When peers share information, such as from teacher to teacher, there is more credibility to those receiving the learning because they are in similar situations to the teacher leaders. To that end, teachers develop self-efficacy through leading within the school. This often leads to higher morale, less days of absenteeism, and longer teacher retention (Lambert, 2002).

Throughout the literature, research shows connection between teacher efficacy and teacher leadership (Mathes & Carlson, 1987; Seltzer & Himely, 1995). Such leadership opportunities include assistance in maintaining a school's sense of purpose, creating collegial relationships with other teachers, and improving instructional practices (Donaldson, 2007). Schlechty (1990) determined that teacher leaders strive to influence peers to become more effective in classrooms when they themselves become active in school change. Gaith and Yahi (1997) determined that similar to Guskey's (1998) findings, a teachers' sense of personal efficacy directly influenced the determination to

implement and share new instructional practices. The rationale for this research is to determine what responsibilities teacher leaders receive above and beyond their teaching responsibilities. Since shared leadership leads to a more positive morale and teacher efficacy, the data examined in this study will serve as a foundation for additional teacher leadership needs. In other words, it will examine what duties teacher leaders receive that other teachers could potentially fill so that teacher leaders would be freed up to provide STEM support and pedagogical support to peers. Future studies could examine what occurs when other teachers receive additional responsibilities encumbering the time of teacher leaders and what occurs when teacher leaders receive time to coach and support colleagues professionally.

The schools in rural high poverty areas historically fail to retain highly qualified educators (Monk, 2007). As a result, these schools end up with the least experienced teachers, from outside of the community, who struggle with teaching in communities different than they are accustomed (Seltzer & Himely, 1995). This occurs because high poverty, rural areas struggle to not only fill but retain teachers. Coupled with low funding, districts need to prioritize spending. Often, when districts decide between necessary materials and opportunities for students and supplies or spending on intense and on-going professional development for teachers, districts choose students (Williams, 2012). For this reason, schools and districts need to focus on training teacher leaders. The use of teacher leaders in such a manner builds self-efficacy among those teacher leaders as they play an essential role in the development of staff. As Darling-Hammond et al. (2017) explain that the most purposeful and meaningful professional development allows for teachers to collaborate in their learning, with a focus on job specific tasks.

Such collaboration and teacher efficacy build communities that positively affect the culture of learning. Additionally, utilizing teacher leaders allows them to provide consistency regarding the professional development of staff, without the school needing to pay for externally provided professional development (Hughes, 2012). Understanding limiting factors for such implementation will help district and school leaders reflect upon current practice to create a more locally effective professional development system.

Research Questions

This dissertation investigated the following research questions:

- 1.) In what ways do administrators at high poverty, rural, schools perceive they are utilizing STEM teacher leaders?
- 2.) How do STEM teacher leaders perceive that they are utilized to provide and support professional development of other teachers?
- 3.) What administrative factors and teaching conditions promote STEM leadership in high poverty, rural districts?

Limitations

This proposed study examined teachers from a ten county area who worked in high poverty, rural schools in a Southeastern state and therefore the study may not be generalizable to other populations. All of these teachers participated in one specific external professional development program, the Noyce Fellows grant, that provided learning in content and pedagogy with the expectation that these teachers then shared learning within their schools as teacher leaders.

The Noyce teachers in this program had all earned a master's degrees prior to entering the program. Each of the participating teachers worked as math or science

teachers at a middle or high school in a rural school. This study examined the roles of these teacher leaders, and their perceptions, regarding those roles. Each teacher completed more than ten years of experience prior to joining the Noyce program. To participate in the Noyce program, the teachers applied, interviewed, and submitted recommendations from their respective principals. Therefore, the population was restricted to those with support from their administrators at the time of application. Through their schools' designation as Title I, all teachers taught at high poverty schools with an average population of seventy seven percent of the students receiving free or reduced lunch. The schools averaged 493 students with a range of 193 to 1255 students.

At the start of the Noyce program that the study subjects participated in, all schools included in this study were designated as Rural Fringe, Rural Distant, or Rural Remote. At the time of this research, of the twelve schools represented, six held the designation as rural fringe, two as rural distant, two as small suburb, one as suburb, and one as small town (National Center for Education Statistics, 2017). Excluded in the study were teachers not involved in the program.

The data for the survey was gathered prior to the interviews, without further questions from the researcher, therefore, there may have been faulty teacher or administrator memory. It is also possible that in some cases, the administrator may not have been knowledgeable about a specific teacher. The survey alone was not enough to measure or determine all of the teacher leaders' responsibilities.

Delimitations

This study focused on one sample of fifteen STEM educators, all with ten or more years of teaching experience. All teachers were certified to teach in the content and

grade level in which they were teaching. Each teacher was an active participant as a Noyce Fellow through a five-year program.

Definition of Terms

1. STEM: science, technology, engineering, and mathematics- this may include any combination of these skills and the engineering process such as collaborating, collecting data, analyzing data, creating, and sharing. STEM includes actions “characterized by the human endeavor of anticipating outcomes based on background knowledge, making sense of what is observed, the use of logical reasoning, approaching unknowns systematically, and the necessity of transparency for the purposes of replicability and evaluation (Peters-Burton, 2014 p. 100).
2. Teacher Leader: An educator whose primary responsibility is teaching students but works formally and or informally to continue to support other teachers on an on-going basis (Wenner & Campbell, 2017).
3. Professional Development: Collaborative effort designed to encourage STEM teachers to understand and change practices and beliefs and in turn, improve teacher efficacy in classrooms both in school and across the district. (Loucks-Horsley 2001).
4. Onboarding: The process of engaging a new employee, in this case an administrator, in a process to learn about all aspects of a school. It offers on-going support to the new employee, so they not only develop an understanding of policy and procedures, but norms and culture, as well.

Chapter II contained a review of literature in the areas of teacher as leaders of professional development, effective professional development for teachers, professional development in high poverty and high minority schools, perceptions of teacher leadership, and professional development strategies for rural schools.

Chapter III described the methodology of this study. The study consisted of a survey for teachers who were identified by a school administrator as a teacher leader. A principal of each teacher received an invitation to complete a survey about those teachers and their activities involving teacher leadership. The principal was offered the option of asking one of the other administrators at the school to complete the survey and the interview. The teachers were interviewed and asked about how their perception regarding obstacles that interfere with opportunities to lead in assisting with professional development and how their opportunities allow them to assist with professional development. Interviews of administrators were compared to teacher' responses to determine if administrators and STEM teacher leaders perceived teacher leadership opportunities similarly. Additionally, the survey data were analyzed to determine trends in perceived teacher leadership experiences.

Chapter IV included the results of the surveys completed by both the STEM teacher leaders and their respective administrators. The chapter then examined the interview responses from the administrators as they pertained to research question one. Next, this chapter explains the responses from the STEM teacher leaders regarding their perceptions of opportunities to lead professional development and the support they receive from administration for doing such. Following that section, the research included a general comparison regarding teacher and administrative responses. The choice to not make a

side by side comparison between teachers and administrators was made in order to preserve the identity of the teacher leaders and their respective administrators. The final section of this chapter looked at both the administrators' and STEM teacher leaders' interview responses regarding perceptions of favorable conditions promoting STEM teacher leadership to support teachers.

Chapter V provided a summary of the results. Through an analysis of the data from both the administrators and teachers, the researcher drew conclusions and answered the three research questions. This included a section of analysis regarding a gap in current research and where further research is needed. Suggestions to use teacher leaders to provide and sustain professional development were suggested, along with a plan for districts to ensure those plans remain in place during times when new principals transition in. Finally, the researcher suggested ways to retain STEM teacher leaders and promote efficacy in high poverty rural districts. The research included suggestions for further research to continue improving the retention rate and efficacy of high poverty, rural STEM teachers.

CHAPTER II

LITERATURE REVIEW

Introduction to Literature Review

A teacher leader is an educator whose primary responsibility is teaching students but works formally and or informally to continue to support other teachers on an on-going basis (Wenner & Campbell, 2017). In addition to typical leadership roles, teacher leadership also includes teachers who lead research groups in their schools, those who write curriculum and design lessons in their districts, and those who work for positive change in the community (MacLean & Mohr, 1999; Stigler & Hiebert, 1999; Moses & Cobb, 2001; Yow, Morton, & Cook, 2013). Teacher leaders know the needs of their schools and colleagues intimately and therefore carry the potential to influence peer learning in substantial ways through peer to peer collaboration. Peer to peer support of teachers' learning can serve as efficient and effective professional development focused on the specific needs within a school (Darling-Hamond, Hyler, Gardner & Espinoza, 2017).

While science teachers need to implement inquiry practices in the classroom, those teachers also need support from teacher leaders to better understand how to facilitate students into applying knowledge while engaging in practices of science (Wilson, Schweingruber & Nielsen, 2015). This research goes on to show that learning occurs in the formats of formal and scheduled professional development, professional

learning communities, coaching, and collaboration with other teachers, such as teacher leaders. While there needs to be a variety of professional development, such content needs to target learning encourages teachers to implement those new skills (Wilson, Schweingruber, & Nielsen, 2015). It is essential for professional development to be considered as long-term and specific within context. While teacher leaders play a role in professional learning, it is imperative that school and district leaders work to continuously build capacity (Wilson, Schweingruber & Nielsen, 2015).

Administrative and Teacher Turnover

What influencing opportunities do teacher leaders receive when new administration arrives or when the teacher leaders themselves transfer to a different school? High poverty, rural schools face a higher rate of turnover than a typical school. Teachers who serve high poverty schools with large numbers of students of color, often feel less compelled to stay because of frustration over inadequate professional development, teaching conditions, and struggling students (Grissom & Truman, 2011). This results in a loss of skill to be shared with the newer teachers because when experienced teacher leaders leave, it is not just with content expertise. They leave with institutional knowledge and the relationships they built within the learning community and with the knowledge of the needs of the students who learn there. Especially in historically hard to staff schools, supervisors serve as the key influencing factor in employee turnover (Jaussi & Dionne, 2004). Research suggests that teacher turnover results in negative effects on school performance, particularly for schools that were low-achieving and served larger high-needs populations (Hanushek, Rivkin, & Schiman, 2016). Effective administrators more successfully retain teachers due to positive school

climates, greater support for teachers and they offer ongoing support for professional growth (Kraft, Marinell, & Yee, 2016).

Grissom and Truman (2018) stated that awareness of teacher leadership is not enough for school leaders to support and retain those teachers. Rather, research shows that teachers stay more often when they experience encouragement and acknowledgement for efforts (Grissom, 2011). As such, Grissom and Truman (2018) suggested principals need to strategize to retain valuable teacher leaders. For example, they may offer leadership opportunities and other desirable responsibilities to inspire those teacher leaders to stay. Despite efforts to retain teacher leaders, what happens when school administrators themselves leave?

Blanton and Harmon (2005) investigated rural school in North Carolina, South Carolina and Virginia to determine the efficacy of capacity building for mathematics and science in rural schools. They wanted to examine sustainable strategies in science and mathematics education in school districts “with a long history of low student expectations, persistent poverty, low teacher pay, and high administrator turnover” (p.6). They sought to address common issues in rural school districts that, in the past, limited the ability of staff to develop sustainable improvements in their math and science programs. Some of the problems they identified included “limited teacher access for professional development activities” and “turnover in key leadership positions” (p.6). In order to sustain professional development that is on-going and purposeful, schools need high-quality and stable school leadership. (Lambert, 2003).

The researchers utilized the Coastal Rural Systemic Initiative (CRSI) model to attempt to build capacity and stabilize turnover in the process. At the time, teacher

turnover was a concern of the schools involved. The process that Blanton and Harmon implemented with CRSI included eight steps for schools to follow. These increments included: developing continuous improvement teams, collecting and analyzing data, self-reflecting, identifying needs of the school, developing priorities to move forward, and applying new interventions (2005).

At the time Blanton and Harmon published their study, which was halfway through the CRSI research, they reported that “100% of principals and 76% of math and science teachers participated in the development and enhancement of their local mathematics and science curricula” (2005 p. 10). This indicated new and increased involvement of administration. The data also showed that the administrators created defined partnerships with mathematics and science departments with the hopes that this would lead to longer administrative tenure.

Hard to staff schools, such as high poverty rural schools, not only struggle to retain teachers, but they struggle to retain administrators as well. With the departure of administrators, school performance and teacher departures often occur soon thereafter (Miller, 2009). Miller examined the consequences of principal turnover on teacher attrition by reviewing the staff changes that occurred following the initiation of new school administration. When new administration is hired from outside of the school, they need to learn the strengths and weaknesses of each member of the faculty. Those who used to serve in leadership roles may find themselves acknowledged less and underutilized as teacher leaders (Miller, 2009). As such, when administrators leave, relationships between administration and teachers change. When positive relationships

with administration failed to exist, either through administrator attrition or through leadership style, significant impact on teacher attrition occurs (Darling-Hammond, 2003).

Boyd, Grossman, Ing, Lankford, Loeb and Wykoff (2011) utilized research to understand why strong teachers leave schools. They examined the “relationship between the assessments of school contextual factors by one set of teachers and the turnover decisions by other teachers in the same school” (Boyd, et al., 2011). They found that teachers’ perceptions of their school administrators significantly served as the most influential reason whether to stay at or leave a school. Administrative support that retains teachers included providing professional development opportunities for teachers and shielding them from negative influences (Hirsch & Emerick, 2007). Ingersoll (2011) also examined similar aspects of administrator influence on teacher turnover. It was determined that limited faculty influence along with general poor support from administration led to dissatisfaction and attrition among teachers, even those with a long history at the school.

Local Systemic Change

Supovitz and Turner (2000) conducted research, based on the National Science Foundation Teacher Enhancement program called the Local Systemic Change Initiative that investigated effective science professional development. Empirically, the study examined whether or not focusing on superior professional development resulted in higher levels of student achievement. The data, collected from 666 teachers represented twenty four communities nationwide and examined teacher beliefs, teaching practices, and demographic information. The research showed that the deeper and more sustained professional development received, the more likely teachers were to utilize the new learning long term in an effective manner (Supovitz & Turner, 2000).

Examining mathematics, technology and science specifically, under the context of local systemic change, Banilower, Boyd, Pasley, and Weiss (2006) investigated the efficacy of teachers' STEM instruction in STEM content with the utilization of the local systemic change framework (2006). As with Supovitz and Turner (2000), Banilower, Boyd, Pasley, and Weiss (2006) also analyzed the efficacy of the National Science Foundation's Local Systemic Change Initiative. This approach focuses professional development at the local level to best address the pedagogical and content needs of teachers. Program-wide the researchers collected data from 2,400 observations over a ten-year period. Banilower, et al. (2006) reported the most personalized and purposeful professional development for teachers. The researchers suggested that when principals actively participate in ways that support teacher leaders and create opportunities for teacher collaboration, a more significant positive change in teaching and learning occurs (Banilower, Boyd, Pasley, & Weiss, 2006). Through analyzing a decade of observations and surveys of teachers and schools participating in the Local Systemic Change efforts, data showed that local reform models focusing on on-going support of a local and specialized nature to meet the needs of schools, resulted in a culture that promoted teacher learning (Banilower, et al., 2006). These environments were effective in creating a culture conducive to teacher learning and in preparing teachers to use high-quality materials and appropriate pedagogy in their classrooms (Banilower, Boyd, Pasley, & Weiss, 2006).

As part of their research, Banilower et al. examined external partnerships through the inclusion of local stakeholders and found that in that context, Local Systemic Change initiatives established "diverse" partnerships with "significant collaborations" with

informal science partners, research institutions, and professional development centers (2006). Connecting these concepts, Lotter, Yow, and Peters (2014), examined the efficacy of pairing school-based instructional coaches with math and science teachers at the middle school level, in order to determine the development of a stronger inquiry model of teaching. This study examined professional development of a longer duration than that of the Supovitz and Turner study (2000). The goal was to examine the establishment of a professional learning community which encouraged inquiry-based instruction. Thirty six middle school teachers and thirteen coaches participated in the study. The format included an initial two week summer training with four follow up sessions throughout the school year for the teachers and coaches. Teachers received content instruction utilizing inquiry lessons, the practice of teaching lessons to middle school classrooms with content and reflective coaching. The coaches had previous middle school experience and received training above and beyond that of most teachers in their schools. Researchers used seven different data collection instruments including: “pre-institute questionnaires, pre-institute inquiry lessons, daily reflections on practice teaching sections, final reflection paper completed after the summer institute, post-institute questionnaires, end-of-the-year questionnaires, and post-institute inquiry lessons.

Lotter, Yow, and Peters (2014) referred to Wegner’s (1998) theory that effective communities of practice involve mutual engagement along with a shared interest and goal which involves a diverse group that works together with mutual accountability. This is significant because in this case, both the coaches and the teachers share accountability and responsibility for teacher improvement and increased student learning through inquiry, via this process, while building teacher leadership. This supports a shared

leadership model which encourages teachers to engage in collaborative professional learning efforts (Wenger 1999). Teachers receive support from other educators and it builds self-efficacy, as well (Wenner & Campbell, 2017).

Kraft, Blazar, and Hogan (2018) examined sixty previous studies to determine the effect of teacher coaches on the instructional practices of teachers. They defined coaching as “an observation and feedback cycle in an ongoing instructional or clinical situation” (Joyce & Showers, 1981, p. 170; Kraft, et al., 2018). Additionally, coaches maintain a level of expertise both instructionally and pedagogically in their fields (Kraft, et al., 2018). As such, the teacher training and support occurs both one on one with the coach and teacher, and also with a coach leading a group of teachers with similar needs. The research sampled for the study examined the coaching interventions, design, and outcomes of teachers and coaches in k-12 schools located in the United States. Coaching was utilized to support professional learning that occurred prior to the coaching (Kraft, et al., 2018). They found that implementing coaching to support professional development, significantly increased instructional change by the teachers (Kraft, et al., 2018).

While Kraft, et al.’s study (2018) considered coaching as a way to support teachers after professional development, Hartman (2013) examined coaching as a way to not only support professional development that already occurred, but as a way to embed professional development throughout the year with mathematics teachers. Hartman investigated the influence of rural instructional coaches and the strategies they used to access teachers’ classrooms to guide instructional practice. She sought to determine how coaching affected trust with teachers along with teacher resistance to new learning.

Howley and Howley's (2004) research regarding the relationship in rural schools determined that the typically smaller size of staff in a rural district promotes close relationships, which have the potential to allow teachers and coaches to work collaboratively in a natural way, without the learning being forced. As such, Hartman, found that by already having an established relationship with the teachers allowed each coach to spend less time establishing a trusting relationship and more time coaching the teachers (2013). This also occurred because with such status, teacher coaches understood the needs and norms of a teacher from a school, community, and teacher's perspective. The data in the research by Hartman, showed that even if the teacher coach had established relationships at the school, connecting with new teachers proved to be challenging and as such, it took significant time to work as effectively with new teachers compared to the efficacy with teachers where a relationship had been established (2013).

Teacher Leader Identity

Shifting from teacher to teacher leader occurs most effectively when teacher leaders receive support and on-going communication from administration (Lieberman & Friedrich, 2007). As teachers engage in "communities of practice" (Lieberman & Friedrich, 2007) it evolves their professional practice as well as how they construe their own actions and identity (Wenger, 1998). Lieberman and Friedrich examined how teacher leaders identify their roles. They found that identifying teacher leadership proved challenging because in previous studies such leadership occurred embedded throughout the teachers' days. Therefore, for their research, Lieberman and Friedrich designed a writing vignette to compare the writing of teacher leaders as a common data source so that they could compare similarities and differences across teacher experiences. They studied teachers identified as teacher leaders with leadership responsibilities within the

school, district, or state (Lieberman & Friedrich, 2007). In addition to the writing, the researches collected a work history of the teacher leaders and their professional accomplishments. They also asked the teacher leaders to address how they viewed themselves as teacher leaders.

Through analysis of the work history and writing vignettes, Lieberman and Friedrich (2007) determined several commonalities that those teacher leaders shared. Those teachers felt moral obligations to “do what is right for students” (p.9). They also concluded that the teacher leaders pursued on-going professional learning of their own. Teacher leaders in the study suggested that serving as a teacher leader often meant supporting others informally and receiving informal, rather than formal recognition for their efforts. Collectively, the data showed that the teacher leaders identified themselves as such because they extended responsibilities beyond their own classrooms to contribute to school wide success in teaching and learning (Lieberman & Fredrich, 2007).

Hunzicker (2017) suggested a framework of characteristics that identifies teachers as teacher leaders. By collecting data from an e-mail questionnaire and self-reflections and completed artifacts from the teacher-leaders, Hunzicker analyzed ten teachers from elementary, middle, and high school who neared completion of a STEM graduate class at the time of the study (2017). She suggested that teacher leadership is more of a way of thinking rather than specific roles. Smulyan suggested that teacher leadership occurred naturally rather than through the receipt of official titles (2016). Like Lieberman and Friedrich (2007), on-going reflection of practice through both informal and formal learning opportunities creates stronger pedagogical skills by connecting their own experiences to new learning (Aharonian, 2016; Hunzicker, 2017).

In addition to reflection of practice, knowledge of content itself creates “credibility among peers, which expands their ability to influences others” in regard to the influence of teacher leaders among peers (Hunzicker, 2017, p. 22).

Compared to peers, teacher leaders exhibited higher motivation to collaborate and support co-workers because they supported teaching and learning and led change to ensure it occurred (Huang, 2016; Hunzicker, 2017). Furthermore, teacher leaders valued environments that offered them both the opportunities to teach students as well as support teachers (Carver, 2016; Hunzicker, 2017). When the teachers initiated opportunities to advocate for both students and teachers they developed influence over teaching and learning within their respective schools (Hunzicker, 2014; 2017). In Hunzicker’s study (2017), the teachers who identified as teacher leaders shared that their influence depended on the level of support from their schools or districts. However, the findings from the study did not present connections between district support and whether or not the teachers perceived themselves to be teacher leaders (Hunzicker, 2017).

Wenner and Campbell studied urban fifth grade teachers by engaging willing principals to identify two “go-to” (p. 6) teachers in the school who the principal felt contributed to the success of school through leadership (2018). The principals and the teacher leaders were interviewed regarding their communities of practice to better understand their perceptions of “competencies, performances, recognition” (p. 7) that occurred through teacher leadership. They also examined the benefits and constraints that occurred as a result of serving as a teacher leader. They then separated how each learning community, or community of practice affected each teacher’s perception and satisfaction of their role as teacher leader (Wenner & Campbell, 2018).

Wenner and Campbell (2018) found that teachers without official leadership titles found it more difficult to label themselves as leaders. They aligned their stance regarding teacher leadership with Carlone and Johnson (2007) that suggested that teacher leadership only occurred through both individual acknowledgement and the acknowledgement by others, as teacher leaders. Wenner and Campbell used the term “thick identity” to identify teachers who consistently viewed themselves as leaders throughout the school and throughout the course of their responsibilities and “think identity” as teachers who saw themselves leading occasionally or in specific and infrequent situations (p. 10).

The research of Wenner and Campbell (2018) provided insight to the varying perceptions that teachers carry regarding their roles as teacher leaders. The data from the research highlighted the varying levels of confidence and comfort teacher leaders have in various situations, which they referred to as communities as practices. The researchers clarified that some teachers identified as effective leaders across settings and felt comfortable in taking the lead to influence change while other teachers who principals identified as leaders felt confident in supporting others and seeking change in specific situations but not on an on-going basis. Furthermore, Wenner and Campbell suggested that the teachers with thick identities, those who led confidently across situations, more effectively contribute to the teaching, learning, and positive changes at a school (2018).

Rural Teacher Leadership

Anderson (2008) examined the role of teacher leaders in rural schools in transforming schools to higher levels of achievement and student success. He examined one school and the role of the teachers who he hypothesized promoted the greatest successful efforts toward transformation of instructional practice. He also referenced

data from a larger study of his, conducted in 2002, from six rural schools. Anderson reflected that in the previous study the small rural schools, which served sixty five to three hundred fifty students, did not have a need for typical teacher leader roles such as lead teachers, department heads, and grade level heads. To that end, Anderson suggested that informal teacher leadership opportunities would serve the growth of teachers and needs of the school more adequately than traditional leadership structure (2008).

For the study, Anderson (2008) chose the teachers based on their ranking of leadership influence offered by other teachers within the school. He also included the principal in the interview. He conducted interviews while focusing on two research questions: “What is the nature of teacher leadership in schools and What are the influences on teacher leadership in schools” (p. 10)? Through the interview, Anderson found that two of the five teachers mentioned that formal teacher leader roles are not used due to the fact that all of the teachers are expected to promote a level of collegiality and direction for professional growth based on individual and group needs (2008).

Through the interviews Anderson (2008) determined that three types of teacher leadership prevail at small rural schools: assuming necessary roles, modifying or extending roles to meet a need, or creating leadership to accomplish a common goal or to fill a need. Significantly, Anderson found that distributed leadership, where teachers assumed roles and influenced change in teacher involvement in the school developed greater satisfaction with their jobs. There was a change also, in reciprocal leadership, where teachers and administrators benefited and appreciated the contributions of each other, influenced the willingness of teachers to continue to take on leadership roles.

Anderson concluded that distributed leadership, where many of teachers take leadership roles to meet the needs of the school, led to a great amount of transformation over time, throughout the school. He suggested that shared decision making among administrators and teachers represents the highest level of distributed leadership (Anderson, 2006; Daresh, 2007; Spillane, 2005). Anderson also determined that informal teacher leadership roles allows for a wider development of talents and creates a larger pool of experts with whom to collaborate (2008). Conversely, by formalizing the process and roles of teachers, talent and opportunities may be inherently missed through exclusion. In other words, if administrators designate roles to specific staff, they exclude others who have talents to offer. Therefore, Anderson (2008) suggested providing opportunities for teachers to share their skills and expertise informally and collectively.

In rural districts, schools often need to accomplish the same rigor and achievement as suburban and urban schools though they often struggle financially to fill all needs (Franklin, 2012). Franklin ascertained that utilizing teacher leaders in high poverty rural schools allowed schools to meet the needs of other teachers and students (2012). By using the strengths of all teachers, leaders created a positive and effective teaching and learning environment designed to meet the needs of most instead of some (Avolio, 2007).

Teacher leaders in high poverty rural schools seek out or volunteer for opportunities to support learning excellence throughout the school, including in classrooms in addition to their own (Franklin, 2012). Franklin suggests that teacher leaders need professional development so they can, in turn, offer on-going support to others. Additionally, teacher leaders need meaningful and purposeful use of their time. Franklin concludes that in order to address the needs of rural schools, those districts need

to “develop teacher leaders who can share their expertise with student, fellow teachers, and administrators alike” (p. 31, 2012).

In order to adequately contribute to school improvement efforts, teachers need to receive on-going support for their professional development efforts (Darling-Hammond, 2013). Often, rural schools do not have practices in place to improve the teaching and learning capacity of teachers. Cherkowski and Schnellert (2017) examined capacity-building of teachers as leaders through collaborative inquiry, with the purpose of teachers learning through on-going and collaborative active learning. Current research supports the theory that in order for school improvement to occur, teachers need to engage in collaborative inquiry regularly by leading and sharing with each other (Muijs & Harris, 2003; York-Barr & Duke, 2004). As such, professional learning along with teacher leadership together, provide a strong foundation for school improvement (Cherkowski & Schnellert, 2017).

Teacher leadership arises through vision and action rather than an assigned position (Cherkowski & Schnellert, 2017). Agency encourages collaboration and growth between teachers as teachers develop a sense of purpose as they lead (Harris & Muijs, 2004). For their research Cherkowski and Schnellert conducted a study in a small rural secondary school. A first year principal, with an interest in inquiry based professional learning and collaboration volunteered the school to participate. In the school, one large group of teachers represented teachers with fifteen or more years of experience, mostly in that community and the other large group of teachers represented new teachers who frequently changed. Teachers were placed into inquiry groups and asked to identify their

own inquiry based learning need to work on collaboratively throughout the school year (2017).

In order to gather detailed analysis of the teachers' collaborative experiences, Cherkowski and Schnellert (2017) applied the case study method of research (Merriam, 1998; Stake, 2006; Yin, 2003). Interviews provided most of the data used and coding those interviews was used to develop themes from those findings. Primarily, Cherkowski and Schnellert focused on the question: "In what ways did teacher leadership emerge through PD as collaborative inquiry?" (p. 5). The results of this study found that collaborative groups of teacher leaders at this rural school, who learned through an inquiry-based process identified three main ways in which this process changed their teaching practices. This included: "(a) Strategic action (e.g., making/carrying out shared plans); (b) Ownership (e.g., deriving a focus, relevance, meaningfulness); and (c) Agency (e.g., feeling of making a difference, motivated to make a difference, sense of contribution)" (Cherkowski & Schnellert, 2017 p. 5). By taking part in developing and facilitating plans, teacher leaders developed a sense of how to utilize shared leadership for change. When teachers received time to discuss issues and inquire about potential needs and solutions, they found success in developing and carrying out plans in regard to their inquiry (Cherkowski & Schnellert, 2017). With teacher-directed and on-going opportunities teachers lead change in teaching and learning practices. The agency and self-efficacy developed through this process contributed to the likelihood that teachers continued to lead and grow through this process.

Rural Teacher Professional Development

Professional development is a collaborative effort designed to encourage STEM teachers to understand and potentially change their practices and beliefs and in turn,

improve teacher efficacy in classrooms both in the school and across the district. (Loucks-Horsley 2001, i). High poverty rural school districts face high turn-over of staff annually. As a result, skills developed to meet school and district needs leave with the outgoing class of teachers and the district starts all over again. Annually, schools develop complex professional development plans in order to introduce new content, strategies, and research to educators. However, professional development topics often fail to align with rural teachers' needs (Jimerson, 2004). Teachers typically receive new professional instruction during professional development sessions at the start of the school year, prior to the arrival of students, on other designated professional development days throughout the year, or during monthly faculty meetings. As such, when teachers receive new information gained through professional development at the start of the year, they typically receive little follow through resulting in little, if any, changed practice.

Rural schools tend to highly underutilize and under-consider teacher leaders for the continuation and facilitation of teacher professional development (Anderson, 2008; Wenner & Campbell 2017). In order to create effective professional development programs, districts and schools need to build a solid and comprehensive knowledge base which includes diverse and differentiated approaches, sustained by teacher leaders, via an on-going support process. This type of professional development supports STEM instruction and serves as a major influence on aligning instruction with effective learning in STEM (Banilower, Heck & Weiss, 2006).

Research on teacher leadership shows that teacher leaders develop an increase in confidence and self-efficacy (Katzenmeyer & Moller, 2001; Lieberman, Saxl, & Miles, 1988), improved leadership skills (Lieberman et al., 1988; Ryan, 1999), and a more comprehensive perspective on how all facets of the educational process work. (Barth,

2001; Ryan, 1999; Wasley 1991). Furthermore, serving as a teacher leader by assisting others in professional growth decreases isolation between teacher leaders and their colleagues (Dehart, 2011; Harris & Muijs, 2005). Teacher leaders also assist colleagues in overcoming resistance to change (DeHart, 2011; Katzenmeyer & Moller, 2001). York-Barr and Duke (2004) explained that teacher leaders change “their instructional practices, in part because their leadership roles afford more opportunities for exposure to new information and practices and more opportunities for observation and interaction with other teachers around instructional practice” (p. 282).

Effective Teacher Instruction

While no one program or set of strategies results in effective instruction across all settings, research provides commonalities among instruction in successful high poverty schools. Instructional success occurs in instances where the full school community collaborates and agrees with what content, pedagogy, performance expectations, occur throughout the school. Kannapel, Clements, Taylor, and Hibshman (2005) explain that effective instruction results as part of a larger collaborative effort, not individual teachers who decide on their own what and when to teach. The research by Kannapel, et al. (2005) determined that successful instruction at high poverty schools occurred when schools provided ongoing, job-embedded professional development regarding instruction.

To examine successful instruction, one must consider pedagogy. Pedagogy consists of the creating of knowledge for the learner through culture and identities (Barton, 1998; Giroux, 1991; Gore, 1993). In effective STEM classrooms, instruction consists of pedagogy that connects to and creates values and beliefs regarding STEM knowledge (Barton, 1998). Barton (1998) researched effective science pedagogy among homeless students. What leads to student success? Through research, Barton determined

that when teaching students of poverty, successful STEM instruction creates a place for science in the lives of such students (1998). In other words, effective instruction relates to students in ways in which they engage to build self-efficacy in applying such STEM skills effectively. Such effective instruction integrates cultural practices that create accountability and purpose among students (Barton, 1998). As such this creates self-efficacy among students learning STEM.

Situated Learning

Situated learning takes authentic, not contrived situations, and encourages participants to learn through application of theory and learning in a purposeful way (Sadler, 2009). Such a learning framework connects the social and physical context where learning occurs (Lave, 1991). In other words, the environment provides the meaning for learning. Sadler suggests that learning and change occur when the participants understand the functions within the culture where the learning and change takes place (2009).

Similarly, teaching content and skills with the expectation that students automatically make connections abstractly to real-life application, fails to support STEM learning in the most significant way (Nadleson, Seifert, Moll, & Coats, 2012; Kelley & Knowles, 2016). Rather, an integrated approach seeks to locate connections between STEM subjects and provide a relevant context for learning the content, in alignment with a situated framework (Kelley & Knowles, 2016). Kelley & Knowles proposed a situated learning framework which connected “situated learning, engineering design, scientific inquiry, technological literacy, and mathematical thinking as an integrated system” (2016, p 4). Each piece in the framework connects common practices within the four STEM disciplines and connects the community of practice.

Authentic learning situations not only leverage the context of the learning but also the social aspects of learning. Furthermore, Kelley & Knowles suggested that when engaging students into a community of practice, learning outcomes need to focus on common shared practices (2016). For example, Kelly and Knowles suggested that instructors need to create situational learning opportunities for leaders to engage with local experts as STEM partners and professionals who can help focus the learning around real-life STEM application (2016). This is essential because STEM related professions require specific skills unique to such content. By including experts, teachers are able to integrate career ready skills into instruction. Through their review of strategies, the authors suggested that in order to most effectively prepare STEM educators those providing instruction and facilitation need to begin by establishing a conceptual understanding of integrated STEM education by providing professional development experiences for in-service teachers that support a strong conceptual framework of an integrated STEM approach and include opportunities to build the confidence of teachers from an integrated STEM approach through on-going support in actual teaching situations (Kelley & Knowles, 2016).

Allen and Penuell conducted research with science teachers to examine the necessity of teacher professional development and how its influence regulates teacher efficacy of implementing standards and their subsequent curriculum and the assessment of student learning (2015). Allen and Penuel (2015) suggested that minimal research existed which, has examined how teachers formulate these judgments about professional development. In their study, they examined how sensemaking affects teachers' responses to professional development related to the Next Generation Science Standards. Utilizing situated learning, where they teachers experienced professional development in their

schools based on their professional learning needs, their study showed that teachers' perceptions of connection between the professional development and their teaching developed from interactions within professional development, related curriculum materials, and with colleagues and leaders in their schools (Allen & Penuell, 2015). They further determined that teachers need to make sense between the new teacher learning, the activities and the intended student outcomes. As teachers engaged in the sensemaking, their understanding of the practices and standards lead to a greater likelihood that they would implement the newly learning professional practices aligned with the standards (Allen & Penuell, 2015). Professional development and support by STEM teacher leaders for teacher leaders allows teachers to experience learning in the same format in which they should teach.

Distributed Leadership

One way to encourage teacher learning to take place situationally, is through distributed leadership where teacher leaders take on roles to support the professional development of teachers. To do so, other teachers take on purposeful non-instructional roles around the school, too. Not only does this allow for teacher leaders to support teachers and their needs, but it potentially develops more personal connections of teachers to their schools. One study further examined the relationship of teacher leadership and a teacher's commitment to school. The framework is based on the belief that teachers with leadership opportunities within the school exhibit greater job effort and involvement and are less likely to leave their positions and display other negative behaviors, such as absenteeism (Singh & Billingsley, 1998.) Furthermore, this framework is based on the theory that schools are not run by just one or two people. Rather, it takes the expertise of all employees to create the most effective and positive learning

environment. In other words, the framework includes distributed leadership, where a variety of different employees carry the responsibility for specific tasks or roles.

Hulpia and Devos (2010, p. 566) utilized the definition of organization commitment as a:

sense of loyalty to the workplace and individual identification with its values and goals. Organization commitment implies that members of an organization wish to be active players in that organization, have an impact on what is going on in it, feel that they have high status within it, and are willing to contribute beyond what is expected of them.

Transformational leadership requires that the organization's leader holds responsibility for sharing the vision and motivating others to carry out the vision. Cooperation in this framework as "a cohesive group with open expression of feelings and (dis)agreements, mutual trust among the team members, and an open communication (Bennett, Wise, Woods, & Harvey, 2003; Holtz, 2004; McGarvey & Marriott, 1997)" (Hulpia & Devos, 2010, p. 266).

Hulpia and DeVose researched the support and supervision of teachers. Their research utilized semi-structured open-ended interviews at four schools with key school personnel including administration, teacher leaders, and teachers. An interview protocol in alignment with the objectives was established and focused on distribution of the support and supervisory actions of the school leaders. It also examined the collaboration of the leadership team and the interactions among the group, in addition to opportunities teachers took to participate in significant decisions at the school (Hulpia & DeVose, 2010).

The seven main coding categories included: setting directions, developing people, supervision of teachers, cooperation of leadership team, social interaction, participative decision-making, and organizational commitment. The researchers suggest, based the findings, that when people feel appreciated and valued, they will more likely meet or surpass expectations (Hulpia, & DeVose, 2010). These categories provide relevance to the proposed research because much of those categories align with roles and emotions examined within the upcoming research. These categories represent aspects of shared leadership which promote learning among teachers as well as purpose and self-efficacy among teacher leaders (Hulpia & DeVose, 2010).

The findings regarding educational commitment aligned with the teachers' epistemic orientation showing that in schools where teachers felt appreciated and actively participated in decision making, the teachers showed a commitment to the organization and exhibited positive behaviors. Likewise, at the schools where leaders and not teachers made decisions, and where teachers felt as though expertise and input was not valued, there was a low commitment, along with low morale. Where distributed leadership existed, and teachers showed commitment; the study found that leadership and opportunities were not equal, however. Often one or two people set the tone and expectations, leading the others in a direction. At the high functioning schools, the support and development of people remained a priority, while at the lower distributed leadership schools, where teachers and staff exhibited less commitment, interest in and support from school leadership remained a low priority. At the schools scoring high with distributed leadership and committed teachers, the research showed that the teachers felt supported and received encouragement to try new things. Additionally, the researchers suggested that the school leaders recognized their drive and showed interest in the

teachers. However, in the schools with low distributed leadership teachers felt as though they needed to solve issues independently and effort and accomplishments received little to no recognition.

The leaders at the schools with low teacher commitment and distributed leadership felt overwhelmed and unsure of how to make the change and struggled to identify why the school exhibited low morale. Teachers with low levels of commitment participated in the minimum required activities, had frequent absences, and lacked strong positive relationships with peers and students. This investigation ties into the teacher leadership study because it connects to the notions that if teachers feel unsupported and not needed than that affects their commitment to schools and improvement.

Wahlstrom and Davis (2008) examined leadership efforts from teachers rather than just from the principal and detailed how interactions between teacher leaders and other teachers impact instructional practices within the school, as with distributed leadership. Utilizing surveys to collect quantitative data, Wahlstrom and Davis evaluated over 4,100 surveys completed by teachers in grades k-12 in schools around the United States. Through the surveys, they looked for relationship connections such as trust and efficacy between teachers and teacher leaders in shared leadership environments. One way in which teacher leaders influence an organization's effectiveness is through creating a positive environment (Hoy, Hannum, & Tschannen-Moran, 1998; Schein, 1992) where teachers lead and share. Wahlstrom and Davis (2008) suggested that shared leadership and professional learning communities led to a greater sense of self-efficacy with teachers and therefore greater engagement in activities, decision making, and with students. The study showed that teacher self-efficacy resulted in high levels of instruction focused on specific and accurate content.

This theory establishes precedence for this study because in order to identify teacher leadership roles, teachers will need to establish what goals and roles make them successful leaders in their current positions. Many teachers fail to see themselves as teacher leaders. Teacher leadership is “not just acquiring knowledge and skills for leadership, but developing a new professional identity” (Hanuscin, Cheng, Rebello, Sinha, Muslu, 2014) . As teachers develop leadership roles, being identified as such might put challenge those teachers if their schools’ norms of isolation and seniority at risk with dominant school culture where norms of isolation, and seniority prevail (Hanuscin, et al., 2014) To counteract such negative forces, Luehmann suggests developing safe spaces where teachers learning to lead can practices their skills without fear of rejection and failure (2007).The study by Criswell et al., (2017) found identity as a teacher leader necessary in order to truly guide teachers as change agents within their schools.

Also examining collaborative approaches to STEM education, the Teacher Learning Continuum (2015) completed research that examined collaborative components of STEM teaching and learning. The characteristics of support included the utilization of specific content and inquiry support rather than broad strategies and generalized professional development. Collaborative components focused on the use of peer learning such as implementing support to colleagues and receiving support through peers by sharing the leadership and professional development responsibilities.

They suggested that the purpose of such support enables teachers to develop teaching and learning which results in systemic changes to current professional development processes. In return, those changes resulted in sustained, career-long learning. Teacher Learning Continuum (2015) suggested that there is a need to create a

system where there are diverse opportunities to grow professionally. This study concluded that science pedagogy needs to reflect the practice of engaged student learning and inquiry in purposeful ways. The study also concluded that teachers themselves fail to obtain “rich” experiences related to the content they teach, and the findings showed this to be even more significant with elementary teachers, as well as in schools with a large percentage of low-income students.

Furthermore, the study concluded that schools or districts spend a low percentage of time specifically developing “collective” teaching capacity within a school or district (Teacher Learning Continuum, 2015). The shared leadership models for professional development will contribute to STEM capacity because they focus on the shared interests of teachers while focusing on their own needs to grow their teaching practices.

Professional development often fails to reach the specific needs of teachers and is also not responsive to the cumulative learning of teachers. While teachers usually receive professional development designed to meet the needs of a general school, school leaders need to develop ways to differentiate for the various needs of teachers who teach science, mathematics, disciplinary core ideas, and science specific pedagogy which supports rigorous student learning (Teacher Learning Continuum, 2015). The study also showed that in order to obtain evidence of growing instructionally most effectively, teachers need to engage in analyzing their instructional practices.

According to the Teacher Learning Continuum (2015) while teacher leaders play a role in professional learning, it is imperative that school and district leaders to find ways to build capacity for teacher learning within the district. These needs of individual teachers must be addressed in order to move to new practices in the science classroom (Teacher Learning Continuum, 2015). Changing professional development topics by

varying goals and approaches, leads to an inconsistent vision and incomplete growth in any one area, which leads to frustration for practicing teachers. Additionally, a teacher's lack of autonomy in determining how growth and practice of new skills occurs, leads to a lack of professional growth, as well as negative views of professional development (Berry & Farris-Berg, 2016). Often, teachers feel as though general professional development pertains to some, and not the entire audience, including themselves (Teacher Learning Continuum, 2015). Others fail to take an interest in the development because they hold the perception that the new topic will soon be replaced with something else. Many lose the vision that "Becoming an effective science teacher is a continuous process that stretches from preservice experiences...to the end of a professional career" (National Science Education Standards, 1996, p.100). Many teachers find deficiency of professional development programs at their school to be the lack of time spent learning, practicing, and refining. Research shows that without such opportunities, significant pedagogical change fails to occur (Fishman, Marx, Best, & Tal, 2003). Therefore, if districts or schools utilize teacher leaders to support personalized and relevant professional development at schools, teachers will engage in a more purposeful way as their instructional skills improve (Teacher Learning Continuum, 2015).

Distributed leadership environment. First, a culture of trust needs to occur within a school where teachers receive not only freedom, but encouragement to collaborate and focus professional growth, not just formally, such as in professional learning communities or staff meetings, but informally through conversations (Hartman, 2013). Schools need to provide educators with the opportunity to try new strategies and pedagogy without fear of penalization (Luehmann, 2007). In order to gauge teaching efficacy, utilizing a team of teachers to observe each other offers a strong tool for honesty

and reflection, as long as the culture of the school promotes the ability to ask tough questions, state specific and necessary goals, and respect diverse perspectives, without fear of retaliation or a negative reflection on an official evaluation (Singer, 2015).

By creating an informal support system, led by teacher leaders, educators receive the ability to develop personal mastery of strategies and content expected from initial professional development (Danielson, 2007). Mastery, a specific level of proficiency, allows teachers to consistently obtain effective results to the goals which matter most to them, by committing to their own on-going learning (Danielson, 2007; Senge, 2006). As Senge states (2006):

Personal mastery is the discipline of continually clarifying and deepening...vision, of focusing energies, of developing patience and seeing reality objectively. As such, it is an essential cornerstone of the learning organization- the learning organization's...foundation. An organization's commitment to and capacity for learning can be no greater than that of its members (p. 7).

To that end, by designating committed teacher leaders to monitor and encourage the continued growth and practice of learning initiatives, it creates an environment of focused determination and specific yet individualized professional growth objectives, related to the school's or district's professional development goals (Senge, 2006). Focusing the on-going piece of professional development within the schools, for teachers, by teachers allows the professional growth to focus specifically on the needs of the teacher and students, specifically at that location, promoting deep and reflective

collaboration resulting in professional growth as well as an increase of student learning (Kise, 2006).

Further research by Kardos and Johnson, Peske, Kauffman, and Liu, suggested that new teachers stay at their jobs when they work in an environment supporting the development of shared responsibility for the school (2001). Encompassing that work, Kardos and Johnson examined shared responsibility with the inclusion of new teachers. Their research examined first and second year teachers over four states. They found that when new teachers work in a school culture that supports professionalism, teachers share a sense of shared accountability. (Kardos & Johnson, 2007).

Peer Coaching

Often, professional development designed at the district level for teachers around the district, is often ineffective because it lacks a connection to the school's site-specific needs (Black, 2007). Peer coaching alleviates the disconnect because it occurs when teachers support colleagues for the purpose of learning new skills, developing new strategies, and sustaining the use of new skills (Joyce and Showers, 1982). Research shows that on-going, relevant professional development which addresses the needs of teachers, in a realistic and practical way, by teacher leaders, offers the most effective way to sustain professional development throughout the year which most dramatically increases effective teaching practices and student learning (Joyce & Showers, 1982). When teachers engage in peer coaching teachers and the coaches engage in problem-solving cohesively, sharing and exchanging ideas (Zwart, Wubbles, Bergen, Bolhuis, 2007.)

Bruce and Ross (2008) suggest that peer coaching serves as specific and focused learning in which teachers provide feedback to each other. In their study, Bruce and

Ross (2008) examined mathematics teachers in both grade three and grade six and how their instructional practice and beliefs changed through peer coaching. Their framework focused on the Social Cognition Theory (Bandura, 1997) and that such work promotes self-efficacy, which in turn leads to a positive change in behavior. Using field notes, teacher surveys, classroom observations, and interviews, the research team examined effective math instruction and how it develops and improves through peer coaching. The research of Bruce and Ross (2008) suggests that pairing teachers with similar competence provides opportunities for teachers to observe and support each other and grow in a non-threatening way. In return, the teachers grow through mutual experiences by attempting and evaluating experiences at similar times to reflect upon best practice. During the research program on Bruce and Ross (2008) teachers learned to focus not on whether or not students attained a correct answer, but rather, the depth of knowledge application of students.

Through the use of peer coaches, the results of the research by Bruce and Ross (2008) showed that the teachers involved in the program more effectively moved their teaching toward a standards-based approach. Second, results showed that initially, teachers' self-efficacy for implementing a standards based-approach tended to drop at the initiation of the peer coaching program. However, at the conclusion, teachers developed a strong sense of self efficacy as shown through a willingness to take risks to strengthen their instruction, as well as through the creation of mastery experiences. Finally, the data suggests that peer coaching lead to on-going self-reflection regarding effective teaching in the classroom.

Charteris and Smardon (2014) examined dialogic peer coaching between teachers to determine whether or not such an approach lead to mutual influences on professional

learning. The researchers implemented a qualitative case study to examine professional development which occurred at the school of each of the nine peer groups. They examined interview data from two years and compared evidence from the peer group teachers as well as from thirteen other teachers who volunteered for analysis. While schools and districts recognize the need for on-going professional development, they struggle with implementing support. Peer coaching potentially leads to and supports sustainable change through professional growth because it builds capacity leading to transformation (Stoll, 2011).

Lom and Sullenger (2010) suggest that the most effective professional development occurs through teachers collaboratively engaging in the identification of problems and then working together to support the change necessary to strengthen teaching practices. More specific to Charteris and Shardon (2014), dialogic peer coaching refers to a process where teacher participants serve as co-learners and co-developers of expertise. Through implementing such an approach, the research suggested that through peer dialogue teachers created an environment for themselves where they shared their reflections, thoughts, and learning as they developed into experts. Furthermore, the research suggested that peer coaches begin to construct solutions based on their collaborative knowledge and continue to learn collaboratively resulting in positive instructional change within the school.

Through research, van Driel, Beijaard, and Verloop examined peer coaching in the context of science education. In essence, they theorized previous efforts to enhance and strengthen instruction failed because such efforts ignored the skills and perceptions of teachers (2001). Van Driel, Beijaard, and Verloop suggest that on-going professional development resulted in the most effective change in instructional practices. They

focused on the importance of teachers' practical knowledge because it is that knowledge which most teachers view as the "core of their professionalism" (2001, p. 142). Therefore, in science education, when teachers with similar interests and goals coach each other, they develop the ability to cooperate, to exchange ideas, implement these ideas, and change their own teaching practices. They further suggest that teachers' experiences and knowledge serve as the starting point for growth and change. In order to effectively implement a peer coaching program teachers and administrators need to collaborate in order to facilitate peer coaching, with the understanding that time is necessary because authentic change in practice takes time, especially as peer teachers develop trust and the unique collegial relationship that occurs through the process (Thompson and Zeuli, 1999).

Finally, research shows that utilizing teacher leaders to support professional development endeavors in the professional growth of teachers allows on-going conversation, learning experiences, and analysis. For teachers of science, it makes the most sense, and data shows, that receiving on-going pedagogical support helps to dissolve misconceptions and to perfect inquiry and engineering practices due to the frequency of support (Loucks-Horsley, et al, 2010). However, ideal situations which provide informal opportunities for learning, access to non-threatening support, and relevant topics of development, offer the most efficacious learning. As with any learning situation, these vary between each situation and can vary even within a school. Ensuring that a large number of teachers receive effective support and learning remains a challenge, even with the teacher leader model. However, when schools offer generic development to meet a general audience of teachers, very few skills transfer to the classroom for an on-going basis, especially when it comes to the implementation of

teaching science (Loucks-Horsely, 2010). If science teachers fail to receive opportunities to change practice by receiving opportunities to implement new skills and content with support from other teachers, they often lack the necessary components to create change in practice (Loucks-Horsley, et al., 2010). Consistently research shows that offering a lead teacher opportunities to promote and support the learning of content and teaching strategies offers the most change in teaching practice. Nevertheless, it is only effective if the teachers understand that on-going collaboration with each other is essential to continued professional growth and improved teaching and learning (Foltos, 2015).

Application of Effective STEM Professional Development

In order for teachers to implement effective teaching that leads to students developing a solid preparation in STEM fields, in a manner in which those students are prepared for college and career, teachers need to receive on-going instructional support (Jeanpierre, et al., 2005). Such a structure requires first-hand knowledge of teacher and student need, the ability to offer support and continued research-based instruction for growth, along with on-going collaboration in a teacher-safe environment. Current educators best address this because generally speaking, "...much of the professional development currently offered to teachers does not meet any definition of effective professional development; current practice is out of step with research" (Jeanpierre, et al., 2005). Teachers need to receive the same inquiry and investigative types of experiences that students receive in order to analyze and thoroughly understand best practices.

Leaders of such support must show mastery of STEM and inquiry skills but also be willing to learn from collaboration (Jeanpierre, et al., 2005), as well. That is why teacher leaders offer the most insight and efficacy. In science education research, the word "change" is often associated with a need to improve practice, content knowledge,

and attitudes (Jeanpierre, et al., 2005), but educators need to accept that change means growth and does not always reflect a negative or something lacking. Because educators develop agency through professional development which they perceive to connect directly to content and situational experiences, directly including teachers in the contribution and participation of such development, creates purposeful learning where teachers feel empowered (Sterrett, 2016).

Implementing STEM skills, whether in science, math, or cross-curricularly, requires refinement, analysis, and practice. With on site-support, educators are able to implement new theory and pedagogy, while facilitating new practice and receiving fairly instant reflection or support afterwards. As utilizing inquiry skills for effective STEM learning builds purposeful discovery by students, it takes practice to refine the implementation of such skills as an educator (Jeanpierre, et al., 2005). With the ability to apply such strategies and to soon after, engage in reflective conversations with school-based coaches, professional learning communities, and other teachers, educators more willingly attempt new skills and ideas as their peers do the same (Allen & Penuel, 2015). With the support of administration, offering teachers the opportunity to lead and collaborate, the willingness of teachers to engage in the use of new learning and strategies fosters growth, not only for teachers, but in the learning of students, as well (Jeanpierre, et al., 2015). In STEM programs, where teachers receive opportunities to “enact, reflect, and negotiate” instruction, the environment through which professional growth occurs, creates the engagement of teachers and coaches, alike, encouraging the practice of inquiry, along with a shared vision and common language (Lotter, Yow, & Peters, 2014, p. 16).

By providing on-site support within a school to encourage the utilization of new professional learning while applying STEM skills, teachers receive on-going coaching and encouragement not only for pedagogy, but for science and STEM conceptions, as well. Frequent maintenance, or collegial contact, creates changes in teaching perception and practices over time, as teachers' core conceptions mesh with the on-going experiences and reflections provided by supportive inquiry-based professional development programs.

When teachers receive support and opportunities to practice the implementation of STEM processes, they begin to view teaching through inquiry as a process of solving problems by implementing a variety of strategies (Lotter, et al., 2014). Encouraging such engagement within a school creates strong learning communities which result in teacher effectiveness, and also prepares students for experiences and success in the future. As Lotter, Harwood, and Bonner (2007) found in one study, often, a teacher's core conceptions regarding the teaching of inquiry drives the way professional development concepts receive implementation in the classroom. In this study, participants received an intense two week professional development program which focused on utilizing inquiry to teach science. In addition to the two week portion, participants received three academic year workshops. With the support through the academic year, the study, which utilized classroom observations, surveys, and interviews to determine inquiry utilization, showed that teachers' conceptions influenced how inquiry was utilized as a teaching tool, and when it was used. This study shows that regardless of the type of support offered, sometimes, in addition to content or new strategies, perceptions or conceptions must be addressed in order to create the greatest amount of professional growth (Lotter et al., 2007). Agreeably, *Designing Professional Development for Teachers of Science and*

Mathematics, (Loucks-Horsley, Tiles, Mundry, Love, & Hewson, 2010), supports that what learners, including teachers, already know, influences learning. Teachers often present a resistance to change despite receiving optimal support and environments for learning.

Luft and Roehrig (2007) conducted Teacher Beliefs Interviews with science teachers semi-structured interview, to investigate the beliefs of new science teachers at the secondary level. They compared those beliefs with those of experienced science teachers. Through the use of the interviews, Luft and Roehrig (2007) compared the beliefs of pre-service, induction, and experienced teachers. The teacher beliefs process with the secondary science teachers gave teachers the opportunity to reflect on their misconceptions. Through the process the teachers also collaborated with other educators and school leaders which led to the development of collaborative experiences (Loucks-Horsley, et al., 2010).

By conducting reflective practice in this way, educators developed accurate and effective STEM related learning opportunities (Luft & Roehrig, 2007). Through the implementation of such an approach through professional development, The educators “Recognize what they do not understand and when they need new learning, recognize strategies needed to assess their own understanding, realize the importance of building their own theories, and recognizing their intellectual strength and weakness.” (Donnelly & Linn, 2014, p, 42). In doing so, teachers develop critical thinking skills and the inquiry skills needed to design curriculum to engage students in inquiry.

Teachers want relevant and interactive professional development sustained over time, by someone who understands their experiences and by someone who treats them like professionals (Bill & Melinda Gates Foundation, 2014). Teacher leaders within a

specific school most likely relate, understand, or at the very least, are familiar with the perspectives, perceptions, and experiences of the other teachers that they are tasked with supporting. Therefore, teachers develop a more responsive approach to professional development (Bill & Melinda Gates Foundation, 2014). Furthermore, working together to focus collaboratively on the planning of instructional design and delivery provides the most effective and meaningful professional development (Bill & Melinda Gates Foundation, 2014). According to the Bill and Melinda Gates foundation (2014) the format of professional development is less relevant, than the support itself. Support should differentiate based on time, teachers, and what needs to be addressed. Some forms of teacher led professional development include professional learning communities (PLC), formal staff meetings, grade level or content meetings, along with informal or formal one on one sessions (Borasi & Fonzi, 2002).

In order to determine the most efficacious programs, Darling-Hammond, et al. (2017) used a comparison group design process and examined student outcomes. They then used a coding system to identify elements of professional development which resulted in the most effective results. Furthermore, they examined obstacles interfering with positive outcomes from professional development. They found that often teachers feel that implementing new skills into teaching takes away from already limited time. In other words, without knowing a return on time investment, teachers are reluctant to try new skills. Research also showed that lack of materials prohibited teachers from implementing new strategies. Lack of materials play a significant factor for strategy implementation in the science classroom. Without the proper supplies, teachers have no way to even try what they learn in professional development. Might this lead to teachers feeling as though the professional learning wasted their time due to the lack of resources?

The authors also found that in urban settings daily distractions interfere with implementing new strategies.

The authors concluded that linking professional development to teacher need and giving teachers a voice in the type of professional development offered leads to more purposeful and well received professional development. Their research also showed that collecting data to evaluate outcomes results in more focused and meaningful development in the future.

Darling-Hammond, Hyler, Gardner, and Espinoza (2017) examined effective professional development programs to determine factors leading to the most sustainable aspects. Their research examined thirty five studies regarding professional development from schools across the United States. They found four commonalities among the most effective professional development programs. These features included focused content, engaging teachers in the learning, collaboration, on-going support, feedback, modeling, and on-going learning (Darling-Hammond, et al., 2017). In other words, teachers need more than one or two sessions at the start of the school year to put learning in to practice.

Teacher Leadership and Perceptions

Whether or not identified teacher leaders informally lead others or if they receive an official title, the first step in understanding STEM teacher leadership and teacher leadership, starts at perception. How do administrators perceive teacher leader opportunities? Does the perception of the administrator align with the perception of the teacher leader in regard to leadership opportunities? The Mathematically Connected Communities Leadership Institute for Teachers (MC2 - LIFT) examined the preparation of teachers to lead the development of exemplary learning environments in their schools and districts. Uribe-Florez, Al-Rawashdeh, and Morales (2014) examined the two year

program, MC2 -LIFT, which engaged thirty-one K-12 mathematics teachers in learning experiences that prepared them for teacher leader roles. Additionally, the schools' administrative staff also participated as a way to support the teacher leaders. To establish the efficacy of the MC2 - LIFT, the researchers examined the similarities of teacher leadership perceptions between both groups.

To evaluate the common ground between teacher leaders and administrators, the researchers utilized the Content Analysis Methodology (Berg, 2009) by utilizing perceptions described on a leadership survey. The researchers of the study indicated that there are some similarities between the perceptions of the teacher leaders and administrators but determined that some perceptions need to be addressed between both groups to further develop teaching and learning (Uribe-Florez, Al-Rawashdeh, & Morales, 2014). This study showed that teacher leaders need to communicate effectively with teachers and administrators. However, at times teacher leaders perceive their roles and responsibilities differently than administrators which leads to miscommunication (Uribe-Florez, et al., 2014).

According to research (Uribe-Florez, Al-Rawashdeh, & Morales, 2014; Harris 2004), principals often fail to perceive teacher leaders as a change agent due to cultural and structural norms. At times, school leadership perceives teacher leadership as threatening in terms of perceived authority and because those school leaders give up some autonomy and control when teacher leaders act on their initiatives (Harris, 2004). Top down cultures inhibit teachers from implementing leadership initiatives (Harris, 2004).

Similarly, Huplia, Devos and Rosseel examined the perception of distributed leadership of teacher leaders in secondary school. Their study examined the connection

between leadership and job satisfaction. They identified leaders, including teacher leaders, as those in the school who collaborated (Huplia, et al., 2009). The researchers distributed a questionnaire to both teachers and identified teacher leaders in an attempt to determine what connection exists between perceived leadership and teacher and teacher leader satisfaction. In order for Huplia, et al., (2009) to develop insight to the perceptions of teachers and teacher leaders regarding formal distributed leadership, they developed the Distributed Leadership Inventory. This instrument attempted to quantify supportive and supervisory positions. Unlike the dissertation, Huplia, et al. examined three types of leadership groups including the principal, assistant principal, and teacher leaders, and the perceptions of leadership among those groups (2009). Through the use of multiple regression analysis of 1770 participants from forty six secondary schools, the researchers found that the more cohesive the leadership team, the more perceived support that team provided, and that related to the educators' satisfaction with their jobs (Huplia, et al.,2009).

Smylie and Denny (1990) also examined the perceptions of teacher leadership. They stressed that in order for change to occur, need at the local levels should be addressed and resources at the local levels need to be utilized. As such, they stressed the importance of using local expertise, such as that of teacher leaders, and applying that expertise to create professional learning. While schools and districts often support teacher leadership, teachers often receive a lack of training to prepare them as change agents (Smylie & Denny 1990). Without preparation, teacher leaders struggle to define their roles and the objectives for peer learning and improvement. The researchers modeled their study after the Lead Teacher model (Devaney, 1987) and included 230 teachers who taught approximately 3,100 students in an urban area.

For the research, two of the questions Smylie and Denny investigated included: “How did the teacher leaders define and perform their new leadership roles?” and “What factors did the teacher leaders believe influenced the development and performance of their roles” (1990, p.242). Thirteen teacher leaders participated in the study. For data collection the teacher leaders participated in a tape recorded interview that the researchers evaluated utilizing the Comparative Method of Content Analysis (Glaser, 1978; Glaser & Strauss, 1967) which identified themes and patterns (Smylie & Denny, 1990).

After analysis, data showed that teacher leaders consistently defined their role as one who supported peers within their own school. A second commonality showed that teacher leaders perceived themselves as responsible for assisting in the improvement of classroom practice by sharing their content expertise and pedagogical insight (Smylie & Denny, 1990). The proposed study will examine the perceptions of teacher leaders regarding their opportunities to support teachers. Those perceptions will be compared to the perceptions their administrators have regarding teacher leader responsibilities.

The researchers also asked the teacher leaders to express the leadership activities they engage in through work. After receiving approximately thirty six different answers, the researchers created categories of similar activities that participants mentioned in the interview. They then created a survey for the teacher leaders in which the participants indicated the activities they participated in throughout the year. The teacher leaders also ranked the top five activities which took most of their time (Smylie & Denny, 1990). My proposed research examines which activities the teacher leaders perceive as purposeful and which they perceive as something that takes away from their time as leaders within the school and which contribute to professional support and growth.

By reviewing the data, the researchers proposed that the roles teacher leaders participated in depended on opportunities and constraints within their individual schools where they developed and implemented their expertise (March & Simon, 1958; Smylie & Denny 1990). Furthermore, they suggested that leadership formation is a phenomenon of organizational development (Bolman & Deal, 1984; Morgan, 1986, Schein, 1988; Smylie & Denny, 1990). As such each component of a school's culture mutually impacts the efficacy of leaders (Smylie & Denny 1990).

Sometimes it is difficult for schools or teachers to define teacher leadership because of the varying models. Teacher leaders often question where they fit in regard to leadership expectations. In addition to coaching, Smylie, Conley, and Marks (2005) examined models of teacher leadership. First, they examined leadership roles of teachers through teacher led research. Teacher research refers to intentional forms of teacher inquiry involving any systematic inquiry in the form of "action research, practitioner inquiry, teacher inquiry, and so on" (Smylie, Conley, & Marks, 2005, p. 168). However, this type of leadership lends itself to individual improvement (Henson, 1996). It arguably also contributes to the knowledge base of the school community, as well (Pappas, 1977). Research may include longitudinal studies regarding school initiatives, efficacy of implementing new practices and strategies, and so on (Smylie, Conley, & Marks, 2002).

Another model, which is discussed in this literature review in more detail, is distributed leadership. With this model, leadership serves as the performance of key tasks by a variety of staff and not just those in formal leadership roles (Firestone, 1996). "When leadership is defined as certain kinds of work, it is more important that the work be done well than that it be performed by a particular individual" (Smylie, Conley, & Marks, p 174). Additionally, Ogawa and Bossert, (1995) suggest that another essential

component to distributed leadership includes the notions that the power and influence of leadership exists throughout at organization and not just within a few selected staff members.

A third model for implementing teacher leadership is through the implementation of teams. In this model, self-managed teams collaborate to influence more effective teaching and increased student learning outcomes (Pounder, 1998). The members in these groups all work toward a common purpose, utilizing their individual talents, without much oversight (Smylie, Conley, & Marks, 2005). Through the implementation of teams, the groups develop as social units that produce work that may lead to the improvement of teaching and learning at the school level (Yukl, 1998). Also, when the teams function effectively, the influence of the group on individual teachers influences “thinking, beliefs, and behaviors” (Yukl, 1998; Smylie, Conley, & Marks, 2005) leading to changed behaviors based on the support of other peers in the group. Regardless of the teacher leader model, it is up to the school administration to promote their support for teacher leaders and the models utilized. It is also up to the administrators to encourage and acknowledge new initiatives and to back initiatives by teachers and teacher leaders to move forward with learning.

Similarly, Garand (2016) examined teacher leaders’ perceptions of their influence on the distributed leadership process at a middle school. This qualitative study suggested that some types of leadership styles better support each other more effectively than others, depending on the various influence of leadership (Fullan, 2011; Northouse, 2012; Shields, 2010; Spillane, Halverson, & Diamond; 2001). “These parts include the interplay of leveled-leadership, the theoretical frames guiding each team member’s leadership style, and transformative vision shared by all team members” (Garand, 2016 p.6).

Garand utilized interpretive qualitative analysis to determine how teacher leaders perceive their experiences within the middle school (2016) as part of a distributed leadership team (Merriam, 2009). For the purpose of this study, all teacher leaders formally received the title of teacher leader from their assigned schools. The researcher asked interview questions to focus on experiential storytelling to answer the perceptions that teacher leaders held through their own perspectives (Garand, 2016). The researcher utilized two rounds of coding to determine meaning from the interviews and to identify significant themes, pertaining to the research. Garand found evidence of self-efficacy among teacher leaders. Furthermore, teacher leaders at schools where principals provided support, perceived their role as leaders to be successful (Fullan, 2014; Garand, 2016). Teachers who received little support or communication from administrators perceived greater challenges and felt they needed to accomplish more (Garand, 2016). The proposed research will add to our knowledge about how teacher leader perceptions affect their encouragement and discouragement regarding work and purposefulness. Furthermore, the proposed research may encourage reflection among school and district leaders around the benefits and disadvantages of teacher leader roles.

Summary of Literature Review

In addition to time spent learning and implementing professional development, schools need to attend to the quality as well as the quantity of professional development (Fishman, Marx, Best, & Tal, 2003). In order to empower teachers and increase the validity and efficacy of professional development, schools and districts need to create a comprehensive plan which implements a variety of formats for learning, time to learn, implement, and reflect, and such opportunities, need to be led by teachers. Teachers who participate in focused and specific professional development activities for more than

eight hours, especially when connected across initiatives for the school, improve teaching, while those involved in less focused, shorter experience fail to improve (Yow & Lotter, 2014). No one method of professional development works for all audiences, nor does it work all of the time. Decisions need to be made based on goals of the school, district, or teacher, while offering sustained and intensive engagement rather than a few workshops or readings (Borasi & Fonzi, 2002).

Intense professional development assists in the improvement of teacher knowledge and creates change in practice but, a combination of types of growth needs to occur. While initial professional development, consisting of one to three sessions with little to no follow up provides an increase in new teacher learning and leads to the implementation of new strategies, the intensity in which the new learning is implemented in the classroom, and the efficacy of student learning is short-lived and makes only minimal impact (Redding & Walberg, 2013). More drastic results emerge when professional developed experiences are deeper and sustained for an on-going basis (Supovitz & Turner, 2000). Research regarding peer coaching suggests that the professional development of teachers improves through “experimentation, observation, reflection, the exchange of professional ideas, and shared problem-solving” (Zwart, Wubbles, Bergen, & Bolhuis, 2007, p. 165). Reciprocal peer coaching promotes opportunities for teachers to engage in professional growth while actively embedding new learning into teaching. Research by Zwart, Wubbles, Bergen, & Bolhuis, (2007) examined teachers who participated in a reciprocal peer coaching and whether or not that type of professional support resulted in a change in teaching practices.

Teachers need to establish subject matter mastery, and such mastery changes as state and national requirements and standards change and as the world evolves.

Additionally, they need to understand student thinking and learning, along with effective instructional practices, which round out essential pieces of teacher efficacy (Borko, 2004). Starting with an initial training for teachers, enables teacher leaders to establish norms and expectations for outcomes. While districts and schools often attempt to implement district wide, or even content or grade level wide professional development, embedding teacher leaders with a dedication, determination, and passion for excellence, who communicate well with others, enables the ability to schedule more frequent updates and support to initial professional learning (Borko, 2004)).

By utilizing the guidance of teachers and designated coaches, professional development opportunities continue, throughout the year, both formally and informally, in ways that most significantly reach the needs of teachers. The most effective and sustained changes take place over years (Borasi & Fonzi, 2002) and therefore even as overall initiatives change, teachers, offer consistency of focus and are able to best integrate new initiatives with current learning goals.

In order to create effective professional learning opportunities, such development needs to include a well-defined explanation of effective teaching and learning in the classroom, opportunities for teachers to continuously build content knowledge as well as teaching skills, the modeling of strategies, learning community opportunities, and the support of teachers as leaders by administration and other teachers (Jeanpierre, Oberhauser, & Freeman, 2005). When administrators trust teachers to lead relevant learning, drive professional growth, and initiate substantial conversations with teachers, teachers benefit from the extra time and support from colleagues, that administrators are often not able to offer due to time constraints, along with the nature of the relationships they have with teachers, as administrators. Additionally, as school administrators work

to encourage the staff to not just learn, but to contribute in the learning process by creating key supports, this in turn, allows teachers to share and produce their own professional development instead of only serving as the receivers of professional development (Sterrett, 2016). A culmination of this research shows that in order to obtain significant professional growth, which continues to result in an improvement of student learning outcomes, professional development must offer a variety of ways for the teacher to learn and practice new information, along with opportunities to fine tune the learning to the specific needs of each teacher and specific students, occur in a culture that offers trust and collegiality without high-stakes evaluation or penalty when implementing new content, strategies, or research, and most efficaciously, and provide continued support and learning opportunities in order to initiate all facets that the complexities of challenging professional development offers.

While initial sessions at the district or all-school level help to ingrain the district's or school's vision with professional development, utilizing teacher leaders most effectively results in professional growth and the likelihood that the new skills and content will be implemented correctly, and on a perpetual basis (Reeves, 2010). Additionally, by utilizing teacher leaders to sustain professional development goals, such learning develops beyond what any two or three day sessions offer, in order to create personalized synergistic pedagogy meeting the specific needs of teachers and students in a specific grade level, content, or school.

When educators as teacher leaders share the responsibility of supporting teachers through distributed leadership, it provides on-going support for colleagues as well as self-efficacy and commitment to the change at hand. Such shared leadership offers interventions for school improvement where educators contribute to improvement

(Spillane, Halverson, & Diamond, 2001). In high poverty, rural school district, resources are limited, and turnover is high. Schools need to rely on STEM teacher leaders to promote success of all students while preparing them for college and career.

Throughout the literature search and review a consistency developed: The current professional development systems, generally speaking, offer varied and inconsistent support for teachers. With high attrition in rural areas, STEM teachers receive inconsistent support and new learning, as schools often fail to utilize teacher leaders as resources in the professional development continuum. Much of the research showed the need for administrative support, access to appropriate materials, and on-going support throughout the year. The resources of Darling-Hammond, Hyley, Gardner and Espinoza (2017), Loucks-Horsely, et al. (2010), and Lotter, Yow, and Peters (2014), among others suggest that teacher engagement in relevant STEM learning, along with follow-up throughout the year leads to a greater likelihood of educators applying new knowledge from professional development into practice. Additionally, much more literature focuses on high poverty urban areas, whereas a gap remains in the study of the unique situations in high poverty rural areas. The research did list lack of time, the need for supplies, and professional support as reasons that professional development often fails to translate into practice in the classrooms.

CHAPTER III

METHODOLOGY

Introduction

High poverty rural school districts struggle to meet the professional growth needs of teachers. With the high rate of attrition large numbers of new and inexperienced teachers enter the workforce. These teachers often need support. One way to alleviate some of this need is for schools and districts to utilize teacher leaders to assist in the professional development continuum. However, even with teacher leaders willing to assist, hurdles prevent the implementation of on-going quality professional development (Anderson, 2012). This study examined whether some of the assumed hurdles truly prevented professional development support and if so, which hurdles lead to the most detriment.

In order to identify the efficacy of STEM teacher leaders in future research, the perception of both STEM teacher leaders and administration regarding the roles of teacher leaders should be considered. To determine such perceptions, it was essential to collect data from both administrators and the Noyce participants regarding their ideas about how STEM teacher leaders were utilized. It was also imperative to further interview the STEM teacher leaders in the Noyce program to gather greater insight regarding their perceptions of their opportunities and abilities to support others.

Research Questions

To determine how school leaders perceived how they utilize identified STEM teacher leaders, and how those teacher leaders perceived they were utilized, the researcher asked the following questions:

- 1.) In what ways do administrators at high poverty, rural, schools perceive they are utilizing STEM teacher leaders?
- 2.) How do STEM teacher leaders perceive that they are utilized to provide and support professional development of other teachers?
- 3.) What administrative factors and teaching conditions promote STEM teacher leadership in high poverty, rural school districts?

Research Design

Type of study. The purpose of this research was to understand the perception of how school leaders utilized identified STEM teacher leaders and whether STEM teacher leaders perceived their roles as purposeful for supporting other teachers' professional growth and support. As such, utilizing a descriptive phenomenological approach to this study supported the most appropriate approach to analyzing such data (Sousa, 2013). Because reality is subjective (Sousa & Santos, 1987) and receives its explanation via "empirical facts" (Sousa, 2013), collecting facts in this manner allowed the researcher to quantify the perceptions and experiences of the participants of the study. Such a study provided insight into the perceptions of the teachers and administrators as well as the attitudes about the roles in which teacher leaders engaged.

Phenomenological descriptive studies such as this study, focus on the interpretation of the input from the study subjects and how those interpretations

contribute to future decisions and actions by administrators regarding the use of teacher leaders for professional support (Sousa, 2013). As such, the interpreted results of the data in a phenomenological descriptive study contributed new perspectives or understanding of the data collected (Polio, Henley & Thompson, 1997).

Methodological approach. This mixed methods research, predominantly relied on qualitative data. However, quantitative data for the study was gathered first to gain a general understanding of the perceptions both teacher leaders and administrators held regarding work responsibilities of the teacher leaders. Data was gathered by initially sending out a letter to invite the teacher leaders and administrators to participate (Appendix A). The invited participants included STEM teacher leaders and their administrators to individually answer a survey. Then, the researcher interviewed the teacher leaders and administrators over the phone or via an online system where the questions occurred face to face live to the participants, over the internet. This allowed further insight to the research questions and allowed for follow up to the survey. As partially an interpretive qualitative study, the researcher examined data to determine meaning regarding how STEM teacher leaders in high poverty, rural schools perceive their experiences as a teacher leader (Merriam, 2009) to determine whether or not they professionally support teachers, and how those STEM leaders perceived their job satisfaction. Interviewing gave insight to perceptions of experiences, first hand (Glesne, 2016). Conducting a live interview allowed for the opportunity to ask clarifying questions to better understand the perceptions (Glesne, 2016) of the teacher leaders engaging in the study. The cross-reference occurred on general terms, of teachers and administrators. The teachers were not compared directly to their respective

administrators because, together, the data potentially revealed identifying information which could have potentially revealed identifying information.

Their responses helped to understand teacher leaders' perception of their value within the school. These questions led to reflection and insight regarding the extra responsibilities offered to teacher leaders when considering on-going support for professional development.

Data Collection and Analysis

Data source: online surveys. The online surveys were comprised of questions with the purpose of gathering background data. The online format advantage is that Internet-based survey research may have saved time for researchers as well as participants (Wright, 2017). In order to meet the time needs of teacher and administrators involved, participants in each group initially received ten days to complete the survey, at their convenience. The teachers and administrators received an extension of a week to complete the survey, as well as reminder e-mails regarding the opportunity to participate. That extension made the total data collection period, including the surveys and interviews, six weeks. Distributed prior to the interviews discussed in the next section, the online surveys served as an initial data set for the researcher.

Regarding the teacher surveys (Appendix B), all eighteen Noyce teachers were invited to participate. Their surveys served to glean insight regarding their duties beyond the classroom and opportunities they receive as STEM teacher leaders, as well as their perceptions of those opportunities. Likewise, the administrator surveys (Appendix C) were distributed to one administrator per teacher involved in the study, which resulted in thirteen administrators receiving an invitation. While the principal was contacted first, he

or she had the option to choose a designated administrator to complete each survey when they felt it more appropriate to do so. The administrator surveys aligned with the teacher surveys but asked about STEM teacher leadership from the administrative perspective. The both types of surveys sought to inform the researcher on basic background information for each teacher in order to prepare additional probing questions in addition to the planned questions.

Data source: interviews. The questions listed for the STEM teacher interview were designed specifically to gather data about the responsibilities in which STEM teacher leaders engage and their perceptions involving each (Appendix D). The questions design included a presupposition format, requiring feedback, to encourage a detailed response from the participants. Additionally, the open-ended questions asked insight without leading the participant in a particular direction (Glesne, 2016). As such, the interview questions helped to gather the data necessary to answer the research questions (Maxwell, 2013). Teachers identified specific activities and self-identified whether that reflected typical duties expected of most teachers or if those duties represented unique leadership opportunities. The perspective of the STEM teacher leadership served as the central phenomenon needing further research, as limited information exists within the literature from the perception of the teacher leaders themselves (Angelle & DeHart, 2011). To investigate how STEM teacher leader roles limit and enhance their leadership opportunities, the identified teacher leaders and their principals were asked to list the leadership responsibilities each teacher leader took on since joining the Noyce program, about four years ago. This list was analyzed, and the responses were coded in to categories of responsibilities. Identified teacher leaders were

interviewed to determine the roles of STEM teacher leaders and whether or not those roles encourage or inhibit professional growth and support of teachers (Appendix A).

The interviews for the administrators directly correlated with the teacher questions from an administrator perspective. The questions sought to understand how administrators utilized STEM teacher leaders and how they perceived their assistance and time encumbered by those teachers (Appendix E).

Analysis of surveys and interviews. The goal of these interviews was to determine what common responsibilities are bestowed upon STEM teacher leaders and the value STEM teacher leaders placed on these responsibilities. The teacher and administrator aligned interviews were designed to help determine if there were common perceptions of STEM teacher leaders and their responsibilities between the teachers and the administrators. Additionally, the information was analyzed to determine what responsibilities administrators perceive that STEM teacher leaders engage in and compare that to responsibilities STEM teacher leaders perceive they engage in. By cross analyzing the surveys and interviews from both the STEM teacher leaders and the administrators, the researcher sought to determine perceived qualities within job experience that lead to job satisfaction for the STEM teacher leaders.

On the survey, participants ranked how they valued and perceived different aspects of teacher leadership. Utilizing the rankings and follow up interview data from both the administrators and STEM teacher leaders, responses were analyzed to determine if there was a correlation between the factors and conditions that both the administrators and STEM teacher leaders listed and the perception of STEM teacher leadership environment conducive to supporting teachers. In other words, the research analyzed the

correlation to measure the direction and strength of the relationship between what administrators perceive as positive roles STEM teacher leaders serve in supporting teachers and the perception of the STEM teacher leaders regarding their leadership opportunities to support teachers (Moore, Notz, Flinger, 2015).

Setting and sample. The investigation occurred through live interviews with the teacher leaders in a one to one format. The teacher leaders worked in middle or high schools and taught science or mathematics. The investigation occurred over a six week period during the 2018-2019 school year. All teachers involved, identified as teacher leaders for this program, held a continuing contract status and had at least five years of teaching experience. There were nine math and nine science teachers invited to participate in the study of which, two were male and sixteen were female. All served as full time classroom teachers. Those who participated came from ten school districts and twelve different schools. At the time of this research, of the twelve schools represented, six held the designation as rural fringe, two as rural distant, two as small suburb, one as suburb, and one as small town (National Center for Education Statistics, 2017).

For the administrator interviews and surveys, the selected administrators served as an assigned administrator to the schools where the teacher leaders worked. Principals responded, or they may have chosen an administrative designee they felt most appropriate to answer the questions. This existing group of teachers had been together since 2014-2015, engaged in leadership work. To determine if a school qualified as high poverty, the South Carolina Department of Education website regarding socio-economic status was used (South Carolina Department of Education, 2018). Of the eighteen

teacher leaders invited to participate in the surveys, fifteen completed the surveys. Five of the twelve administrators completed the surveys.

When this cohort of teachers began the Noyce program, all of their districts qualified as rural. To classify as rural, the schools were identified as rural by the National Center for Education Statistics and defined as one of the following:

| | |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fringe | Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster |
| Distant | Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster |
| Remote | Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster” (National Center for Education Statistics, 2018; Office of Management and Budget, 2000). |

Since the start of the program, the classification of some of the participants’ schools changed based on the National Center for Education Statistics most current classifications. At the current time the breakdown of location classification is as follows:

six rural fringe, two rural distant, two small suburb, one town distant, and one suburb school (2018).

The teacher leaders and administrators were asked to list tasks, above and beyond teaching duties, in which the teacher leaders engage. This occurred both through an online survey and interview. Not all of the participants of the survey chose to participate in the interview. Of the fifteen teachers who completed the survey, ten (66.7%) participated in the interview process.

The interview process examined the perception of the teacher leaders' engagement of leadership opportunities and how their leadership role influences others where they teach and lead. The responses were coded to determine the roles and responsibilities of teacher leaders and whether those roles enhance or impede professional growth and learning. These responses served to give insight to the types of extra tasks that teacher leaders encumber. These data may be used for future research to determine which of these roles other teachers may take on as a shared leadership model. Additionally, based on the data, the results may lead to the development of a sustainable model for rural teacher leadership.

Prior to the start of the interviews, teachers received written notice of the purpose of the study, information that it will be utilized for research purposes and they were informed that information would be shared in the following way: pseudonyms would be used instead of their real names, the names of their individual schools and districts would not be used. Additionally, the study would identify that the teachers participate in the Noyce Fellows program. These steps were followed to maintain confidentiality of

participants (Johnson & Morgan, 2016), and all participants were asked to provide voluntary informed consent to participate in the research.

Teachers received the survey before interviews were scheduled. All surveys were collected by the researcher via an online survey software format. The answers from the surveys of both the teacher leaders and their designated administrators were analyzed together with the coding patterns found within the interviews of select teacher leaders and their administrators. Following the distribution of surveys, teachers and administrators were interviewed. Each person chose a time that was most convenient. During the interview, the researcher used answers from the surveys to gather additional information and clarify any survey answers, in addition to administering the semi-structured interview protocol. The interviewer asked one question at a time, waited, without interrupting, until the teacher finished answering and then when necessary, the interviewer to asked clarifying questions

Data analysis consisted of transcribing the interviews and then developing a classification system, developing codes in response to the teacher answers to the interview questions, and analyzing the subsequent information. All interview audio files were transcribed, and codes were developed from the transcribed text. Answers listing job responsibilities as well as those listing what encouraged and prevented teachers from participating in professional development were put into list form during data analysis to attempt to quantify the most common answers and patterns. Care was utilized to focus on the phenomenon of the study, which is the perceptions of STEM teacher leaders. The researcher applied first and second cycle rounds of coding to identify meaning from

interviews and to identify significant themes. Data were utilized to analyze the responses. (Saldaña, 2013).

The interviews were analyzed using conventional content analysis to determine categories regarding perceptions reported by the teachers (Goodpaster, Adedokun, & Weaver, 2012). To conduct content analysis the researcher interpreted the interview responses by classifying, coding, and identifying themes from the participant responses (Hsieh & Shannon, 2005). Responses from the survey asking the teacher leaders and administrators about leadership endeavors were cross-referenced between the teachers' responses and their respective administrator to see if the teacher's perceptions of leadership opportunities are recognized and align with that of the administrator. This occurred in general terms, as to protect the anonymity of each subject. The surveys provided a list for the teacher leaders and for the administrators to rank tasks. The ranking of the teacher leaders was compared to the ranking of the administrators to determine if both groups value the same tasks as supportive of professional support for teachers. Further examining the online surveys from the teachers, in combination with the codes from the interview, produced informed conclusions to be drawn regarding job satisfaction based on perceived responsibilities as a teacher leader. The researcher informed the selected participants of the then upcoming study and gave both the administrators and the STEM teacher leaders the survey.

Pilot Study

Prior to administering the survey, the researcher tested both the survey and interview with four non-participants of the actual research to ensure clarity and to ensure that the survey and interview address what the questions ask. Based on feedback from

analysis of the pilot study data, the survey and interviews were revised prior to proceeding with the rest of the study.

Initiating Research

Noyce participants and their respective administrators were initially asked to complete the survey within a two-week timeframe. The participants were also invited to participate in a one on one interview. It was originally anticipated that interviews would be completed by approximately two weeks after the completion of the last survey. They were also asked to sign up to participate in an interview either face to face or through live media. There was a three week time frame planned for this. However, two of the STEM teacher leaders asked to participate past the three week allowance and that time was granted to gather as much data as possible. The surveys and interviews were open for a total of six weeks. All interviews were recorded, and transcripts were created.

From there, examination of the codes from the face to face interview determined categories to give insight. (Saldaña, 2013). Through the coding process, themes were formed not necessarily based on similar wording, but rather because of commonalities that existed (Saldaña, 2013). The categories formed an identity for explicit and specific data (Rossman & Rallis, 2003). In other words, the researcher analyzed responses and grouped them by similarities to then determine experiences of the STEM teacher leaders as perceived by both those teachers and the administrators. In addition to the original responses, the researcher analyzed the answers to the clarifying questions. By determining the participants' insights and perspectives, the researcher further developed their perceptions of truth (Saldaña, 2013). Within the categories, commonalities were evaluated to draw conclusions to the study. The data was shared in the dissertation

through descriptions of the outcomes, an analysis of the data and the interpretation of that analysis (Wolcott, 1994).

Data Validity

It is human nature to make decisions based on perceptions and teachers' perceptions drive their professional decisions. To verify the codes and increase validity evidence, an external peer evaluator analyzed 4 of the sixteen interviews (25%) of the interview responses by classifying, coding, and identifying themes as well, in order to ensure accuracy of the coding. The peer researcher evaluated the codes to check regarding the inference level in the codes and allow for the primary researcher to question the choice of codes (Carspecken, 1996). The themes of both the researcher and the peer evaluator matched, with the exception of the evaluator referring to school culture and the peer evaluator labeling it communication. After going back and analyzing the data again, both decided to utilize the theme of school culture and consider communication as one of the pieces within culture.

Carspecken (1996) encouraged researchers to approach research with a level of ignorance. In other words, he encouraged those conducting this type of research to approach it without applying bias or assumptions. He further suggested utilizing in depth description and details to sharpen the awareness of phenomena that routinely occur. For example, by offering surveys and interviews, this allowed for clarification and in-depth discussion to gain perspective regarding the daily perceptions regarding routine and significant responsibilities of the teacher leaders.

Another way to validate these data was through triangulation. With this validity procedure the researchers sought conjunction among multiple and different sources of

information to form themes and categories in the study (Carspecken, 1996). The researcher for this dissertation used the data collected through the interviews with both the administrators and teacher leaders, in conjunction with the surveys from both, to corroborate the evidence. Multiple forms of evidence rather than a single incident or data point in the study helped to validate the data (Creswell & Miller, 2000.)

Findings were presented to random research subjects verbally regarding the interview transcription, to comment on and add additional information. Participant feedback from three participants established research credibility by providing the subjects with the opportunity to sanction whether the interpretations aligned with the intent of the research summary. As a result, this allowed the participants to clarify where necessary (Lincoln & Guba, 1985).

CHAPTER IV

RESULTS

Results

The research sought to inform an understanding of the perceptions carried by rural STEM teacher leaders and focused on three questions:

- 1.) In what ways do administrators at high poverty, rural, schools perceive they are utilizing STEM teacher leaders?
- 2.) How do STEM teacher leaders perceive that they are utilized to provide and support professional development of other teachers?
- 3.) What administrative factors and teaching conditions promote STEM leadership in high poverty, rural districts?

To gather data to inform the answers to these questions, a survey and interview were offered to the STEM teacher leaders and one of their administrators.

Part one of this chapter presents results from a survey distributed to the teacher leaders and administrators designed to gather initial insights regarding their perceptions of teacher leadership. Part two includes the results of interviews conducted with each teacher and administrator to better gather perceptions regarding teacher leadership. The researcher decided not to compare interview and survey responses from specific administrators to the specific teacher or teachers from their schools. Although every care was taken to preserve confidentiality, comparing these data side by side would have made

it evident to the participants who their colleagues were from their responses. Therefore, to protect confidentiality as much as possible, side by side comparisons were not made. For some of the themes such as culture and time both the administrative perspectives and teacher perspectives were compared in the results, but not with a teacher compared to his or her own administrator. Principals had the option to designate another administrator to answer the interviews and surveys. If the administrator name was listed with the word Principal preceding it, that indicated that the principal answered the questions. If the name of the administrator has the word ‘administrator’ preceding it, then the person answering the questions was an administrator at the school designated by the principal to participate. Fifteen teacher leaders participated in the surveys and of those fifteen, ten chose to participate in the interviews. Five administrators participated in the survey and one additional administrator participated in the interview.

Part One: Perceptions of Leadership Survey Results

Of eighteen teachers and twelve administrators invited to participate in the survey, fifteen out of eighteen teachers (83.3%) and five of twelve administrators (41.6%) completed the surveys, for an overall completion rate of twenty out of thirty participants (66.7%). One administrator answered the survey for one teacher and not the other Noyce teacher at the school. This administrator informed the researcher that he could not answer the survey for the other teacher because he had not worked with her much during the year and was not aware of her Noyce status. One additional administrator filled out the survey for all three of his teachers at once, despite instructions to fill out one for each teacher. A phone call with a voicemail, along with requests by e-mail for the administrator to re-do the survey, and an offer to drop off a hard copy at the school were not responded to and a

correction was not made by the administrator. The requests were unanswered. Therefore, the data from those unclear surveys were not used.

Teacher perceived leadership. Perception drives decisions, often, about whether an employee wants to stay at a place of employment. This section of the research sought to determine how administrators and teacher leaders perceived the types of leadership roles teachers participated in and whether the teachers' perceptions of those responsibilities affected their job satisfaction. Among the fifteen teachers responding, eleven of fifteen (73.3%) perceived that they provide professional development for other teachers over the course of a day on a regular basis. Eight teachers of fifteen (53.3%) described that they serve on a team or committee which further supports teachers such as a technology team. In regard to providing extra services to students, five teachers of fifteen (33.3%) perceived that they support clubs or teams for students. Out of the fifteen teachers participating in the survey, nine (60%) described serving on leadership teams such as the School Improvement Committee, school safety committee, or a school leadership team. Likewise, nine teachers of fifteen (60%) served as a grade level chairperson or department head at their school.

Table 4.1

Survey Results Showing Teacher Perceptions of Leadership

| <u>Responsibility</u> | <u>Number of Teachers</u> | <u>Percent of Teachers</u> |
|--------------------------------------------------|---------------------------|----------------------------|
| Professional Development to Teachers | 11 | 73% |
| Leadership Team/Committee for School | 9 | 60% |
| Grade Level, Department, Team Lead | 9 | 60% |
| Leadership Team or Committee Supporting Teachers | 8 | 53.3% |
| Support Clubs or Teams for Students | 5 | 33.3% |

In the survey, the five leadership categories, identified in Table 4.1, were specified for the participants. Teachers provided a count of their participation in each of these categories. Of the fifteen teachers, one out of fifteen (6.7 %) participated in one of those designated leadership categories, three of fifteen (20.0%) participated in two of the designated categories, eight of fifteen (53.3%) participated in three leadership categories, two of fifteen (13.3%) participated in four categories and one teacher of fifteen (6.7%) participated in all five. Teachers' participation in these leadership roles was in addition to the typical day to day required teaching duties that all teachers were expected to complete at each of their respective schools. The majority of the STEM teacher leaders, eleven of fifteen (68.6%) participated in at least three of the leadership categories.

Additionally, eight of the fifteen teachers (53.3%) perceived that they engaged in additional leadership activities not included in the survey grouping. While the researcher considered these leadership responsibilities to fall into the categories listed in the paragraph above, the teacher leaders did not have this same perception. Of those fifteen teachers, one teacher chaired a Relay for Life School Team and served on a STEAM committee (leadership/committee for school), one lead student council (leadership/committee for school), one supervised an afterschool program (leadership/committee for school), one participated with collaborative cohorts (leadership/team supporting teachers), one served as a PLC facilitator and district professional development facilitator (leadership/team supporting teachers), one lead their grade level "house" which was an endeavor to lead her team, overseeing English, Math, Social Studies, and Science (leadership/team supporting teachers), one served as an unofficial mentor for teachers at the school (leadership/team supporting teachers) and

provided Algebra I support to the community (leadership/team supporting school), and one lead Clemson scholars after school, served as a wellness liaison for their grant and served as a STEM club advisor (leadership/team supporting school). Because Table 4.2 represents the teachers' perceptions of how they categorized their responsibilities, and they did not list those responsibilities as fitting in to those categories, they were not tabulated for those categories. However, the data are significant to note as additional responsibilities and roles of the STEM teacher leaders as they do fit into those categories.

Taking in to consideration all leadership responsibilities both assigned and unassigned, teachers were asked: On a scale of 1 to 4, how much time do you feel you spend supporting teachers, outside of your regular teaching duties? The number 1 represented hardly any time supporting, 2 represented a little time supporting, 3 represented sufficient time supporting, and four represented too much time supporting. Of the fifteen survey participants, two teachers (13.3%) did not answer the question. Three teachers (20%) perceived that they spent little time supporting, eight (53.3%) felt as though they spent sufficient time supporting and two (13.3%) felt as though they spent too much time supporting teachers at school.

Table 4.2
Number of Categories Teachers Perceive They Lead in Based on Listed Choices

| <u>Number of listed leadership choices</u> | <u>Percent of teachers</u> | <u>Number of teachers</u> |
|--------------------------------------------|----------------------------|---------------------------|
| One listed leadership category | 6.7% | 1 |
| Two listed leadership categories | 20% | 3 |
| Three listed leadership categories | 53.3% | 8 |
| Four listed leadership categories | 13.3 | 2 |
| All (5) listed leadership categories | 6.7% | 1 |

Table 4.3
Teacher Perception of Time Spent on Leadership Duties

| 1-hardly any | 2-little time | 3-sufficient time | 4-too much time | no answer |
|--------------|---------------|-------------------|-----------------|-----------|
| 0 (0%) | 3 (20%) | 8 (53.3%) | 2 (13.3%) | 2 (13.3%) |

Of the three teachers (20%) who felt as though they spent little time supporting, two served in three of the leadership categories in Table 4.1 and one teacher served in one. Five of the fifteen (33.3%) participants who felt as though they spent sufficient time on leadership reported on the survey that they participated in three of the leadership categories, two participated in two of those categories, one participated in four and one participated in all five. Of the two teachers that perceived that they spend too much time supporting teachers, one participated in three of the leadership categories listed in Table 4.1 and the other participated in one. Based on these data, no clear trend emerged. The number of categories did not result in a distinct pattern regarding whether or not teachers felt they spent too much time, not enough time, or sufficient time leading.

When comparing teacher leader perceptions to those of the administrators, two administrators who participated and answered this section had teachers who participated in the survey. One administrator did not complete this section and therefore there is no data available for that teacher. One principal, like the teacher leader at her school, felt that the teacher spent “sufficient time” on non-teaching responsibilities, according to the survey. The other administrator perceived the teacher leader at the school to spend little time supporting the school with a ranking of a two, while the teacher perceived that enough time with a ranking of a three, was spent at the school.

Three teacher leaders and their administrators who participated in the surveys were able to be compared because both an administrator and a teacher at his or her school

completed the survey section regarding leadership duties. In all three cases, teachers listed at least one more leadership duty differently than the administrators listed. The interview data, which is more comprehensive, differed slightly. In one case, the administrator listed two ways that the respective teacher leads that the teacher did not list. This activity included sponsoring a paint party for the school and going out of the way to make everyone feel happy and enjoy working at the school. The teacher in that case listed two different leadership efforts which included serving as a chairperson for a school and community activity and serving on a STEAM committee. These responses connect to the theme discussed later, regarding relationships as discussed in the interview section below. In the other two cases, the teachers listed one of the same duties but also listed two other additional duties each that fall under the teacher leadership description. In both of those cases, the administrator listed the teachers as spending little time supporting the school through leadership.

Given the variety of responsibilities, the STEM teacher leaders were asked what responsibility they would give up if they could. Nine of the fifteen teachers (60%) stated they would not give up any of their responsibilities while six of the fifteen (40%) stated they would give up a responsibility. A more in-depth analysis of this occurred in the interview section of this chapter. The teacher leaders' identified first choices of a task or responsibility to voluntarily give up, varied and none repeated. They included Relay for Life, School Improvement Committee, the Technology Lead, Department Chair, a student club, and a committee. In the case of one teacher who served as the department chair, she felt that with the current and new administration, she could no longer serve the other teachers at the depth she was accustomed to because she no longer held that

position. As a result, she felt as though her “voice was gone.” Her narrative suggested that she felt as though her input was no longer valued by the administration at her school.

On the survey, as well as in the interview, teachers were asked what responsibilities they wished they could perform. Based on the survey responses from teacher leaders, two of the fifteen (13.3 %) teachers were happy with the roles they currently held at school and they did not wish to hold any other roles. For those two teachers, one teacher’s roles currently included serving as a staff member who provides professional development, leading a team or committee, serving on a leadership team, serving as a department or grade level chair, assisting with technology, and serving with the superintendent’s panel. The other lead a team or committee supporting teachers, lead a student sport, served on a leadership team at the school and served on the School Improvement Council. Ten of fifteen teachers (66.7%) answered this question with specific new responsibilities they were interested in pursuing. In other words, they wanted additional roles. Of those ten teachers, eight of the ten (80%) wanted responsibilities that focused on supporting teachers. These responsibilities included serving as a coach in math or science, serving as a teacher coach in general, working as a curriculum coordinator, and serving as one who develops professional development. Those roles were further examined in the interview section of this chapter.

Comparing the perception of STEM teacher leaders to those of the administrators, 11 of 15 teachers (73.3%) and 4 out of 5 (80%) of the administrators perceived that the teacher leaders provided professional development support to teachers during the school day. Due to the low response rate of the administrators 5 out of 12 (41.7%) acute comparisons between teachers and administrators was not possible. However, one

category where a clear discrepancy occurred with the survey was with perception of whether or not teacher leaders support students through extra activities. Teacher leaders perceived that they engage in sponsoring and supporting student clubs and teams at 33.3% (5 out of 15 teachers) while three out of five of the participating administrators (60%) perceived that the teacher leaders supported student in clubs, teams, and other extracurricular endeavors. A more in depth look at this occurs in the section of this chapter that addresses the interviews.

Part Two: Interviews

Administrator responses about teacher leadership. Twelve principals represented the eighteen teachers and were all invited to participate in the interview. Six of the principals (50%) chose to participate in the interview process and were connected to seven of the teacher leaders. However, while the one principal represented two teachers, he did not know the one teacher was a Noyce teacher, and as such, was not specifically aware of her leadership duties. This principal is new to the school. So, even though the principals represent seven teachers, only six teachers were referred to in this section of the research.

To determine the answer to the first research question: In what ways do administrators at high poverty, rural, South Carolina Schools perceive they are utilizing STEM teacher leaders, participating principals or their administrative designee answered a series of questions. The interviews with administrators showed that at three different schools, administrators were new to their schools (50%), at one (16.7%) the principal served at the school more than two but less than five years, and at two (33.3%) the principals had been at their schools five years or more. The high administrative turnover

impacted the detail in which they responded to the questions during the interview. To overcome this, if the administrator struggled to answer open-ended questions regarding the roles and responsibilities of the teacher leader, the researcher asked about specific responsibilities. For example, the researcher then asked if the teacher leader engaged as the department chair, or as the lead for planning STEM events.

Likewise, at one of the schools where the administration was not new, the teacher was new in the last two years to the schools. In other words, over 83% (5 of 6) of the administrators were new or their teachers were new out of the group of six interviewed. As a result, these shortened relationships may have been a factor for the perceptions of involvement. To examine the administrators' perceptions of the teacher's leadership connections, the transcripts were analyzed for themes and organized into sub themes which included relationships, sharing of knowledge, professional development, emotional outcomes of leadership responsibilities as perceived by administrators, and the potential of the teacher leaders to lead professional development.

Relationships. While dissecting the data and noting patterns from codes, the theme of relationships became apparent. Through active communication and involvement with others, leaders invoke mastery through active engagement and create a positive state of communication. This results in efficacy by most, which in turn leads to the perception of a leader's efficacy (Sudha, Shahnawaz & Farhat, 2016). When speaking of teacher's leadership ability, the way the teacher is perceived at school, and whether or not the teacher should lead professional development, school administrators listed positive communication and approachability as reasons that teachers exhibit leadership success in

the school. Additionally, they shared how teachers visit the classrooms of teacher leaders informally, to seek assistance.

Within the theme of relationships based on the perception that the administrators had of their teacher leaders, the ability of teacher leaders to serve as mentors, both formally and informally fell into that relationship category. For example, school administrators in two of six schools (33.3%) mentioned that teacher leaders worked with international teachers to help teach them about relationships, culture, content, and strategies. Specifically, Principal Richards stated that the STEM teacher there, “supported international teachers with pedagogy, customs, nuances of the new school, and by taking teachers under her wing.” Throughout the state of South Carolina and especially in rural, high poverty areas it is common practice to fill otherwise unfilled teacher vacancies with international teachers to provide instructional help when other candidates fill positions elsewhere. With over 340 teaching positions unfilled at the start of the 2014-2015 school year, schools, most of them rural, in South Carolina, turned in part to teachers from outside of the United States to fill the positions (Self, 2015). “Vacancies are especially hard to fill in rural districts,” Such rural districts struggle to offer salaries competitive with suburban and urban districts (Self, 2015). CERRA (Center for Educator Recruitment, Retention and Advancement) in South Carolina acknowledged the revolving need for new teachers by “developing incentives to recruit and retain classroom teachers in rural and underserved districts that have experienced excessive turnover of teachers.” This occurred in rural districts that had an annual teacher turnover rate of more than eleven percent for the “five most recent state report cards” (CERRA, 2019). Ms. Ranger’s reflected that without this peer-to-peer support, “we lost teachers within the first

five years because teachers don't lay a foundation for new teachers and make sure they are brought into the teaching profession and understand what is going on." Principal Ranger also noted that the STEM teacher leader, "has a team of brand new teachers and she spends tremendous time working with them." Her duty to mentor and work with them was not an official duty or position. Principal Parton stated that his STEM teacher leader "engages different groups (more) than the average teacher."

Likewise, Principal Parton later stated that his STEM teacher leader "Shows other teachers how to build relationships." Administrator Moss explained, in reference to the teacher leader at her school, "teachers go to her for advice." School administrators also cited relationships via outreach to create community connections started because of the STEM teacher leaders. Ms. Hawk stressed that helping new teachers "is imperative if we have a chance of them staying." The STEM leader at her school supports new teachers when "someone needs help." Connecting to the relationship theme, Ms. Moss shared that while the teacher at her school chose to step down from a large formal role during the school year when the interview occurred, "people (teachers) e-mail her and talk to her one on one," when they have "any problems."

Therefore, strong positive relationships between the STEM teacher leaders and others was reflected as a positive leadership quality. In all, five of the six administrators, 83.3%, expressed that the STEM teachers' leadership is reflected in both formal and informal mentoring. Two of the six teachers, 33.3%, currently served as formal mentors through a specified mentoring program at the time of the interviews, according to the administrators.

Sharing of knowledge. Another on-going theme throughout the interviews was that of knowledge-sharing. Administrators' responses in this category were divided into knowledge of the school or community and also into content and pedagogical knowledge. In regard to knowledge of the school or community, teacher leaders assisted new, and in some cases, struggling teachers, to better understand the school. This included knowledge of norms and expectations, how to work with the students at the school and address their needs, and how to work with others both in and out of school.

Knowledge of school. Knowledge of the school and community resulted in the need of the STEM teacher leaders to support teachers who were new or who struggled to succeed in regard to relationships, communication, and community and school norms. The STEM teacher leaders showed knowledge of school norms and or expectations. For example, Principal Hawk shared, "We utilize her to help new teachers coming in." Additionally, Administrator Moss indicated that the STEM teacher leader at her school helped acclimate new teachers to the needs and norms of the school on a regular basis because of the, "high turnover rate at school, so that helps. For example, one principal specifically placed teachers near her STEM teacher leader so that the teachers could informally observe how the STEM teacher leader engages with students both in the hall and in the classroom. This also created easy access between the teachers and the STEM teacher leader to collaborate. Because the STEM teacher leaders knew the students and the community, they developed strong positive relationships with both students and parents that the other teachers were able to observe.

Community knowledge. Administrator Moss continued to use her STEM teacher leader to organize community events, such as the eclipse program for the community.

Also, at that school, the STEM teacher leader “connects to partnerships outside of school.” Administrator Moss shared that the partnerships were mostly related to the STEM and eclipse days and essential to those programs. According to Ms. Moss, these relationships were possible due to the “knowledge of the community and its needs.” Like the STEM teacher leader at Administrator Moss’ school, Principal Parton’s STEM teacher leader showed leadership by connecting through the community by reaching out to “local groups and other businesses” that could support some needs at the school. That STEM teacher leader went to businesses based on her knowledge and needs of the community and school. Administrator Mickey shared that the STEM teacher leader at her school “strengthened relationships with families and the community by volunteering to lead the fall family night.” Therefore, four out of six administrators (66.7%) discussed situations where their STEM teacher leaders utilized knowledge of the community to lead a program or assist other teachers. One teacher, knowing the business owners in the community, as well as the needs of the community, utilized her knowledge of the community to develop relationships with the local businesses for the STEM festival.

Focus on STEM content. Content also developed as a sub-theme. Administrator Moss explained that she “encourage(s) her (the STEM leader) to take a role in education technology,” because of her skill in that area. Principal Richards recognized his teacher leaders’ strength in the content and chose her to “serve as a liaison for content between the district and the school. Principal Hawk’s interview included several references to that STEM teacher’s STEM knowledge serving as a strength. The STEM teacher leader at his school, served as the “state teacher of the year in her content.” Principal Hawk also cited the teacher’s role to “lead weekly PLCs (professional learning communities) in her

content.” At Administrator Mickey’s school, that STEM teacher leader was assigned the lead to “help the math and science department determine the best hands-on activities for families,” at the school’s STEM night. When asked about leadership duties of her STEM teacher leader, Administrator Moss stated that her teacher “lead PBL (project based learning)” due to her experiences and expertise with it, where other teachers had not been exposed to it.” Principal Richards mentioned that his STEM teacher leader regularly “gives professional development sessions at school each month” because of her background and experiences. Through these insights the data showed that knowledge in both the content area and in some cases, technology, was a way to open doors to teacher leadership opportunities.

Likewise, as reflected in those statements, both formally and informally, these teacher leaders provide content support for other teachers. Teacher leaders, according to administrators, clearly exhibited instructional and content competence which encouraged teachers to seek them out for support. The STEM teacher leaders’ knowledge then led to professional development opportunities. Four out of six administrators (66.7%) commented on skills and responsibilities of the STEM teacher leaders connecting to the sharing of professional knowledge within the school. Sharing knowledge was also displayed through leading professional development.

Professional development. Notably, most teacher leaders do not support other teachers through on-going professional development initiatives, but rather day to day content needs, according to their administrators. As reflected in the previous section, two out of six administrators (33.3%) stated that their teacher leaders participated in regular professional development support such as weekly Professional Learning Communities.

Principals Parton and Hawk mentioned ongoing and consistent support opportunities with STEM teacher leaders through leading professional learning communities. Principal Richards stated that the STEM teacher leader at that school had to be “push(ed) to include more STEM activities,” in other professional development endeavors throughout the school. In other words, he felt as though the teacher needed to engage other teachers in more STEM activities cross-curricularly.

Since this study looked at the five years that the teacher leaders participated in the teacher leadership program, the data reflected that the teacher at Administrator Moss’ school previously supported on-going professional development in Project Based Learning but chose not to do so this year. All but one, five of the six, (83.3%) of the administrators stated that they felt as though their teachers could serve as professional development leaders. The one dissenting administrator cited a lack of time and an upcoming considerable amount of administrative change as a reason for not thinking that teacher could serve as a professional development leader at this time.

The majority of administrators, 4 out of 6, (66.7 %) mentioned that the teacher leaders participated in the development and facilitation of a STEM or STEAM night. As Noyce participants, the teachers were required to plan and facilitate a STEM or STEAM night at their schools for parents and students. Therefore, that requirement needs to be taken in to consideration when synthesizing these data. After the initial STEM or STEAM night, administrators of three teacher leaders (50%) mentioned that they and or their STEM teacher leaders decided to pursue additional events at their discretion. However, whether or not they intended to implement a second or third STEM night was not specifically addressed during the interview. In all cases, the administrators were

excited about the end results of the STEM events and were looking forward to conducting similar events in the future.

Two sub themes that developed were that of informal and formal professional development. Informal professional development for the purpose of this study is defined as activities conducted by the STEM teacher leaders that they were not assigned to do or that they volunteer for without it being designated as an official activity or responsibility. Formal professional development were duties formally assigned to the STEM teacher leader.

Informal professional development by teacher leaders. Informally, Principal Richards stated that the STEM teacher leader at that school, “takes teachers under her wing. She is a mentor but does this unofficially.” Principal Richards further explained that the teacher leader at the school “is a mentor but does it unofficially.” As mentioned before, this teacher leader works with new teachers, including international teachers to support them with customs, norms, expectations, and pedagogy. In regard to informal professional development of teachers, Administrator Moss explained that the STEM teacher leader at her school “continues to be a big support to the science teachers teaching (with) PBL.” She also mentioned that “her content teachers come to her and even the other content teachers.” Principal Parton strategically placed teachers around his STEM teacher leader who needed assistance. “She has teachers around her who need assistance. That is why they are placed close to her.” They received assistance in building relationships with students, as well as other day to day needs at the school. Principal Hawk that the school’s STEM teacher leader “has the most cohesive department”, and that teacher “works with

other teachers in the department” to support them informally. However, that principal was unable to offer specific examples.

At the school of Administrator Mickey, that STEM teacher leader informally supported the professional development of other teachers by “talking with teachers about what they struggle with and anyway she can help, she does.” Administrator Mickey also added that “Anytime on her break you can find her helping other teachers.” As all of the administrators shared ways that the STEM teacher leaders supported the professional development of teachers informally, Principal Ranger stated that the teacher at that school, “Supports new teachers and helps bring up morale at the school.” That principal further clarified that the morale boost comes from supporting teachers. Informally, four of six administrators (66.7%) perceived that their STEM teacher leaders served informally as mentors to support teachers and two of six, (33.33%) determined that their leaders offered content support.

Formal teacher professional development. Formally, the teacher leaders served in different ways to support the professional development of educators at their respective schools. Principal Richards stated that at his school, the teacher leader attends instructional roundtable meetings with a statewide group monthly and “brings back the information for the school.” He also stated that the teacher “gives a professional development session at the school monthly.” When asked for details about the type of professional development the principal stated that it involved “content but also information about state testing information.”

Administrator Moss stated the teacher at her school previously assisted formally with new technology and as the PBL lead for professional development but that this year

neither is a part of her official duty. The teacher “previously taught four teachers PBL and created PBL lessons.” Also, leading teachers in formal professional development, the leader at Principal Parton’s school has “a group that formed a PLC (professional learning community) this year. She has led this.” As a newer principal, Principal Hawk commented only on the formal professional development opportunities of the teacher at that school this year. This is significant because administrators received the opportunity to reflect on the last five years. Most recently, Principal Hawk’s teacher leader formally participated on the STEM team, designing STEM activities across the school, serves as a leader on her PLC group and worked a STEM camp in the summer for rising 9th grade where she assisted in planning as well as facilitation. Principal Hawk also went on to share that this teacher, “is a mentor, done a session at a conference, and has gotten (sic) trained to teach IB (International Baccalaureate).” At Administrator Mickey’s school the STEM teacher leader attended a “math cluster every week which is a sit-down at the family table and all teachers are involved in that professional development.” Leading “content department meetings, leadership meetings, helping new teachers on her team and staff development such as a book study,” are the formal ways that Principal Ranger recalled the STEM teacher leader at that school leads professional development.

The administrators shared that teacher leaders serve as content leaders and leaders of committees and schoolwide projects. For example, Principal Ranger stated that the school utilized their STEM teacher leader to “engage differently” this year as they pursued the schoolwide opportunity to “become a STEM school.” Principal Ranger chose that teacher leader because, “We all believe in her ability to lead in her role.” Principal Parton’s STEM teacher leader stood out as a leader because she “reached out to

businesses and other groups,” for STEAM night. Stating an example of how the STEM teacher leader serves on committees, Administrator Moss shared that the STEM teacher leader at that school also “connects to partnerships outside of school,” to support the new STEM programs such as STEM night. Though the experiences were varied, the administrators recognized the contributions of the STEM teacher leaders through professional development and support of other teachers.

In conclusion regarding formal professional development, one of six (16.67%) administrators believes that the STEM teacher leader formally supported Project Based learning, two administrators of six (33.33%) mentioned that two teacher leaders formally served as mentors, three administrators (50%) stated that their teachers lead professional learning communities or groups similar to such avenues for professional learning, and four administrators of six, (66.7%) stated that their STEM teacher leaders lead professional development in STEM content.

Time. Due to the teachers’ leadership endeavors and responsibilities being fluid, the administrators were not able to pinpoint a specific amount of time spent on leadership. In other words, leadership needs changed on an on-going basis. The range of time that administrators perceive teacher leaders spend on extra duties ranged from one to two hours per week to twelve with an average range of four to 6 hours per week. However, not every administrator was willing to state a specific amount of time. Every administrator tried to exemplify the amount of time their teacher leaders spend on duties outside of their typical teaching duties. All administrators, 6 of the 6 (100%) struggled to give a specific amount of time that the STEM teacher leaders commit, due to the changing duties based on the time of year. Principal Richards estimated that regarding his

teacher leader, “she spends twelve hours a week, staying until 5 o’clock four days a week,” but that “her duties vary.” Due to administrative changes this year, Administrator Moss stated that they “changed principals this year so there is no more STEM night. Last year her leadership was at a higher level.” She went on to explain that meant that her teacher spent less time serving as a leader this year because the new principal changed leadership responsibilities. In the case of this school, the STEM teacher leader “doesn’t have extra responsibilities,” this year compared to in years past. Administrator Moss suggested that the teacher leader at her school, during the year of the interview, spent approximately “two hours a week” at leadership. Principal Parton also struggled to define the amount of time that the STEM teacher leader at her school committed to leadership stating, “we cannot put a number on it. She does it on her time off and outside, on the weekends and after school. I have no trouble saying she spends ten hours a week outside of her teaching duties.” Principal Hawk estimated the leadership time of the teacher leader in a more definitive manner and stated that the teacher has “PLCs every Monday and that is an hour to an hour and a half that she facilitates.” Principal Hawk also stated that “this teacher arrives early too.” On the other hand, Administrator Mickey shared the concern of most while trying to determine how much time the STEM teacher leader spends on leadership responsibilities because “it depends on the time of year,” but noted specifically that this teacher works at “data analysis (which) includes five to six hours a week and then STEM night takes one to two hours a day as we get close.” Principal Ranger estimated that the teacher at that school dedicated “two to three hours a week working with teachers. She has a team of brand new teachers and spends tremendous time working with them.”

Volunteered, asked, or mandated. Though all of the administrators stated that the teacher leaders volunteered for some or all of their leadership responsibilities, three out of six (50%) of the school administrators stated in the interviews that the teacher leaders were asked to participate as a leader by the administration and they agreed to do so. There was inconsistent feedback as to whether being asked and agreeing was the same as volunteering.

Principal Richards stated that he was not “the type of leader to tell teachers what to do. They need to find what needs done and take care of it. I trust them to do what they need to do.” Therefore, all leadership duties were chosen by the teacher, according to his narrative. However, as he described the scenario in more detail, he shared that he asked the teacher to volunteer. This indicated that he asked the teacher to serve as the department chairperson and asked her to lead the implementation of a grant. Similarly, Principal Hawk indicated that if the teacher was not asked to do things, “she would step up and do things anyway.”

Emotional outcomes as perceived by administrators. While the teachers experienced stress at times, the administrators perceived that the teacher leaders experience fulfillment and gain motivation by participating in leadership tasks that result in serving others. While little feedback was given regarding the specific stress, three of the administrators out of six (50%) brought up the fact that when a big project is due or imminent, their STEM teacher leaders expressed feelings of being stressed or overwhelmed. Those three also each clarified that along the way, the teachers “enjoyed” the process and “thrived” on their roles.

Principal Hawk specifically stated, “I have never heard her say she is stressed out. She is the person who whatever obstacle she has, she finds a way around it, so I would say she feels empowered.” In reference to the STEM teacher leader at her school, Administrator Mickey stated, “Right before fall festival adds a lot of stress but in general it helps her feel like she is contributing to the overall success of the school and students.” Later in the interview, Administrator Mickey referred to the multiple responsibilities of the STEM teacher leader saying, that the responsibilities, “make her feel like she is part of the family.”

Potential to lead professional development. The administrators were asked whether or not their STEM teacher leaders could provide professional development that would better meet the needs of the teachers at their schools compared to what they already received. Due to some of the administrators’ and teachers’ recent arrival at their perspective schools, each administrator held different relationships and insight regarding their STEM teacher leaders. Principal Ranger profoundly analyzed that the teacher would, “need more time and yes she could.” When asked what prevents principals from using teachers in that manner she stated, “She is already burdened. You have those best teachers you already rely on for so many things.” Principal Richards, new to his school this year expressed that the STEM teacher leader “is kind, and soft-spoken- not rude or overbearing.” He acknowledged that her success as a STEM teacher leader occurs because “she is received well because she knows how to deal with people and follows up with suggestions. She is seen as a mover and shaker.” When asked if she had the ability to take on more professional development at the school, he stated that “absolutely she

could. I don't know what I need to do to make that happen. She is busy, and her plate is full.”

When asked about the perception of leadership by the STEM teacher leader at her school, Administrator Moss stated, “her content teachers see her leadership. Other contents do not see it as much.” In reference to future endeavors in leadership Administrator Moss followed up by saying “district initiatives are on hold due to consolidation. I can see her coming in and playing a bigger role but not right now because we are at maximum capacity.” In other words, Administrator Moss envisions her STEM teacher leader playing a bigger role in leadership in the future because right now all roles are filled.

Principal Parton, as referenced earlier, stated that the STEM teacher leader at her school “is a relationship person, so most people are open to her. Our teachers are grateful and since she is strong and willing to work with kids and (she) is humble.” Principal Parton added later that regarding that teacher, “She is top notch. However, you want to measure, she is at the top, one of the best teachers I have ever been around.” To follow up with those sentiments, Principal Parton was asked whether or not this teacher could better meet the STEM professional development needs at the school. He was the only administrator out of six (16.6 %) to state that “she already is. She is very vocal and fully involved. We hear that coming out of those meetings,” referring to the meetings that the teacher already leads as part of her formal and informal professional development. The STEM teacher leader at that school took active roles in leadership and supported other teachers and they “respond to her due to the relationships she has built.”

Principal Hawk stated that the teacher at her school effectively led professional development at times and a difference between leading teachers from various content was not noted. Principal Hawk stated that “She is allowed to present for us and is a resource for administration. When asked if this teacher could better lead professional development, Principal Hawk responded yes, because a “teacher leader is better (to lead teachers in Professional Learning Communities) because it is on their level and they can see how she is doing it and how she incorporates it.” In other words, the teachers responded well to the STEM teacher leader because the leader herself applied the same knowledge and strategies in her own classroom that she shared at PLC meetings. It is suggested that based on Principal Hawk’s statement, using a teacher to promote development offered validity evidence about the instructional strategies to the teachers.

Administrator Mickey struggled to determine whether the teacher at her school possessed the skills necessary to lead professional development because she did not know that teacher well. She stated it is, “hard to answer because I don’t know her well. She can lead professional development on certain topics because she is great in the classroom, but I don’t know how comfortable she would be. She has really made a difference. Teachers recognize her as a leader in her field.” Though she hesitated to commit during the interview that the teacher had leadership qualities, her statement contradicted that.

Teacher Interviews

All eighteen of the current STEM teacher leaders identified for this study were invited to participate in the interview process. Of those, ten teachers (55.6%), chose to engage in the one to one interviews. To encourage the most participation, the eighteen teachers were told about the upcoming opportunity to engage in the research by their

Noyce leaders, they received an introductory e-mail outlining the process and two follow up e-mails encouraging them to participate. To honor their professional voice, after those contacts, they were not contacted again if they did not respond to the offer to participate. The interviews were scheduled throughout the day or evening, at the teachers' convenience.

Of the ten participating teachers, three (30%) recently, within the last two years, transferred to their respective schools, though all remained teachers in their same general content areas of math or science. Additionally, four other teachers (40%) noted recent administrative changes within the last school year, which impacted some of the teachers' leadership experiences and duties. Three of the teachers (30%) expressed that they and their administrators worked together for more than two years. In total, 7 out of 10 (70%) of the teachers interviewed were in schools where they or the administration were new. When examining how the STEM teacher leaders perceived how they were utilized to provide and engage in professional support to other teachers by their administration, the following themes developed: administrative support, opportunities to learn and share beyond school, and formal and informal opportunities to lead professional development.

The following responses, from the ten (55.5%) participating teacher leaders stemmed from questions designed to answer the second research question which asked: How do STEM teacher leaders perceive that they are utilized to provide and support professional development of other teachers?

Administrative support. The participating teacher leaders expressed ways administrators contributed to their ability to serve as a STEM teacher leader. All but two of the teachers (80%) felt that their administrators offered some or much support, at least

in part, for their teacher leadership endeavors. Those two teachers (20%) who did not feel supported as a teacher leader were at the same school. Two of the teachers (20%) perceived they were denied most opportunities to grow professionally if the growth opportunity required them to leave the classroom for a day or more. This aligned with the same two teachers who did not feel supported. While examining administrative support a second level of themes were developed by the researcher.

Opportunities to learn and share beyond the school. One theme that developed as a second level from administrator support was regarding whether or not administration offered approval for the STEM teacher leaders to grow by attending professional growth and leadership opportunities outside of the school. When asked how administrators supported them, a pattern developed showing that if administrators denied growth opportunities, then that showed a lack of support. Ms. Stern expressed that with her new administrator when she said, “I told my administrator in April that I had to go to a conference, and he is okay with that and that is showing support.” She added, “That’s the only interaction we’ve had.” Ms. DiBastiani relayed that her current, new principal provided support for the Noyce activities she engaged in, whereas previous principals did not offer the same level of support. For example, she stated, “in the last three years we have had three different principals. We had a run in with (previous) principals.” She went on to explain that, “we couldn’t use the building for professional development (with Noyce),” but with the new principal they utilized the building for Noyce activities.

Ms. Kirschner, who also experienced a new administrator, stated that her administrator stated, “When I go beyond and get different proposals that require me to be out of the classroom, he is not for it.” She went on to share that she received an

acceptance to present at a national event. Her administrator sent her an e-mail requesting a meeting to discuss it. She shared, “he said I was out a lot and I am the district teacher of the year, so I have to be out. It is hard to say whether he is supportive.” Reflecting on her time as a teacher leader since starting Noyce, Ms. Kirschner noted that with this administrator, it is “totally different that the last person who encouraged me to go beyond. This person does not understand.” She feels as though she is not being utilized for professional development in the manner in which she previously served.

Ms. Sink came from a school with more stable administration where her administrators served more than two years. At that school her administrators were “flexible toward the Noyce program requirements,” of attending and facilitating professional growth opportunities outside of the school community, noting that the administration “doesn’t give backlash for going to a conference.” Ms. Sink added that other administrators at other schools sometimes viewed attending conferences as a negative. Other ways that Ms. Sink’s administrator showed support for her as a teacher leader included, “they forward us information and encourage us to participate in teacher leadership programs.”

As a newer teacher to her school, Ms. London perceived that she received ample support from her administrator. “He is open to us going to professional leadership workshops.” She also stated that she was encouraged to present. Similarly, Mr. Lee stated that “I put paperwork in to present...and there is not a question.” He was referring to facilitating and learning at a national conference. “It is embraced at our school. I am fortunate our principals, district leaders encourage our folks (to) get what they need to

improve themselves.” He shared that this allows teacher leaders to share as STEM teacher leaders.

When asked how administrators supported his teacher leadership, Mr. Grajcar shared that he received support because “they are always allowing me to take time or if I need to do events, like when we are speaking at conferences, they agree when I have to take time to do that.” He added he was able to lead due to the support communicated from his administration because “they praise our work with the leadership program because it is kind of directly related to what we are doing at a school level.” That praise and appreciation was communicated to him as a teacher leader which created an environment where STEM teacher leaders shared and that was influenced by the interest communicated by the administrators. “They (administration) are appreciative of that and ask about it and have me talk about it and ask how it improves my teaching.” In other words, the interest and appreciation for his efforts drove Mr. Grajcar. “They ask for, you know, my feedback for situations based on my experiences.” This communication promoted his desire to participate in teacher leadership.

Formal and informal opportunities to lead professional development. The STEM teacher leaders answered questions about their perceptions of how they engaged in school leadership roles. Through conversations with them, it became clear that in alignment with Hunzicker, Badiali, Cosenza, and Burns (2019), teachers often engage as leaders but do not always recognize their actions as leadership, especially regarding the informal ways they interact to lead around school.

Formal. Formally, eight of the ten teachers (80%) served as a department, team, or grade level head at the time of the interview. Two of those eight served as a

department head since being acknowledged as a STEM teacher leader through Noyce, until the school year when the research occurred. One of those two, had new administration and no longer felt as though she received encouragement to lead. The other teacher was new to the school and understood that leadership opportunities occur in other forms and that as a new teacher, opportunities will “come over time.”

Seven teachers (70%) considered that they received opportunities to lead professional development sessions intermittently for the district or school. They implemented the professional development by way of specific sessions that the school or district requested. Of those seven, three (30%) led PLCs (professional learning communities). Two (20%) teachers mentioned that they were tasked with organizing a new STEM day or night for the school, following the STEM night that they were required to implement through Noyce. One of those two mentioned that prior to the arrival of her new principal she planned to lead the organization of another STEM night but since the arrival of her new principal “that’s on hold. It’s on, it’s off, it’s on again.” While four teachers (40%) served as formal mentors at the time of the interviews, one other previously served as a formal mentor but during the year of this interview, that teacher did not. This brings the total number of teachers in the last five years serving as official and formal mentors, to five of ten (50%). Eight of the ten teachers (80%) stated that they received opportunities to lead at the school and or district levels by designing and facilitating professional development. That included the three (30%) mentioned above who lead professional learning communities.

Professional conferences and subsequent professional development. Six teachers (60%) expressed that they led through presenting at state or national conferences. It is

important to note that all of the STEM teacher leaders in this study were asked to submit proposals to present at state conferences and during the year of this study they were asked to submit proposals to their national science or mathematics teacher conference, but not all were accepted. Ms. Piazza stated that she presented at one conference but attended three. Following the conferences, she developed and facilitated “professional development over the summer by sharing things I have gotten.” Ms. Stern reported, “I did the state conference and from that I had an opportunity to go to (another rural district in South Carolina) and branch out to them.” When asked how this contributed to leadership she shared, “by me having that knowledge and having that relationship, I can send them examples and that benefits them.” Attending a national conference not through Noyce but because her school was a Title I school, Ms. Beach explained, “It is nice to be Title I and have the money to do it. Because of that, then, there are four or five of us from the district that went.” When asked why attending a conference with several colleagues was important, she shared that with the information gleaned from the conference, the team “did a professional development session at the start of the school year with what we brought back.”

Formal technology leadership. Ms. DiBastiani, Ms. Tuner, and Ms. Stern all formally served in leadership positions that assisted teachers and other staff with technology. “I was on the district technology board where they take the technology plan, looked through it, and made changes as needed,” explained Ms. Stern. Ms. DiBastiani explained that her role focused more on technology use related to her content specifically. Relating to an online tool, Ms. DiBastiani shared, “the teachers didn’t know how to get into their account.” When asked further how she assisted with technology she shared that

the summer prior to this interview she, “showed them how to navigate their documents,” as she referred to the online resources. Likewise, Ms. Tuner shared that, “most of the professional development I conducted is mostly technology based.” She clarified that “I have done some professional developments in my department on how to use certain resources or how to [do] researched-based research,” and referred to showing teachers this using technology.

Leadership through community outreach. Both Ms. Beach and Ms. Piazza served in official leadership roles through community outreach. Ms. Beach stated that she supported the school and other teachers by leading the school and family relations committee. She explained that in that role, she is, “the planner of all things.” Ms. Piazza led Relay for Life and “we have come out as one of the top five every year.” When asked how this contributes to leadership, Ms. Piazza stated that “We work with teachers and students to promote that.” She explained that by working together with teachers and students, and leading that, it creates positive relationships between teachers and students and also between teachers and the community.

Uncommon threads of formal professional development. A few of the other formal professional development responsibilities named individually by the teacher leaders and served by only one person from this research group each (10%) included, Ms. DiBastiani with curriculum writing and serving as state teacher of the year in her content area, Ms. Tuner served as an official teacher evaluator, Ms. Beach was a leader for a trademarked leadership program for students at her school, Mr. Lee served as an after school program supervisor and he also collaborated with the administration to develop strategies for decreasing student tardiness to class. Ms. Stern analyzed data that the

school submitted for the state school report card. She also worked on the formation of the master schedule for her school. Ms. Piazza served as the school level teacher of the year and she served on the STEM advisory committee for her school. Ms. Kirschner assisted with a schoolwide grant project.

Table 4.4
Perceived Formal Professional Development in Last Five Years

| <u>Responsibility</u> | <u>Teacher names</u> | <u>Percent of teachers</u> |
|---------------------------|----------------------------------------------------------------------------------------------------------|----------------------------|
| Team/Dept./Grade leader | London (previously) DiBastiani Tuner Stern Beach Piazza Kirschner (previously) Sink | 80%, 8 of 10 |
| School/District PD/PLC | DiBastiani Tuner Grajcar (previously) Stern Beach Lee Kirschner (previously) | 70%, 7 of 10 |
| Plan New STEM Night | London Kirschner (possibly) | 20%, 2 of 10 |
| Formal Mentor | Tuner Grajcar (previously) Lee Beach Sink | 50%, 5 of 10 |
| Present/Attend Conference | London Grajcar Stern Beach Sink Piazza | 60%, 6 of 10 |
| Formal Technology Support | DiBastiani Tuner Stern | 30%, 3 of 10 |
| Community/Parent Outreach | Beach Piazza | 20%, 2 of 10 |

Number of formal roles. Table 4.5 shows the number of professional development roles that the STEM teacher leaders engaged in with arrange from one to six.

Table 4.5
Number of Formal Professional Development Roles of STEM Teacher Leaders

| Number of Roles | Number of Teachers | Percentage of Teachers |
|-----------------|--------------------|------------------------|
| 1 | 1 | 10% |
| 2 | 2 | 20% |
| 3 | 1 | 10% |
| 4 | 2 | 20% |
| 5 | 3 | 30% |
| 6 | 1 | 10% |

Perception comparison of formal professional development. Did the perceptions from the administrators align similarly to those of the STEM teacher leaders regarding involvement in formal professional development opportunities? Again, to protect anonymity, the researcher chose to not list a side by side comparison of each teacher and administrator. Four of the six participating administrators (66.7%) had STEM teacher leaders who also participated in interviews. Ms. Piazza’s responses aligned with her administrator in that her administrator listed two of the three Ms. Piazza shared. The administrator did not list attending or participating in conferences as leadership. On the other hand, Ms. Piazza’s principal listed two additional activities that Ms. Piazza did not include during the interview. This included analyzing data by “talk(ing) about MAP test scores, which is a standardized test her school participates in, and the state assessment.”

Ms. DiBastiani’s administrator listed one responsibility that Ms. DiBastiani did not mention, which was working as a mentor. While Ms. DiBastiani did not list that, her

administrator stated, “She is a mentor and if someone needs help, they are assigned to her.” Both Ms. DiBastiani and her administrator listed two of the three same activities including technology leadership and STEM professional development. As a new administrator, Ms. DiBastiani’s principal stated, “I was here in January and not sure what she did in that time (before).”

Ms. Kirschner’s principal began working at her school the summer prior to the research interview. Her principal stated that she is “department chair but has no specific responsibilities.” To that point, Ms. Kirschner did not list herself as a department chair this year but included that in years past, she served in that role.” Her administrator stated that Ms. Kirschner “brings back standards expectations, not only (to) teachers of (her content), but other teachers, from roundtables.” The responsibilities that both Ms. Kirschner and her administrator listed as formal professional development responsibilities aligned. Later in the interview her principal listed that Ms. Kirschner is a “mentor officially,” but also stated that “she does a good job of taking novice international teachers under her wing, more unofficially.” Ms. Kirschner mentioned that planning a second STEM night was tentative because the principal changed his mind off and on. The administrator did not list that as a formal duty. However, Ms. Kirschner saw both of those tasks as something she served prior to the principal starting at her school and not at the time of the interview.

While Ms. London’s principal came up with more formal professional development roles facilitated by Ms. London throughout the interview process, none of their responsibilities aligned. Ms. London did not mention the department or grade level role or leading a second STEM night. However, the principal listed more than six ways

that this teacher exhibited formal professional development, two associated with teaching high stakes courses, and the others included additional ways Ms. London leads teachers. Specifically, teachers in Ms. London's content "formed a PLC (professional learning community) this year. They have scheduled meetings and stated a goal. In that group it is her biggest opportunity for formal professional development," meaning the biggest opportunity for Ms. London to lead professional development.

Informal professional development roles. During the teacher leader interviews, the STEM teacher leaders struggled with what they considered informal professional development roles compared to what it meant to be a professional educator, in general. However, one informal role revered and implemented by the STEM teacher leaders was mentoring.

Informal mentoring. Ms. Hawk contemplated that she "just" had "the personality for mentoring and supporting teachers informally," speaking of informal professional development. "My door is revolving," she shared.

"A lot of times teachers stop by during planning and vent about professional and personal things. It helps to keep it sane around here." Ms. Piazza also informally mentored a teacher. She "tried to make her happier and she feels like she understands more since I worked with her."

Informally, Ms. Kirschner supported teachers as a mentor. Her school hired international teachers on a regular basis, and she shared that often, the international teachers struggled with "developing relationships with students" and with a standards-based curriculum." Throughout the past year she worked with one international teacher in particular, "who doesn't know cultural things the students would do. He doesn't know

how to use certain things and develop relationships, so I teach him things he can do to get to know his students.” Additionally, Ms. Kirschner perceived that she mentored a teacher in another content because that teacher was “not a tech person” and Ms. Kirschner engaged with instructional technology, often. “I help her with stuff on the computer and trying to do things like the gradebook and stuff.” She also shared that when her school planned STEM nights, she assisted “all different teachers. I am in and out of everybody’s classroom. Most people don’t want you to publicize what they don’t know, and I respect that.”

Additional informal support. Ms. Tuner shared that she tried to share information with teachers by “assisting them quietly.” She explained that during the year of this research, the school hired a colleague to serve in the formal capacity of technology support. She explained that teachers “feel as though I have been doing the professional development (for technology) for some time and people feel comfortable calling up and asking me to their rooms.” Without trying to bring attention to herself or to impose on the new technology coach, she helps “colleagues with research or how to use technology effectively in their classrooms.”

Ms. London’s informal assistance consisted of less specific support. She stated that “informal opportunities are based on what I feel is needed at that time. If there are teachers struggling with finding activities for the classroom, I put activities together.” To explain this further, she gathered materials and discussed instructional ideas for teachers. Similarly, Ms. Stern offered assistance when she heard “of a teacher having a problem or issue.” She stated, “It’s my nature to help a teacher if they need it. I do things informally when I see things and I can help.”

Mr. Grajcar shared that as a teacher in a school new to him, most of his leadership experiences during the school year that this interview occurred, were indeed, informal. He shared that “all of my collaborative planning for the grade level, teacher meetings and providing and receiving feedback,” with peers was informal. He was excited to have many opportunities to informally “share Noyce experiences often.” When asked how he shares, he explained that it occurred, “in the hallway, sharing resources, through e-mail, and at planned meetings.”

Ms. Beach, a veteran at her school, stated that “I have been around the school for so long that it is one of those that if teachers have a question, they know I have been here forever, or know the community, so there are lots of opportunities.” Some of the talents that Ms. Beach shared informally with other teachers included, “I like technology. People come in here if they want to know about technology.” Other times that she shared ideas were “a lot of hallway and lunchtime conversations and a lot of, ‘hey what do you think about this. I don’t know how to quantify that.’” When asked if she shared more with her content or not, she explained that “it’s a combination. We are pretty separated in terms of grade levels, so I don’t see a lot of my (content) teachers unless we have a meeting. So yeah, it’s across the curriculum.” Another teacher, Ms. Hawk, “I just share ideas like a site I came across or strategies that another teacher might find useful.” She shared that she supports teachers from a variety of content areas.

Mr. Lee on the other hand, shared more content specific ways that he supported teachers informally, “by helping teachers with a lab.” Like others, “On my hall I serve as the tech guy, informally, helping with the SmartBoard, using my data notebook, and little

things.” He shared that he has been at that school for a “long time” and he helped with whatever “little thing is needed”

Ms. Piazza’s informal professional development experience varied a little bit from the other ten teachers in that she informally collaborated with another teacher leader, the curriculum coordinator. “We share professional development information with each other. We share what we learn about websites and she puts it out to the teachers.” In other words, Ms. Piazza supported teachers in an indirect way, without the teachers knowing some of the information came from her. Regularly, Ms. Piazza said, “I offer myself if someone needs me. When I help other teachers, it is supportive of the curriculum.” Similarly, Ms. DiBastiani shared that she will “just pop in a lot,” in reference to teachers going in to each other’s classrooms to learn from each other. She stated that this occurred, “more in my content area.”

Informal professional development: comparing administrators to teachers. While Ms. London perceived herself as someone who assists teachers on an as needed basis, regarding informal support. Her principal agreed that she helps “wherever and whenever.” Additionally, her principal shared that teachers who are new or who need extra assistance, were placed near Ms. London’s class to learn from her informally. According to Ms. London’s principal, “We put teachers around her in the building, the teachers who are next to her and across from her are there for a reason. It’s so she can rub off on them.” Their perceptions of informal support were similar. While administrators recognized that the teachers influenced professional growth and assisted with teacher support, the teachers each listed more specific ways in which they supported teachers informally on a regular basis.

Relevance of professional development. Both teachers and administrators perceived that the relevance of professional development contributed to its sustainability. The relevance was represented in two ways; relevance of the topics to the teachers and then relevance regarding the outcomes the professional development produced.

A higher percentage of teachers (60 %) determined teacher choice in professional development as an important piece to sustaining instructional growth, while 50 % of the administrators listed that as essential to sustaining professional development. Three teachers (30%) and one administrator (16.67%) focused more on relevant content. Ms. Sink indicated that teacher choice was essential to the success of professional development. Likewise, Principal Parton perceived “grassroot” movements as leading to the professional development that lasted the longest. Both Ms. Kirschner and Ms. Piazza perceived that informally learning with a colleague contributed to animated and purposeful learning because it naturally addressed relevant needs. The STEM teacher leaders all had different visions for what needed to be addressed in the future but they all agreed that relevance was key to successful professional development.

Relevant professional development through STEM teacher leadership. Three teachers (30%) and two administrators (33.33%) perceived that professional development continues when teachers share success or see benefits. Mr. Lee stated that professional development needs to focus on a skill long enough for teachers to see results. He also added, “One and done doesn’t do it.” He further explained, “Schools jump from one thing to another. It needs to be a theme, if you have explicit instruction, that whole year, teachers need to learn about (it) and nothing else.” Principal Richard perceived that teachers need to see the benefit of what they are asked to learn about and implement.

Administrator Moss explained that the professional development of educators included the opportunity for teachers to share successes and struggles with each other, which takes time, in addition to the need for teachers to see results in their classroom from the experiences. Finally, both Ms. London and Ms. Tuner mentioned that seeing a change in data or scores encourages teachers to keep learning and sharing.

In regard to future sustainability of professional development, all but one administrator (83.3%) stated that their STEM teacher leaders could perform professional development. The sixth administrator stated that because the teacher was new at her school, she just could not make that determination at this time. Likewise, nine out of ten teachers (90%) felt that depending on what was needed they could assist with on-going professional development. The tenth teacher stated he could not right now because he was learning about the school which was new to him. However, in the past he not only conducted professional development at his school, he supported teachers across his prior district with sustained professional development. One teacher, Ms. Stern, originally stated that her new principal would not let her conduct professional development. However, as she talked through her answer, she determined that she would take what she learned through Noyce and other endeavors and share it with whomever was interested. To that point, Ms. Kirschner expressed that she is capable and, in the past, supported teachers with professional development. However, she was unsure if her new principal would allow her to do it at her current school.

Resources for professional development. Regarding other factors that support future professional development endeavors, Administrator Moss stated that teachers need supplies and materials: “Showing them the latest and greatest in science instruction that is

where great instruction comes in, exposure.” Principal Parton envisions professional development needs “can best be met by letting the teachers handle it.” Also agreeing that teacher leaders are better to do professional development, Principal Hawk also clarified that for future development to be successful, immediate feedback is needed.

Administrator Mickey envisions teachers having access to “outside resources” to encourage teachers to grow professionally. Mr. Lee suggested that visiting places provided him with new knowledge to share during professional development opportunities at his school. Visiting places that utilize learning in the real world is one way that Mr. Lee suggested for teachers to buy in to and continue to pursue professional development in the future. He stated, “I believe I have something to give to my school.” For example, he mentioned that when the teachers visited a laboratory in the community, they were able to see how their instruction connects to the future of the students. He added, “In content areas, just content, you can’t beat professional development at the university level because they have resources our schools don’t have. Being able to see what happens at the next level, in science and research, that is beneficial for content.”

From the STEM teacher leaders’ perspectives, three teachers (30%) mentioned access to resources as a necessity for sustaining learning moving forward. Ms. Stern suggested that free resources are plentiful. The district needs to support the use of some of those opportunities. Ms. DiBastiani foresaw professional growth in the future continuing through the development of teacher confidence through learning more in-depth about laboratory activities. Due to changes in administrative style and a recent lack of opportunities, Ms. Kirschner foresaw personal conversations and informal opportunities as ways for teachers to grow with each other, noting that teachers will need

time and opportunities to collaborate. One different perspective came from Ms. Tuner who imagined professional development in the future that utilizes cross-curricular expertise for a wholistic approach to learning and finding common and integrated needs among all teachers. In a somewhat opposing perspective, Ms. Beach predicted that the most essential and purposeful professional development moving forward should focus on unpacking and examining standards. Based on the information from the STEM teacher leaders, it is essential to not only learn about contemporary resources, but they also then need the district to provide access to those resources. Additionally, teachers need to determine what resources are needed.

Time for professional development. In order to understand how much time the STEM teacher leaders spent on their leadership roles, they were asked about how much time they dedicate to such responsibilities. When asked how much time they spend on each specific leadership role each week, every teacher, ten of ten, (100%) stated that was hard to determine a specific amount because, as one teacher stated, their “responsibilities are fluid.”. As teachers struggled to quantify specific amounts for each duty, they were then asked to determine an estimate of how much time they spent on leadership duties. The teachers’ estimate of time devoted to teacher leadership ranged from 2 hours a week (20% of the teachers) up to ten or more hours for 3 teachers (30%). When teachers gave a range, such as 4-6 hours a week, the highest amount was used in calculating averages. With these ten teachers, the average amount of time spent on leadership and non-instructional duties weekly was calculated to be 5.85 hours each week.

Conditions promoting and inhibiting STEM teacher leadership. To determine what made STEM teacher leadership support sustainable, a set of questions were asked in

an attempt to answer the research question: What administrative factors and teaching conditions promote STEM teacher leadership in high poverty, rural districts?

Both administrator and STEM teacher leader input contributed to the data used in this section. The data collection in this section pulled from the administrator and teacher data presented earlier in this chapter, along with the tables included after this section of narrative. As stated earlier, the researcher determined that comparing STEM teacher leaders side by side with their respective administrators risked losing teacher confidentiality, therefore, the teachers and their corresponding administrators were not compared to each other.

Culture between teacher leaders and administrators. The theme of culture between the administrators and the STEM teacher leaders became evident as the teachers shared their experiences. This extended beyond a relationship but rather the habits, expectations, and communication between the two. Within that theme there was either a context of positive support and growth opportunities or a context that was prohibitive regarding the opportunities the teachers received to share their skills with others. Table 4.6 summarized the perceptions of STEM teacher leaders had regarding support they received from their respective administration.

Characteristics of a positive professional development culture. Eight of ten teacher leaders (80%) expressed that current communication and culture at their school promoted, at least in part, their abilities to lead. For example, the support of the administrators, along with the communication between the teacher leaders and administrators, contributed to a positive situation where administrator interest drove the teacher leaders to feel empowered. That culture spread to the teachers. Based on that

data, a sub-theme that became evident within administrator support was professional development opportunities for teachers. Ms. London, Mr. Grajcar, Mr. Lee and Ms. Sink (40%) of the ten teachers, as mentioned above, felt as though their administrators offered support for STEM teacher leaders because they received permission to participate in conference and other teaching and learning opportunities away from their home schools. Another way that administrators provide a positive culture is through their forwarding information about outside programs to “encourage us to participate and be a part of these leadership programs.” This indicates positive communication, at least in part between the STEM teacher leaders and administrators.

Ms. London’s principal encouraged leadership by creating a collegial culture in the school. He calls his teacher leaders “buddies” instead of “teacher mentors.” The principal is also supportive of relationships as exemplified when Ms. London shared that he “didn’t move the last buddy because “he knows that I had a bond with her. He looks for ways that we as teacher leaders use our gifts.”

Ms. Tuner, a second year administrator, shared that support from administration at her school came from serving on a committee which they referred to as a board, where they “help give input for different things and different activities.” She expressed that the board represented “the voice of the teachers” and that she felt the principal and district “are supportive of teacher leaders in the school.”

Teacher voice. One of the strongest reflections of positivity came from Ms. Beach who expressed, the new administration at her school, “does a phenomenal job of supporting because they listen. They talk through things.” She stated that she is valued because they take their time (with me) when I need them to.”

At a school with new administrators, Ms. Beach shared that there is a positive growth culture at her school because “they do a phenomenal job of supporting.” When asked why it’s a positive environment, Ms. Beach shared that the “biggest thing they do is listen. If I come with a suggestion or issue, they take time to sit down and talk it through.” Perhaps most significantly, she stated, “The biggest thing is I am valued because they take their time when I need them to.” As she shared, participating in problem-solving processes with her administration allows her to serve as a STEM leader at school.

Mr. Lee shared that he received positive support that promoted teacher leadership. “We are a family at this point; it is like an extended leader family and (in) a rural school there is not a lot of interaction. He further shared while explaining rural schools, that in this positive environment where there is strong communication, “we get all the extra that comes from people who can share ideas.”

Ms. Tuner’s school also referenced a strong and positive culture of sharing and communication at her school in regard to teacher leadership. With a new administrator, she shared that they have a “board of (teacher) leaders” and we give input for different things and different activities.” This process gave her a voice because “If we are making decisions, we represent the voice of the teachers, so he (principal) meets with us to hear the voice and make decisions.” According to Ms. Tuner, this process came from the superintendent because he wants a “cabinet of teachers to report.” Her superintendent views this as a way to “give reports to the superintendent about district operations.” She went on to say, “The principal and district is (sic) supportive of teacher leaders in the school.”

Another STEM teacher leader with a new administrator, Ms. DiBastiani mentioned that “we have had three principals in three years.” Her new principal communicated curiosity about Noyce and asked about it. This communication led to the new principal, who came midway through the previous year, to be “supportive with everything I do with Noyce.” On the other hand, her previous new administrators failed to communicate any interest about Noyce and there was negative interaction because “we had some run ins a little but with some of the other principals because they weren’t quite sure.” In other words, some of the former administrators questioned the need to hold Noyce professional development at her school or for her to leave to go to professional development. Because she experienced frequent principal turnover, principals inherited the Noyce participants without knowing about the program or agreeing to it.

Ms. Piazza also reflected upon the importance of communication. She stated that at her small school teacher leaders “work with me to be able to go,” in reference to Noyce responsibilities.” She also shared that leadership occurs on a team and that they “share notes.”

Six teachers (60%) mentioned a culture that included flexibility, communication, inclusion in decisions, as well as autonomy and support for growth. Ms. Sink explained that her administration acknowledges her when she participated in leadership activities such as with her Freshman Academy. She also shared that, “They ask me ways to help or get teachers together.” “I am on the leadership team. It is well respected.” Mr. Lee expressed that his school has a culture that encourages teachers to improve themselves. These six teachers lead others to grow teachers by communicating to them, meeting with them, and acknowledging them.

Communication. Ms. London shared that professional development with teachers succeed at her school with other teachers, specifically because of on-going communication between herself and other teachers. Mr. Lee also commented that communicating with his principal as well as communicating with other teachers lead to the sharing of ideas, and many times growth and change. Ms. Piazza also mentioned the collaboration between administration between teachers and administrators as a factor that keeps positive change occurring.

To that end, Mr. Lee, Ms. Tuner, and Ms. Piazza, (30% of the teachers) all mentioned that communication, lead to continued growth. Two teachers (20%), Mr. Grajcar and Ms. London, experiencing the first year or second year at their new schools did not offer much input in regard to the current school culture and communication. The teachers each also referred to the lack of response from administrators and shared examples when they were asked to give input and expertise to administrators and or teachers and no further action was taken. That lead to frustration and a feeling of being less adequate.

Table 4.6

Description of Teacher Leaders' Perception of Administrative Support

| STEM Teacher Leader | Perception of administration's support |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ms. DiBastiani | New administrator this year; In the last three years we have had three different principals. This principal has been supportive with everything I do with Noyce; We had a run in with some of the (previous) principals. They weren't quite sure what we had and couldn't use the building for professional development. |
| Ms. Tuner | Second year for administration. "We have a board and we help give input for different things and different activities."; We represent the voice of the teachers; In general, he (principal) and the district are supportive of teacher leaders in the school." |

| | |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ms. Beach | New administration They do a phenomenal job of supporting “because they listen”; “They talk through things” “They help me work through solutions or if it’s a suggestion, the look in to it.” “I am valued because they take their time (with me) when I need them to.” |
| Ms. Sink | Stable administration; Administration is flexible toward the Noyce program requirements and don’t give backlash for going to a conference; They forward us information and encourage us to participate in teacher leadership programs; If you teach an EOC (end of course) class in a small district, it feels as if you are overlooked for growth opportunities because the focus is the test and the school report card for those teachers and so those teachers don’t get picked. |
| Ms. London | Teacher newer to school. Great administrators; He is open to us going to professional leadership workshops; “Encourages us to present.”; We are buddies not ‘mentors’.; The principal didn’t move the last buddy because “he knows that I had a bond with her. He looks for ways that we are teacher leaders and uses our gifts.” |
| Mr. Lee | Administrator is former student; I get good support; “There is not a question when I miss school for conferences. It is embraced at school. Our principals, district leaders, give our folks what they need to improve themselves.” |
| Ms. Piazza | Administration is supportive; They work with me to go (to conferences); They host Noyce events; They encourage me. |
| Mr. Grajcar | New to school; “They allow me to take time to do events like to speak at conferences”; “They praise the work with the leadership program because it is directly related to what we are doing at a school level”; They are appreciative of what I do.” |

Characteristics of a culture prohibiting professional growth. One administrator of six (16.7%), and three teachers (30%) mentioned the lack of communication and interaction with the new principal as discouraging for each of them. They both cited

discouragement from the new administration to lead and grow, such as losing leadership positions they once held. Table 4.7 summarizes what the STEM teacher leaders perceived to be as negatives in the school culture that prohibited professional growth.

For example, Ms. Beach stated that helping teachers grow is hard because with new leadership, they did not receive approval for funding to attend professional development opportunities of their own to grow and bring back information. She said, “They only let one person go and bring back information.” She went on to say that funds are available, they are not used because growth in that way is not valued. Furthermore, when asked what keeps driving her to lead, she answered, “You know sometimes when you go to another school or talk to other teachers and you hear about all these nice school professional developments going on, it encourages you to do better, to professionally grow.” She went on to indicate that she considered moving she still sought to lead and grow because “You might end up at a school like that,” meaning, at a school that needed teachers and teacher leaders to have the new skills she missed out on because she was not receiving professional growth opportunities. “You don’t want to not know so you encourage teachers to get professional development.”

Likewise, Ms. Kirschner indicated that the culture at her school felt unsupportive and her administrator, also new, expressed reluctance to allow her to participate off campus for professional growth activities because she was already out for district appointed leadership duties. In other words, she had mandatory district related responsibilities that took her out of the classroom. Because of this, her administrator did not want her away anymore and was unsupportive when the teacher requested to attend a conference and a professional development opportunity off campus. “It’s not clear what I

am supposed to be doing.” The lack of communication, trust, and responsibilities lead her to think that, “I feel it is time to move on with someone to help me grow, who won’t be intimidated by what I did in the past.” Though she expressed disappointment and less utilized this year due to the change in culture she also shared, “I don’t need to stop because someone is not supportive of me. Maybe it is not the end but a new beginning.”

Table 4.7
Teacher Leaders’ Perceptions of Lack of Administrative Support

| STEM Teacher Leader | Perception of support |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ms. Stern | New administrator this year; “I told my administrator in April that I have to go to a conference, and he is okay with that and that is showing support.” “That is the only interaction we have had.” “He communicates through his assistant”; principal felt intimidation from the “doers” at the school and that led to teachers’ perception of her as a teacher leader as intimidating. “They (teachers) are very intimidated.” |
| Ms. Kirschner | Does not know much about the (Noyce) program. “When I go beyond and get different proposals that require me to be out of the classroom he is not for it.”; I was accepted to present at a national event and my administrator sent an email to talk about it. “He said I was out a lot and I am the district teacher of the year, so I have to be out. It is hard to say whether he is supportive.” “It is totally different than the last person who would have encouraged me to go beyond. This person does not understand.” her principal had not “told me what to do but the superintendent has.” |
| Ms. Sink | “If you teach an EOC (End of Course) class in a small district it feels as if you are overlooked for growth opportunities because the focus is the test and the school report card for those teachers and so those teachers don’t get picked,” for leadership opportunities beyond the school. |

Lack of communication. Within the subtext of school culture, communication or lack of communication, affected the STEM teacher leaders perceived level of appreciation. In an opposite experience to Ms. Kirschner and Ms. Beach, Ms. Tuner stated that with the current administration, there is not communication with some aspects. This being a newer administration of two years she stated that the newer principal does not include teacher leaders when interviewing potential new teachers for the team, compared to the other principal. This lack of communication leads her to feel like a “sore thumb stuck out here” and she no longer feels purposeful due to the lack of inclusion and communication

Ms. Kirschner and Ms. Stern, who shared an administrator, both mentioned that their new administrators lacked communication with them as teacher leaders so that they were no longer able to contribute much as STEM teacher leaders at the school. He regularly responded to e-mails from the teachers to him, by asking his assistant to give the answer to the STEM teacher leaders. He rarely communicated tasks he wanted the teachers to do, and he turned down suggestions from the teachers when they wanted to try something new, though he rarely communicated a reason as to why he turned it down. Additionally, Ms. Stern shared that the principal felt intimidation from the “doers” at the school and that led to teachers’ perception of her as a teacher leader as intimidating. “They (teachers) are very intimidated.” She explained that, “their whole attitude changes when I knock at the door.” “They ask their kids to be quiet like I am an administrator. Their whole attitude changes.” It is frustrating to her that serving as a teacher leader is now negative but that is because of “lack of support”. Because the principal turned down new opportunities and ignored, them, teachers also did not want

involvement from the STEM teacher leaders. One teacher (10%) felt as though her administration did not support her because she was denied opportunities to share her expertise at a national level and learn at that level. One (10%) other teacher of the ten, shared that she had permission to go to one conference, one time, but that overall professional growth opportunities outside of the school are not permitted.

One way Ms. Sink felt unsupported was due to the fact that she taught in a state-tested area because the school's focus was on the test and not the teacher. Therefore, teaching in an End of Course subject may lead to fewer leadership opportunities beyond the teacher leadership level because administration recognized the strength in teaching that these STEM teacher leaders exhibited. Therefore, the administration chose to keep effective teachers who teach courses measured by the state, in the classroom rather than giving them leadership opportunities. "If you teach in an EOC (End of Course) class in a small district, it feels as if you are overlooked for growth opportunities." End of Course tests are exams monitored by the state for growth purposes and the results are reported on the school report card by the state. School administrators put their most effective teachers in those classes. Ms. Sink went on to further explain, "The focus is the test and the school report card for those teachers and those teachers don't get picked (for growth opportunities)."

With a new administrator who "does not communicate much", Ms. Stern felt as if she "always had more purpose but now it is time to search and see what else I could do." For example, Ms. Stern shared, "I started up a lot of different activities with my students like clubs and got different funding with past leadership." Ms. Stern chose to work in the district and travelled to work in the district but stated at the time of the interview, "I

do what I need to do.” With frustration and sadness in her voice she stated, “I feel it is time to move on with someone to help me grow who won’t be intimidated by what I’ve done in the past.” When asked to clarify what she meant she shared that the administrator did not want to do all of the initiatives that the STEM teacher leader involved teachers and students with. “Maybe it’s not the end, it’s a new beginning. The administrator is intimidated because the STEM teacher leader had started STEM initiatives such as the STEM festival and partnerships prior to this principal arriving. Ms. Stern perceived that the principal wanted her to be involved in fewer teacher leadership activities. Prior to his arrival, the STEM teacher leader was engaged in attending professional development off campus, traveling to the state’s Department of Education to learn about new policies, procedures, and initiatives, and she led STEM professional development at school. Her new administrator took those opportunities away.

Ms. Stern also stated that she is restricted in her opportunities to lead because she “wonder(s) if he is intimidated by me.” She shared throughout the interview that there is minimum communication with the administrator at her school. “We don’t really have interaction. If I have to talk to him, we tend to go through his secretary.” She then questioned, “I wonder if he is intimidated by me because I am a teacher leader. He tells me he has to meet with me, and I go but he never meets with me face to face.” This indicates a perceived lack of communication between the teacher and administrator as well as a negative growth environment. This is the administrator’s first year.

Instead of perceiving it to be acceptable to get information from the new principal, Ms. Kirschner sought guidance from the superintendent. Ms. Kirschner expressed that her principal had not “told me what to do but the superintendent has,” told

her what to do, as of December of the school year when the interview for this research occurred. She stated that due to the lack of communication with the principal she was not able to lead this year because in previous years, “we had exposure. Sadly, to say, I stay in my room. I have not had or been able to have conversations with him about what I should be doing.” She stated that she had one responsibility to plan a second STEM night at the start of the year but that the new principal stated that it was off and on. “Maybe once he learns the staff then maybe we will have more opportunities,” she added in regard to leadership opportunities. “It is not clear what I am supposed to be doing or am going to be doing.” Ms. Kirschner mentioned that she cannot grow and help others because of the environment she currently teaches in. “I feel it is time to move on with someone to help me who won’t be intimidated by what I did in the past. I don’t need to stop because someone is not supportive of me.” She felt defeated and ready to find a position at another school.

Ms. Beach indicated that at her school a sense of intimidation existed which made leadership difficult. With this part of the school’s culture, many teachers feared when teacher leaders entered the room. Furthermore, she mentioned that she rarely interacted with the new administrator and more often just left messages with the secretary. She indicated the he did not return her requests to meet because “I wonder if he is intimidated because he sees me as a teacher leader.” She was the only teacher to mention intimidation between teachers and teacher leaders, but she was one of two teachers (20%) who mentioned that the school leader was intimidated by them as teacher leaders.

Time. Teachers and administrators viewed time as a necessity to implement professional development. Time was defined in two ways. First, they defined time as the

amount of time schools or districts give for teachers to learn and plan professional development and whether that time was sufficient to implement and determine efficacy of the new initiatives. The other way they defined time was the time during the day STEM teacher leaders and teachers had to practice, reflect and collaborate about the initiatives assigned for professional development. Three administrators of six (50%) and six teachers of ten (60%), 9 of the total 16 participants in the study (56.25%) referred to the necessity of time to ensure on-going professional development.

Both Ms. Piazza and Mr. Lee commented on frequent changes to the focus of professional development within schools. According to Mr. Lee, "Schools seem to jump from one thing to another. You never get really good at one of them." He also commented that "Schools jump from one thing to another. It's a mile wide and an inch deep. That doesn't work." "It needs to be a theme, if you have explicit instruction, that whole year, teachers need to learn about (it) and nothing else." Likewise, Ms. Piazza indicated that in her district. "nobody sees it to the end. Teachers get burned out." Also needing more time, Ms. Sink state that time is needed to perfect new content learned in professional development. She confirmed that, "by the time you get one thing down, something else comes up and you don't get the opportunity to learn or to try it." These three teachers (30%) and four administrators, making up 43.75% of the group, perceived that districts implement professional development and then fail to provide follow up or interest in that skill. By not showing interest, the professional development occurred as one or two sessions and then the district or building leaders rarely mentioned it.

Therefore, when STEM teacher leaders work to support teachers, the teachers are often

not interested because the school district or school lost interest in the initiative. The STEM teacher leaders need the support of administration.

The personal interviews contributed to research by further informing the education community what STEM teacher leaders and administrators perceive as positive and negative influences on professional development in high poverty, rural school districts. The STEM teacher leaders and their administrators who interviewed for this study expressed that teachers need two things to implement relevant professional development successfully. They need initiatives that last long enough for the teachers to practice them, implement them, collect data on the outcomes. Teachers also need time within the school day to receive support, collaborate, and plan to use those strategies

Time for professional development and collaboration. Ms. Beach expressed that she valued time that the administrators took with the teachers to gain insight into needs. Mr. Grajcar's perspective in regard to time was expressed as appreciation for time given for him to grow and share at conferences. This made him feel valued. Prior to engaging in a teacher leadership program, Ms. Tuner led and coached students in a variety of activities such as sports and after school clubs. Due to her teacher leadership duties, she no longer coached.

Like Mr. Garner who perceived that time to grow and share was important, Ms. Sink also perceived that when time is valued, teachers are willing to grow. She reflected that with previous district administration, teachers received "comp time" when they came in after school or in the summer to engage in professional development. In other words, if they willingly gave their time then, they could use the saved hours if they needed to be out during the school year without using sick time. This appreciation for personal time

encouraged attendance at professional development sessions. Similarly, Ms. Piazza expressed that there is “not time, teachers don’t like to stay after school, but there is no time during the day.”

Administrator Mickey explained that the teacher at her school spent free time helping other teachers on a regular basis. Also, frustrated with the lack of time, Ms. Sink stated, “We are so busy. You are so tired and so you get out of school at three and you are exhausted and have to go to a workshop and have other things you have to do or second jobs.” Their statements further suggested that because of the varied responsibilities, teachers struggle to collaborate and plan ways to implement professional development strategies. This makes it even more difficult for the STEM teacher leaders to meet with and support teachers in that endeavor.

Time to implement sustained professional development. Within the theme of time, both administrators and STEM teacher leaders mentioned that districts do not spend sufficient time supporting the growth of new skills for the teachers. According to Principal Richards, districts “look for short term” professional development because sometimes, small districts have the “mindset” that they “don’t need to do a whole lot, which hinders teachers.” Administrator Moss expressed, The district changes direction too much. “You get initial training and don’t get training thereafter. You go back to your original habits.” Principals Hawk and Ranger also commented on how long-term support for professional development is not sustained. Out of the six administrators, four (66.7%) mentioned on-going changes in regard to professional development.

In this chapter, perceptions of teacher leaders and administrators were analyzed to answer three research questions:

- 1.) In what ways do administrators at high poverty, rural, schools perceive they are utilizing STEM teacher leaders?
- 2.) How do STEM teacher leaders perceive that they are utilized to provide and support professional development of other teachers?
- 3.) What administrative factors and teaching conditions promote STEM leadership in high poverty, rural districts?

The surveys and interviews were administered to both STEM teacher leaders and administrators of the STEM teacher leaders to best understand the perceptions of STEM teacher leadership in high poverty rural schools. In turn it was the goal of this research to better understand why STEM teacher leaders in high poverty rural schools hold negative or positive perspectives of their work, because people make decisions about whether to stay at a job, based on their perceptions of how they are utilized and valued at that job.

CHAPTER V

CONCLUSIONS, DISCUSSIONS AND RECOMMENDATIONS

The importance of researching the perceptions of STEM teacher leaders regarding their leadership roles is twofold. First, employees often make decisions whether to stay at a job based on their perceptions of their experiences (Smith, 2005). Second, as high poverty, rural schools struggle to fill open positions, it is essential to determine why employees, especially those such as teacher leaders, choose to stay. Rural teacher attrition often results in schools staffed with inexperienced teachers (Murphy & Angelski, 1997) unfamiliar with the culture and needs of the schools. Likewise, these schools then struggle to build a culture of efficacy and collegiality when such a culture is established, and turnover continues. In turn, new teachers struggle to stay committed to the school and communities where they work (Hulpia & DeVose, 2010).

Conclusions

This research study showed several trends regarding how STEM teacher leaders and their administrators perceive STEM leadership at their respective schools. The high administrative turnover impacted the relationships and trust between the new administrators and teacher leaders. As a result, these newer relationships may have been a factor for the administrator's perceptions of the teacher leaders' involvement and affected the level of positive perceptions regarding how they perceived that the STEM teacher leaders performed their jobs and leadership responsibilities. This aligned with

Hirsch and Emerick (2007) who suggested high administrative turnover impacted the relationships and trust between the new administrators and teacher leaders. As a result, these newer relationships may serve as contributing factors for the administrator's perceptions of how teacher leaders engaged in and affected change within their schools.

Relationships. Through synergistic engagement with others, leaders promote mastery through active engagement and creating a positive state of communication (Fullan, 2017). In this study, school administrators and the teacher leaders both listed positive communication and approachability as reasons that teacher leaders experience success supporting teachers in the school. This research study showed that relationships both between the administrator and the teacher leader, as well as between the teacher leader and the teachers determined whether or not leadership opportunities were implemented and implemented successfully. In prior research, Smylie (1990) suggested that when anyone takes on a role labeled as a leadership role, then that relationship automatically creates a barrier between the natural interaction of teachers and leaders, whether they are teacher leaders or not. However, later research by Smylie (2012) suggested that when teacher leaders received opportunities to engage with teachers, positive interaction increased compared to how administrators were able to interact with teachers. Prior to the teacher leaders receiving opportunities to interact and support other teachers, teacher leaders struggled to create positive support relationships with their peers. Therefore, when the culture prevents collaboration or increases animosity, it is suggested that such growth opportunities between teachers and teacher leaders fail to form (Zahorik, 1987).

Furthermore, what this dissertation found regarding the need for positive communicative relationships aligned with Dou, Devose, and Delke's (2016) research findings. Their research found teachers' relationships with school leaders significantly influenced their job satisfaction. Positive relationships between school leadership and teachers resulted in a much higher rate of commitment to the schools as well as a higher feeling of self-efficacy regarding the teachers' perception of success working with other teachers and with students. (Dou et al., 2016). Smylie (2012) determined that in order for teacher leaders to obtain this efficacy, teachers, along with teacher leaders, need time to engage in order to collaborate. With this dissertational research, teachers considered leaving the schools where they felt as though the principal neglected to communicate needs and develop a positive rapport with the teacher leaders.

Sharing expertise. Another on-going theme was the importance of school or community knowledge, knowledge of content, and pedagogical knowledge for teacher leadership satisfaction. For knowledge of the school or community, teacher leaders assisted new, and struggling teachers, to better understand the norms, expectations and students within the school. Knowledge of content and pedagogical knowledge empowered STEM teacher leaders to implement content and strategies that led to them being able to see their students succeed. This aligns with suggestions by Lotter, Yow, and Peters (2014). They aligned with Wenger's (1998) idea that effective learning communities require shared engagement and interest as teachers work toward a shared goal. Additionally, with their solid content and strong pedagogical knowledge, they felt confident to assist other teachers and support other teachers, informally and formally, which led to a feeling of satisfaction. This aligns with the idea that when teachers support

others' similar concerns, struggles, and interests, share ideas and support others, they develop an identity as a leader based on their support regarding commonalities (Wenger, McDermott, & Snyder, 2002; Wenner & Campbell, 2018). Teachers find validity with support the teacher leaders offer because those teacher leaders serve in the same schools, work in the same environment, and experience, or have experienced, the same struggles. (Wenger, McDermott, & Snyder, 2002).

The data in this dissertation showed that the teacher leaders felt most purposeful and driven when their expertise was called upon to be utilized for instructional support. Similarly, Jao and McDougall (2015) found that teachers rarely receive systemic opportunities designed to collaborate, receive peer coaching, and improve practice. When they received this opportunity, there was initially frustration and challenges with initiating collaborative opportunities, but in the long run, the teachers, all of whom taught mathematics, presented positive professional growth experiences from receiving designated time to learn from others (2015).

When teacher leaders shared their expertise with other teachers, no matter how informally, this created intentional incidents of learning (Percy, Martin-Beltrán, Silverman, & Daniel, 2015). Percy et al. suggested that learning occurs through the social interactions between colleagues. They recommended that fostering teacher learning through the sharing of expertise needs to continue (2015). For academic support, the teacher leaders in this dissertation study shared their content, pedagogy, and technology use knowledge with other teachers. Both formally and informally, these teacher leaders provided content support for other teachers. Teacher leaders, according to administrators,

clearly exhibited instructional and pedagogical competence which encouraged teachers to seek them out for support.

This connects with teacher leadership identity development. As teachers engage in professional learning communities focused on curriculum and practice (Lieberman & Friedrich, 2007), they not only improve their professional practice, but develop their identity as teacher leaders through these actions (Wenger, 1998). The STEM teacher leaders who participated in the study for this dissertation identified themselves as effective educators who had the ability to support and lead other teachers. When those opportunities were taken, they questioned whether they were still needed in that environment. Therefore, it is suggested that new administrators take time to understand the roles each teacher leader successfully engages in, and how those strengths and talents might be continued to be utilized under the new principal's leadership. Teacher leaders value environments that offered them both the opportunities to teach students as well as support teachers (Carver, 2016; Hunzicker, 2017) and use those two types of experiences to identify what makes them a teacher leader, compared to just a teacher, or just a leader. When the teachers advocate for both students and teachers they influenced teaching and learning (Hunzicker, 2014; 2017). Those opportunities contributed to teachers identifying as teacher leaders.

Professional Development. Professional development, according to this study, needs to be relevant to the teachers and the needs of the school. In other words, professional development does not necessarily mean professional learning sessions or classes but experiences that best meet the teachers' needs (Fullan, 2007). Data collected from the teacher leaders and administrators involved in the dissertation research

suggested that professional development needs to be sustained or on-going, relevant to the teachers, and relatable to the teachers. Similarly, previous research by Darling-Hammond, Hyler, Gardner, and Espinoza found that effective professional development, which results in changed teacher behavior or learning, includes a sustained support model with coaching from an expert. This learning also relates to the content that the teachers teach while the teacher leader includes classroom teachers in active learning, collaboration, and modeling of such practices (2017). Finally, stability from administration affected teacher leaders and their professional development. In other words, when administrators stayed at their schools over time, their vision for professional learning had a chance to more effectively influence the school culture and practices so that teachers had more than one or two years to implement a concept or idea. This resulted in the teacher leaders feeling as though their efforts to learn, implement, and lead other teachers to implement new concepts was purposeful.

As indicated in the dissertation research, the majority of administrators and teacher leaders expressed that time to implement strategies, along with time for on-going support to learn about those strategies, were essential for the most effective teacher learning. Likewise, Darling-Hammond et al. suggested that through implementing professional learning over time instead of through one-shot professional development sessions, teacher learning may result in more hours of learning than through “just seat time alone” (2017, p.16).

STEM teacher leaders and their administrators involved in the dissertation explained that time is necessary when it comes to developing stronger and more effective teaching from new learning. First, data collected from the interviews, collectively showed that

administrators wanted the STEM teacher leaders to implement professional development, but they felt as though the teachers had other responsibilities that prohibited them from implementing sustained professional development on a frequent and regular basis. The data from the STEM teacher leaders, showed that with their other leadership obligations, along with the daily teaching schedules, teacher leaders had little room to provide additional professional development. However, when asked what they would ideally choose to do if given the opportunity, every teacher leader interviewed for the dissertation expressed that in some way they would like to support teachers in pedagogy and curriculum.

Identifying support based on each school's needs and designing the professional development around that, serves as the basis of situational leadership (Howley & Howley, 2005). Such specific professional development design results in change in teacher practice, knowledge gained regarding content, and an understanding for how the new learning fits the needs of teachers and students at the specific school. Furthermore, research on teacher leadership showed that teacher leaders not only develop an increase in confidence and self-efficacy regarding effective teaching (Katzenmeyer & Moller, 2001; Lieberman, Saxl, & Miles, 1988), but they also assist colleagues to overcome struggles with change (DeHart, 2011; Katzenmeyer & Moller, 2001).

The research for this dissertation supports the need for needs-based professional development which is relevant professional development that is designed to meet the specific needs of teachers and their students. Such professional development occurs not in isolation (Lee, 2005), but rather, situationally. Thus, rather than attending conferences or district wide learning, a needs-based approach implements small professional learning

communities, mentoring and on-going support based on the individual needs of the teachers (Lee, 2005). It is suggested that teachers receive on-going support at school in order to implement new professional learning in a practical setting. For example, if teachers analyze student work in a professionally collaborative setting, they develop a more comprehensive understanding of what pedagogical and instructional strategies work most effectively in their actual environments (Darling-Hammond, et al., 2017).

Teacher leaders worked with other teachers both formally and informally to support their professional growth. Formally, STEM teacher leaders in the dissertation study supported other teachers with content and pedagogy on a sporadic basis. Most of the teacher leaders interviewed did not support teachers with on-going professional development initiatives. This was due to the lack of opportunities that the school or district offered. Rather, teacher leaders supported teachers with day to day content needs, according to administrators and teacher leaders. Informally, teacher leaders talked with other teachers in the hallway and during planning time, casually, when other teachers came to them asking for assistance planning, developing activities, or setting up technology.

Both administrators and teacher leaders spoke of the need for relevant professional development and the time to implement it. Prior research, including that of Darling-Hammond and Richardson (2009) found that in order to be effective, stakeholders in a school need to share a common purpose or vision. In other words, a shared vision for professional development goals and topics more likely succeeds when administration and teacher leaders agree with a vision for moving the staff forward with professional growth. When specifically examining STEM professional development,

teachers not only need to learn and develop expertise in content, but they need to develop strategies for pedagogy that actively engage students in learning and understanding how to apply the content (Jao & McDougall, 2015). Therefore, teachers of STEM rely on the expertise of STEM teacher leaders to grow and expand their pedagogy. Those teacher leaders teach in the same situations and face similar needs and vision. Therefore, those STEM leaders are best suited to support the teachers as they learn and implement the new learning. This dissertation data suggested that trust and credibility of the professional development facilitator was inherent to the success of teacher learning.

Within the dissertation, teachers at schools where the relationships between staff were more positive, perceptions of opportunities to share professional expertise were well received based on the teacher leaders. Teacher leaders and administrators commented on the collegiality of the teachers and teacher leaders and noted that because they understood each other's curricular needs they were able to meet the needs of the students at their schools. When teachers believed that they were supported and understood, they were more committed to the vision for professional development (Bogler & Somech, 2002). Based on the data gathered for this dissertation study, formal professional development was most well received by teacher leaders and professional learning communities run by teacher leaders when administration gave time for the teachers to focus on professional development. The time allowed for collaboration and support from the STEM teacher leaders. Additionally, time for planning allowed for teachers and teacher leaders to create well thought out plans and work collegially with each other.

The data collected also showed that when outsiders, who were disconnected with norms and needs of the teachers and students, brought new professional development to

teachers, the teachers felt frustrated and questioned the professional development without taking ownership or steps to follow through with their learning. Feedback such as this from teachers serves to inform district and school decision-makers when planning professional development. The teachers felt disconnected by outside presenters and they felt as though outside presenters were not focused on the needs as those schools. Bogler and Somech found that what affected job satisfaction the most among teachers was growing professionally, the impact they had on teaching and learning with both students and other teachers, and their autonomy and decision making opportunities (2002). Bringing in facilitators from outside of the district may negate that opportunity for teacher leaders and take away part of their autonomy and the opportunity to help other teachers grow and therefore, improve the school.

Administrative support. The participating teacher leaders expressed ways administrators contributed to their ability to serve as a STEM teacher leader. Most of the teachers felt as though their administrators offered some support for them as leaders. One way the teacher leaders felt supported, was based on whether their administrators supported growth by allowing the teacher leaders to attend or facilitate professional development activities outside of the district, such as at conferences. Boyd et al. found that school administrators affect how teachers and teacher leaders convey needs and goals for growth (2011). School administrators affect the professional growth of the teachers at their schools as well as teacher job satisfaction (Boyd et al., 2011). Both of which play a role in teacher retention (Harris, Rutledge, Ingle, & Thompson, 2010; Boyd et al., 2011).

When asked how administrators supported the STEM teacher leaders, a six of the ten teacher leaders (60%) perceived that if administrators denied growth opportunities,

then that showed a lack of support for growing beyond the school. How administration supports teacher leaders affects the success of those teacher leaders in their supporting roles. According to Lieberman, supportive relationships from administration to teacher leaders are essential in order for those teacher leaders to develop successful leadership relationships with teachers (1988). Additionally, Smylie and Brownlee-Conyers determined that when administrators exhibited ambiguous or nonexistent instruction for completing or initiating tasks in conjunction with uncertain support, teacher leaders experienced negative perceptions of their teacher leader roles (1992). This correlates with the experiences of two teacher leaders in the dissertation research who both felt as though their new administrator did not give definitive expectations or answers to questions. On the other hand, the teachers who felt as though open communication and clear direction occurred regularly from their administrators, felt most content with their roles as STEM teacher leaders.

Another way that teachers felt supported occurred when administrators asked for the teacher leaders to assist with a specific task in some way. Furthermore, if the administrators responded to teacher leaders, acknowledging their work, teacher leaders felt supported. On the other hand, when administration encouraged the teacher leaders to attend professional growth opportunities away from school it was seen as a supportive gesture. Teachers who received little support or communication from administrators perceived greater challenges and felt they needed to accomplish more (Garand, 2016). Another way the STEM teacher leaders felt supported came through verbal validation. When administration invited the STEM teacher leaders to participate in something purposeful, the STEM teacher leaders felt as if their expertise mattered. On the other

hand, when administration asked the teacher leaders to assist in some way and then seemed to ignore the expertise offered, this was devaluing to the teacher leaders and led to frustration. Bogler and Somech suggested that when teachers felt as though they received support and opportunities to professionally grow, they felt more committed to improving their knowledge and skills (2004). The teachers involved in the dissertation study exhibited similar reactions. The teachers most frustrated with the lack of support and ability to grow were most dissatisfied and at least two teachers were considering leaving those schools.

Formal and informal roles. When asked to make a list of formal and informal professional development responsibilities of the STEM teacher leaders, the lists from administrators were similar to those of the corresponding teacher leaders at the school. The data showed that most STEM teacher leaders at the rural, high poverty schools served as department, grade level or team leaders and they served as leaders of at least some professional development. However, the majority of the STEM teacher leaders did not implement formal, sustained, focused, and on-going professional development due to the set-up of professional learning in their schools or districts. Typically, outside facilitators or district personnel conducted professional development, typically at the start of the school year.

Informally, the STEM teacher leaders and administrators acknowledged the interpersonal relationships that the STEM teacher leaders created with teachers in order to offer informal support. As suggested by Nguyen and Hunter (2018) teachers are often receptive to the teacher leaders' support because the teacher leaders are cognizant of the needs and constraints of classroom teachers. Thus, the teacher leaders are able to

understand the opportunities and limitations for teachers to implement new learning practices. The STEM teacher leaders listed more detailed and specific ways in which they supported teachers. This occurred through technology, content, and pedagogy support, along with providing a place for teachers to go and ask questions and receive support.

Regardless of whether opportunities to interact were formal or informal, Smylie found that relationships between teachers and teacher leaders more significantly determined the success of the support rather than the type of support itself (1992). That coincides with the culture of a choice situation (Snyder, 1987) where teachers intentionally seek out learning situations in a more social situation where they feel most comfortable. This was reflected in the dissertation data. Collectively, the STEM teacher leaders related repeated instances of other teachers at their schools coming to them to ask for assistance or to ask questions. Because the teachers felt safe to approach the teacher leaders, this relationship allowed for teacher support to occur even when the school did not offer formal opportunities for the teachers to collaborate and learn from the STEM teacher leaders. This exhibited effective teacher leadership as partially defined by Criswell, et al. (2018). To further explain, these STEM teacher leaders utilized their own significant understanding of content and practice to work with the new teachers to develop innovative teaching and learning while also empowering the new teachers to promote teaching excellence (Criswell, et al., 2018).

This was also evident in more of the data from this dissertation study which showed that due to a high teacher turnover, many of the schools had new teachers and some schools utilized multiple international teachers. Both brand new teachers and the

international teachers often struggled to create positive relationships with their students. They also struggled to create and engage with the students and parents. In those cases, the STEM teacher leaders served as formal and informal mentors. Regardless of whether professional support was served in a formal or informal realm, relevance and time to implement such new learning was suggested as needing to occur. Administrators need to support teacher leaders and create opportunities for teacher collaboration, in order for significant positive change in teaching and learning to occur (Banilower, et al., 2006). This time was needed to build relationships between the STEM teacher leaders and the new teachers so that the leaders could understand the needs of the teachers and spend sufficient time with them to work on the skills necessary for those new teachers to find more success in the classroom.

Suggestions for Sustained and Purposeful Professional Development

Both administrators and STEM teacher leaders expressed that professional development needed to be relevant to the school and teachers. Lotter, Yow, and Peters (2014) referred to Wegner's (1998) Community of Practice theory which aligns with what the administrators and STEM teacher leaders expressed in this dissertation study. They suggested that effective professional learning communities include engagement between teacher leaders and teachers along with a shared interest and goal which involves a diverse group that works together with mutual accountability (Lotter et al., 2014). As reviewed in the data, because STEM teacher leaders experienced teaching in real time, they were, according to some administrators, the best choice to provide the professional development because they provided a level of validity to the process. They experienced the same students, similar environments, and same hurdles. Howley and

Howley (2005) explained a theory that contributed to professional growth of teachers in rural areas. Their theory supported data which showed situated learning for teachers contributed to the most purposeful learning experiences which in turn, resulted in more effective teaching (Lave & Wenger, 1991; Wenger, 1998; Howley & Howley, 2005). They further suggested that educator learning must be relevant and connected to the needs and situation of the teacher. Identifying the necessary support and designing professional development around the needs of teachers within a specific school context, serves as the basis of situational leadership (Howley & Howley, 200).

According to the teacher leaders and administrators in this study, outside facilitators, especially those from out of state, and at the very least out of district, had difficulty relating the professional development information to the needs of the local teachers. This disconnect between teacher needs and professional development provided led to disinterest and a lack of commitment to implement the new learning by teachers. On the other hand, professional relationships in rural schools are typically closer due to a smaller sized staff. It is those types of relationships which have the potential to allow teachers and coaches to work collaboratively in a natural way.

In the study, Mr. Lee shared, there are times when outside support may better serve teachers and other teachers expressed the needs to seek additional growth opportunities. When the teachers in this study chose the development by outside experts that they felt was needed, it was better received and utilized by the teachers. Fraser-Abder explained that in marginalized communities, blue-collar work of the past is being replaced by work that requires STEM skills such as collaboration, research, and more specific expertise in content (2013). Traditional blue-collar work was being replaced by jobs that required

much more advanced subject area content, research, and thinking. It is essential for educators in these communities to make a connection between community needs and the need to prepare the students in the community for college and career. Without such learning, students within that community may fail to acquire the skills and knowledge necessary for them to succeed (National Commission on Teaching and America's Future, 1996). Therefore, unless a professional development facilitator clearly understands where the teachers are and what they and their students need to move forward, with all of the other responsibilities and tasks assigned to teachers, the teachers may fail to make connections to initiatives. Teachers may be reluctant to implement new learning they perceive as irrelevant to the needs of their students (Fraser-Abder, 2013).

Another essential piece of effective teacher support and development is when the district or school administrators communicated interest in the results and outcomes of the development and also, when they provided time for on-going development, collaboration, and practice. Research from the dissertation showed that when district and school administrators failed to follow up on implementation results or offer further support after initial training, teachers perceived that administration did not find relevance or necessity in the professional development. Therefore, teachers find it more valuable when professional development is relevant for their classrooms. When they understand that the professional development is a long-term interest and commitment from the district or often picked new topics annually or more often, which gave teachers little time to implement, adjust, and perfect the craft using the new information. The Teacher Learning Continuum presented data from their research supporting the need for relevant professional development to be a continuum and not one or two forgotten sessions

(2015). Using teacher leaders offers the most effective way to sustain professional development throughout the year which most dramatically increases effective teaching practices and student learning (Joyce & Showers, 1982).

Furthermore, teachers sought support for specific issues while the school or district provided a more general type of professional development. Both the teacher leader group as well as the administrator group shared insight that often districts start the year off with new professional development and then rarely offer sufficient support for those topics after a short time. Too often, the decision making for professional development is encumbered in the bureaucracy at the top leadership levels of district office (Fraser-Abder, 2013). Fraser-Abder, (2013) refers to high poverty schools as disconnected from political decision-makers. This leads to long-term underfunding for such schools, which in turn, leads to underfunded professional development efforts. As a result, these schools generalize professional development rather than meeting the specific on-going needs of teachers of different content (Joyce & Showers, 1982). This pattern of generalizing PD for the larger school group pushes aside the needs of the STEM teachers as content specific specialists. This is where STEM teacher leaders can be utilized to support specific instructional needs of teachers by providing content and pedagogical learning and sustained support for teachers at little additional cost to the school or districts.

In association with relevant professional development, the new learning for teachers needs to occur in an on-going manner. Both the STEM teacher leaders and administrators stressed the need for sustained focus of professional development topics. It is suggested that schools or districts ask educators in a school what their needs are, and

after asking, select a topic or two of relevance. Next, collectively with input from the teachers, administrators and teacher leaders should create a professional development timeline, incorporating a sustained length of time to learn, implement and evaluate the strategies or content, and provide a plan for on-going support by teacher leaders as well as other staff. Furthermore, follow through and continued interest in the success of the new skills exhibits to teachers that the school leadership values the new learning as well as the time teachers extended to learn it.

With all of the changes, teachers and administrators tend to go through the motions, knowing something new will come along soon. High poverty, rural schools rely on general professional development that addresses the needs of most teachers at one time which limits specific content pedagogy and content development (Jimmerson, 2004). Educators need to receive on-going professional development that specifically relates to their needs. It is imperative that educators receive the opportunity to put new learning and ideas into practice (Choo, 1998; Howley & Howley, 2005; Senge, 1994; Wenger, 1998). Supovitz and Turner (2000) found, not only do teachers need time to receive support and to collaborate regarding new learning, but they also need time to effectively plan to implement new learning. The STEM teacher leaders and the administrators studied in this dissertation indicated in the interviews that subtle support to discuss, share, and implement new learning, led to the most opportunity for professional growth.

Building Efficacy and a Sense of Purpose Among STEM Teacher Leaders

Another data trend in the research showed that STEM teacher leaders needed to feel purposeful and valued in their work. Teacher leaders develop their identity around

helping other teacher succeed with content and pedagogy (Wenner & Campbell, 2018). Effective administrators achieve more success at retaining teachers when they contribute to positive school climates and offer greater support for teachers and they offer ongoing support for professional growth (Kraft, Marinell, & Yee, 2016). Those climates develop positively when teachers develop a feeling of efficacy for sharing content and pedagogical practices. For example, Criswell et al., (2018) suggested that when science teachers thoroughly know content and communicate pedagogy, they create change in teaching practices within the school and as a result develop a sense of purpose and value.

These STEM teacher leaders were positively driven by their multiple leadership roles at their schools and the perceived effects of this support on teachers. Schlechty (1990) suggested that teacher leaders strive to influence peers to become more effective in classrooms when they themselves become active in school change. Gaith and Yahi (1997) along with Guskey (1998) found that a teacher's sense of personal efficacy for teaching directly correlated with their resolve to share and engage in best instructional practices. The data in this study aligned as such. When the STEM teacher leaders received the opportunity to have a voice and lead, they felt more purposeful. When that was taken away, the three teachers (30%) that lost at least one professional development leadership role felt negatively about the experience.

When teachers lost opportunities to not only lead, but grow, they experienced negative perceptions of their roles, at least at the time. Collaboration among educators, self-efficacy, and shared interests are essential to sustained professional development. (DuFour & Eaker, 1998; Lambert, 2002; Newmann & Wehlage, 1995; Schmoker, 1996; Spillane, Halverson, & Diamond, 2001). When the teachers received an invitation by

administrators to develop a product or program, the teachers felt appreciated and purposeful. Likewise, when they were invited to develop a solution or product and then their input was ignored, as in the case of Mr. Lee, they felt frustrated and unappreciated. Collaboration and teacher efficacy for teaching builds communities that positively affect the culture of learning within schools (Darling-Hammond, Hyler, Gardner, & Espinoza, 2017). Additionally, calling on teacher leaders to implement professional development support allows them to provide consistency regarding the professional development of staff, without the school needing to pay for professional development (Hughes, 2012).

Teachers felt most effective when they developed and implemented support for teachers, both formally and informally. In fact, majority of the STEM teacher leaders spoke in most detail and most positivity about their roles supporting teachers informally and when they formally coached or mentored others. Data from the research showed that the STEM teacher leaders overwhelmingly, when given the choice, imagined themselves as curriculum specialists, or professionals in similar positions, supporting teachers curricularly. However, four felt as though it would not be possible in their current schools due to lack of support from current administration or the inability to grow in their current positions.

This dissertation study also collected data about not feeling valued as a STEM teacher leader. One of the new principals, also a native to rural, high poverty districts, was asked what some positive reasons were for teacher leaders to lead in a high poverty rural district. The administrator had been very positive in his reflection of the STEM teacher leader at the school to that point. However, he then explained that he did not understand why this teacher leader worked at that school when she lived closer to so

many more schools that were more successful. He shared that he did not understand why such a skilled teacher who lived closer to better funded schools, chose to work at a high poverty school so far away from her home. He did not value his own school because of the high poverty status and low academic performance of that school. It was at this school where two of the teacher leaders felt they were no longer valued professionally for their strengths, talents, and leadership.

With the loss of leadership positions, teachers who previously felt satisfied with their work, teaching, and teacher leadership responsibilities became frustrated and disappointed. The teachers who involuntarily lost a leadership position or responsibilities, all due to administrative change, felt frustrated and disappointed with their jobs. Each one of those teachers, desired to carry more responsibility and felt unappreciated by the administration. They wanted to serve and utilize their expertise to its fullest. The literature reviewed for this study led to the conclusion, that, when administration encouraged the implementation of professional development as a collaborative effort utilizing teacher leaders to support new learning, those teacher leaders exhibited higher motivation to collaborate and support co-workers because they supported teaching and learning and led change to ensure it occurred (Huang, 2016; Hunzicker, 2017). The teacher leaders also felt valued because the administration recognized those leaders for their ability to assist other teachers. Furthermore, teacher leaders valued those environments that offered experiences to teach students as well as support teachers (Carver, 2016; Hunzicker, 2017).

Many research studies note the dire need for teachers due to a lack of retention. However, most of these studies failed to examine why teacher leaders felt both positively

and negatively regarding their positions at high poverty rural schools (Scafidi, et al., 2007). Likewise, very little research compared the perceptions of teacher leaders to those of their administrators to determine what commonalities result in satisfied STEM teacher leaders who feel as though they are effective. This study examined perceptions of both teacher leaders and their administrators to better understand their perceptions of the STEM teacher leaders work and what responsibilities would make them most happy. Since professionals often make decisions whether to pursue new employment or stay based on perceptions, this study focused on job satisfactions of teachers in high poverty, rural school districts and it examined what roles they prefer as teacher leaders.

Administrator Use of STEM Teacher Leaders

Another purpose of this study was to determine in what ways administrators at high poverty, rural, southern schools perceive they are utilizing STEM teacher leaders and as such, how that compared to STEM teacher leaders' perceptions of their utilization in supporting other teachers. Schools, especially those in high poverty, rural areas, need to rely on the specific skills of teacher leaders, especially those specific to the content area of each teacher, and not just the principal, to meet the needs within a school. Leading with just administrators causes a loss of momentum and consistency when the administrators leave (Lambert, 2002).

Administrators notably utilized the STEM teacher leaders consistently for department or grade level chairperson responsibilities. On the survey, teachers more often identified one more of the listed leadership responsibilities as something they engaged in, compared to what the administrators identified, when comparing teacher's survey selections to their administrator's survey selections.

The study also examined how STEM teacher leaders perceived they were engaged in leadership. When administrators failed to establish positive relationships with the teacher leaders, those teachers begin to leave or consider leaving, for a different school (Darling-Hammond, 2003). All but one administrator interviewed in for the dissertation research identified formal leadership responsibilities that the teacher chose or agreed to participate in. However, one new administrator suggested that it was his or her leadership style to let teachers take the lead and “do what they had to do to get things done.” The STEM teacher leaders in the study shared how roles sometimes changed when new administrators came to the school. As in Miller’s study (2009) the teacher leaders who participated in the dissertation research who previously served in leadership roles sometimes found themselves acknowledged less and underutilized as teacher leaders. Within the dissertation research, at schools where both the administrators and STEM teacher leaders perceived positive and collegial relationships between the administration and teacher leaders, the STEM leaders perceived a high level of job satisfaction. This is significant because administrative support shown to retain teachers included actions such as providing professional development opportunities for teachers and shielding teacher leaders from negative influences (Hirsch & Emerick, 2007).

In regard to informal leadership, the administrators were often unaware of the collaboration and support that the STEM teacher leaders offer to other teachers. Since teacher leadership arises through vision and action rather than an assigned position (Cherkowski & Schnellert, 2017), administrators might not be automatically aware of the efforts of support STEM teacher leaders offer. This sometimes leads to a negative perception of the work environment because the teacher leaders complete significant, and

what they perceive to be, necessary, work with colleagues, but the administration often fails to express appreciation. Additionally, because the administration is not always aware of the informal leadership roles and responsibilities taken on by the teacher leaders, the administration assigns even more work to the STEM teacher leaders. Ingersoll (2011) also examined similar aspects of administrator influence on teacher job satisfaction. Ingersoll suggested that limited administrative engagement with teachers, along with generally poor support from administration, led to job dissatisfaction and attrition among teachers, even with those teachers who worked at the school for a lengthy time (2011).

Teacher leadership within schools serves as a solution which offers pertinent and on-going professional development, improvement of teacher quality, and assistance with school improvement (Hunzicker, 2017; Poekert, Alexandrou, and Shannon, 2016). If administrators were more aware of support teacher leaders inherently offer to colleagues, perhaps administrators would recognize the contributions of teacher leaders more often and leave them with more time to support professional development within the school.

Characteristics of Positive and Negative Professional Growth Environments

When administration communicated needs at the school such as challenges, and as a result, invited teacher leaders to work to fill those needs, the STEM teacher leaders took on the challenges and felt purposeful. A sense of purpose is often the motivating factor for leaders to act to support teachers (Hunzicker, 2017). On the other hand, when teachers lost responsibilities, when they stayed at a school but experienced an administrative change, STEM teacher leaders developed an unsettled, if not negative, perception when they lost opportunities they previously had. They felt as though they

lost a voice in decisions and in the change process. STEM teacher leaders felt as though the authentic learning situations with their peers that they had previously created no longer existed. Such situated learning takes authentic, not contrived situations, and encourages participants to learn through application of theory and learning in a purposeful way (Sadler, 2009). The theory of situated learning connects social and physical contexts where learning occurs (Lave, 1991) and is therefore essential to professional growth. Explanations were not given to the teachers when leadership opportunities were perceived to be taken away. Because learning no longer occurred in natural teaching and collaborative settings, interest and effort in professional learning dropped among the teacher leaders. Furthermore, they lost efficacy they had developed for supporting teachers. In some instances, the indirect communication left some questions between teachers and the administration although, no administrators indicated a concern.

Teachers stay at their current schools more often when they experience encouragement and acknowledgement for efforts (Grissom, 2011). When administrators and their respective teachers' perceptions of the teacher leaders' responsibilities aligned, the teachers had a more satisfactory perception of his or her perceived work experiences. Likewise, when a mismatch occurred, those teachers seemed significantly more frustrated or unhappy with their roles. When new administration takes away responsibilities or fail to acknowledge efforts of teacher leaders, this leads to despondence of the teacher leaders and attrition occurs (Darling-Hammond, 2003).

As schools in high poverty rural areas struggle to meet accountability standards, most people fail to take into account that many underperforming schools experiences a

multitude of leadership changes, regularly (Finnigan, Daly, & Liou, 2016). The high turnover of both teachers and administration resulted in lower job satisfaction and less school based utilization of the teachers' leadership skills. Teachers' relationships with administrators at their schools served as the most influential reason whether to stay at or leave a school (Boyd et al., 2011). The arrival of new administrators may create a relationship barrier which affects teacher leaders' job satisfaction. Especially without direct communication of prior roles teachers may feel replaced and unappreciated.

Forty percent, 4 of 10, of the STEM teacher leaders who participated in the interview portion of the study, experienced a principal change in the last two years. One of those teachers experienced a change three times in three years. When new principals start at a school, data suggest that academic performance declines and teacher departures often occur, soon thereafter (Miller, 2009). To that end, in the case of new administrators, the STEM teacher leaders all expressed distrust, frustration, and or unhappiness with the change and perceived it as part or mostly negative.

Boyd, Grossman, Ing, Lankford, Loeb and Wykoff (2011) utilized research to understand why strong teachers leave schools. That study examined the "relationship between the assessments of school contextual factors by one set of teachers and the turnover decisions by other teachers in the same school" (Boyd, et al., 2011, p #1). The data suggested that teachers' perceptions of their school administrators significantly served as the most influential reason whether to stay at or leave a school. Administrative support that retains teachers included providing professional development opportunities for teachers and shielding them from negative influences (Hirsch & Emerick, 2007). If they lose trust and their sense of efficacy, they may leave.

Teachers and their coordinating administrators with whom they had sustained relationships described more positive support for each other and the teachers indicated less uncertainty about the future. When administrators develop familiarity with the teaching strengths of the teacher leaders then the entire leadership team is able to share a common vision for teacher professional development (Criswell, et al., 2018). That occurs when teachers and administrators sustain longevity at a school.

The teacher leaders who changed schools within the past two years indicated they experienced many more leadership roles at their prior schools. Due to the newness of each new teaching situation they had not had the opportunity to develop leadership roles due to the short time they had been at the new schools. They understood that their lack of leadership was due to starting in a new situation and not due to their lack of abilities.

Blanton and Harmon (2005) indicated the very specific skills that science and mathematics teachers bring to their schools in reference to other content teachers. Even when administrators have a background in either of those subjects, the teacher leaders bring the most insight to content and strategies. When they are left out of the professional development loop, the entire department of math or science suffers, sometimes slowly, due to the disintegration of capacity due to the lack of involvement from the potential STEM teacher leaders. Specifically, within the context of science, technology and mathematics, those teachers found learning new content and pedagogy to be more effective when it was addressed by local experts in professional STEM fields (Banilower, et al., 2006). Local reform models, especially those with engaged administrators supporting teacher leaders with the effort, that focused on learning of a specialized, content specific nature to meet the needs of schools, resulted in an

environment that promoted teacher professional development and learning (Banilower, Boyd, Pasley, Weiss, 2006).

A surprising set of data that came from this study was the high percentage of administrator turnover experienced by the teachers in this group. In order to sustain professional development that is on-going and purposeful, schools need high-quality and stable school leadership. (Lambert, 2003). Blanton and Harmon (2005) recognized that high poverty, rural schools in the South suffered from frequent administrator turnover and as such, those schools experienced low performing science and math programs. They further determined that those programs struggled because of the limited professional development activities due to frequent turnover of administration (Blanton & Harmon, 2005). With frequent turnover, the vision, expectations, and direction for professional growth and development changes based on the choices of the new administrators. In order to sustain professional development that is on-going and purposeful, schools need high-quality and stable school leadership. (Lambert, 2003). Grissom and Truman (2018) suggested principals need to strategize to retain valuable teacher leaders. When a rapid and repeated turnover of administration occurs, momentum is lost and cohesive efforts to retain teacher leaders often fail.

Administrative turnover, along with the perceived diminished teacher leadership responsibilities for the STEM teacher leaders at those schools, presents a problem that needs to be addressed. For the 2012-2013 school year, the attrition rate for rural educators “was 8.4 percent, compared with 7.3 percent for suburban teachers and 7.9 percent for urban teachers” (NCSL, 2017). When teachers are unhappy, they leave. Teachers who previously were satisfied were now considering leaving due to the

administrative change and the resulting loss of teacher leadership opportunities. As a result, those teacher leaders will take the innovation and expertise with them (Cohen & Ball, 1998).

Conclusions About Sustainable Professional Development

During this study, on-going communication and collaboration, through the sharing of ideas and school responsibilities, produced in the teachers' positive perceptions of their teacher leadership experiences. When STEM teacher leaders support teachers in content such as mathematics and science through coaching, they have the ability to continue support for professional development started earlier in the year. Additionally, through coaching, the teacher leaders are able to offer new professional development specifically designed to meet the needs of STEM teachers throughout the year (Hartman, 2013).

When asked about their future endeavors, every STEM teacher leader hoped to serve in a position that was designed to specifically and intentionally support teachers. Whether in a formal or informal role, the STEM teacher leaders expressed that in order to coach and support teachers, they needed time and opportunity to implement this endeavor. First, they needed the opportunity to share leadership role responsibilities and outcomes with the administrative team. Second, the STEM teacher leaders need time to facilitate professional development and support by offering leadership and supportive roles to teachers during the school day. This potentially meets the learning and support needs of more teachers because the STEM teacher leaders, who also teach in classrooms, recognize immediate needs for professional development in content and pedagogy (Avolio, 2007) and can more readily support the STEM teachers in their schools in more

relevant ways. In order to address the needs of rural schools, Franklin (2012) suggested that districts implement the use of teacher leaders who can share their expertise with other teachers and administrators to create an environment of continued learning.

As a consensus with the STEM teacher leaders satisfied with their jobs, the feeling of purpose, combined with the difference they can bring to their students are why those teacher leaders stay at their current schools. Serving as teacher leaders in professional learning communities supported by the administration improves their professional practice as well as how they identify themselves as teacher leaders in their schools (Wenger, 1998). Hunzicker (2017) suggested that teacher leadership is more of a way of thinking rather than specific roles. Similarly, Smulyan suggested that teacher leadership occurred naturally rather than through the receipt of official titles (2016). For teacher leaders, identifying the professional development and support needs of teachers builds a sense of efficacy for creating improvement in their otherwise struggling schools (Franklin, 2012). This aligns with the theory of distributed leadership. This theory suggests that when educators share the responsibility through distributed leadership, it allows teacher leaders to provide on-going support for colleagues as well as build self-efficacy for their commitment to the change at hand to improve teaching and learning (Spillane, 2005). Such shared leadership provides a way for rural schools that have limited resources and professional positions to implement a school improvement process where educators contribute to improvement (Spillane, Halverson, & Diamond, 2001). This distributed leadership occurs through collaboration with peers, students, parents and external stakeholders to meet the diverse and unique needs of their communities (Murphy & Shipman, 1999).

Purpose and value drove the STEM teacher leaders' desires to support others. Administrators more successfully retain teachers when they encourage positive school climates, and greater support for teachers (Kraft, Marinell, & Yee, 2016). This can occur by encouraging teacher leaders to assist with ongoing teacher support and professional development. This theme was exemplified when Ms. Piazza indicated that at her school her administration supports the STEM teacher leaders. She also suggested that teacher leaders feel supported and are acknowledged as teacher leaders. Those are all reasons that contributed to her job satisfaction and reasons she wants to stay at her current school. She also noted that at previous schools she was not acknowledged and so she left. In historically hard to staff schools, such as high poverty, rural schools, supervisors serve as the key influencing factor in whether or not teachers stay at their school or leave for a different environment (Jaussi & Dionne, 2004). Staying because they felt as though their current situation allowed them to receive support to grow and also offer professional development and support to teachers was a common theme among the teachers in the dissertation study who expressed a satisfaction with their work environment.

Discussion

Ways administrators perceived they utilized STEM teacher leaders. The data from the research showed that administrators used STEM teacher leaders to lead a group of teachers, most often by content or grade level. During that duty, the teacher leaders passed down information from administration or shared a topic or content that administrators asked that they discuss. Two teachers engaged in the leadership of professional learning communities. In one of those two groups, the teachers drove the conversations and the professional development. In the other group, the STEM teacher

leader led a book study. Based on their expertise, several of the teachers were invited to continue their pursuit of developing a second or third STEM night or day at their school. While the administrators assigned specific tasks to the STEM teacher leaders, none of them specifically mentioned that they utilized the STEM teacher leaders to provide prescribed and specific on-going professional development support. Yet, the consensus of the administrators suggested that they acknowledged professional development should be personally relevant, timely, and most-importantly, sustained. Yet generally, the administrators did not utilize the STEM teacher leaders for that purpose.

Informally, administrators utilized STEM teacher leaders to set an example of professional excellence to other teachers through their everyday practice and actions. In that regard, that served as an indirect, yet more sustained use of the STEM teacher leaders. In this capacity, the STEM teacher leaders developed relationships with teachers, shared resources, strategies, and reflections, in a subtle but needed way. This suggests that the intent was to build capacity of the other teachers. Teacher engagement in relevant STEM learning, along with follow-up throughout the year leads to a greater likelihood of educators applying new knowledge from professional development into practice (Darling-Hammond, Hyler, Garnder, & Espinoza,2017; Loucks-Horsely, et al., 2010; Lotter, et al., 2014). By building confidence, competence, and relationships, through this practice, the teacher leaders can build skills which result in maintaining a school's sense of purpose, creating collegial relationships with other teachers, and improving instructional practices (Donaldson, 2007).

Ways STEM teacher leaders perceive that they are utilized to provide support to other teachers. The data from the research suggested that the majority of STEM teacher leaders perceived that their administrators invited them to lead their departments, grade levels or teams. None of the teachers felt as though they were forced to serve on any committee or position without a choice. The only exception to this was a couple of cases where teachers served in a teacher leadership capacity as grade or department lead voluntarily, which automatically required them to serve on the school leadership committee by default.

Often, administrators worry about overloading teacher leaders, but the data collected and discussed in this study suggests that purpose and responsibility drove the teacher leaders to share and engage with the school even more. As such two teachers lost formal responsibilities and opportunities when a new principal came to their school. A third was frustrated that her new principal took away her opportunity to sit in on the interviews for prospective teachers in her content area. This was a responsibility she held before. So, the desire to contribute was a positive strategy to drive professional development. This aligned with the theory of distributed leadership, that teachers with leadership opportunities within the school exhibit greater job effort and involvement, and are less likely to leave their positions and display other negative behaviors, such as absenteeism (Singh & Billingsley, 1998). Furthermore, the practice of distributed leadership is based on the theory that schools are run by the collective expertise of all employees (1998).

The STEM teacher leaders shared that they conducted professional development sessions, sometimes related to what they learned in their Noyce training, what they

learned at conferences, or based on what the district requested they share at their schools. None of the teachers indicated that they provided formal, specific, and long-term professional development. Based on their expertise, several of the teachers shared that they were invited to continue their pursuit of developing a second or third STEM night or day at their schools. Yet, the consensus of the administrators suggested that they acknowledged professional development should be personally relevant, timely, and most-importantly, sustained. Yet generally, the administrators did not utilize the STEM teacher leaders for that purpose.

Informally, the consensus of the STEM teacher leaders was that they developed information relationships with teachers and assisted them in any way they were needed. This included assisting formally and informally with technology integration into teaching and with technology use in general. It included listening to teachers and providing support for them when they were frustrated. Additionally, STEM teacher leaders assisted other teachers in finding materials to use in their lessons. The STEM teacher leaders collectively expressed a feeling of efficacy and pride through helping other teachers feel more successful at their schools. Prior research suggested that when people felt appreciated and valued, they were more likely meet or surpass expectations (Hulpia, & DeVose, 2010). The roles implemented by the STEM teacher leaders represented aspects of shared leadership which promotes learning among teachers as well as purpose and self-efficacy among teacher leaders (Hulpia & DeVose, 2010).

Administrative factors and teaching conditions promoting STEM leadership.

Administrative factors. In this study, administrative factors that encouraged STEM teacher leaders included: (a) the administration asking for expert input from the

teachers and utilizing it in some purposeful way; (b) the administration assigning the STEM teacher leaders to mentorship and other relationship building roles and acknowledging the effort of those teachers; (c) the administration openly communicating in positive and professional ways with the STEM teacher leaders.

To that end, in this study, when administrators asked for input and then ignored that input, that served as a source of frustration for the STEM teacher leaders. When other teachers took over mentor roles or other leadership roles, the STEM teacher leaders felt frustrated and disappointed and questioned their purpose at their current schools. When administrators failed to communicate expectations and made assumptions, the STEM teacher leaders felt less purposeful, resentful, and they questioned the intent.

Conditions. This study found specific conditions that promoted STEM professional development. When teachers received autonomy in choosing the direction of a project or professional learning tool, that promoted a positive outlook toward its implementation. Furthermore, principals who maintained open communications provided a consistent conversation which made it easier for teachers to approach the administration regarding needs. The principals who served at their schools the longest had the most engaging relationships with the STEM teacher leaders. Over time these principals developed positive relationships and used the STEM teacher leaders' strengths to grow other teachers in the school.

On the other hand, 40% of the teachers had new administrators. Three out of four of the teachers who had new administrators experienced at least a loss of one administrative duty without communication as to why, when the new principal arrived. The greatest negative impact on STEM teacher leaders' perceptions of their roles and

responsibilities came in the form of feeling less useful when roles and responsibilities were taken away. Daly, Finnigan, and Liou (2016) explained that while it is widely understood and accepted that interpersonal relationships affect the quality of growth and success of teaching and learning, most organizations do not understand how critical relationships, such as those between administration and teacher leaders, threaten the success of schools. As such, when administrators frequently leave a school, this creates a type of “social network churn” resulting in a loss of, among other things, organizational memory (Daly, Finnigan, & Liou, 2016, p. 184). Administrator turnover is not often addressed (Daly, Finnigan, & Liou, 2016). Frequent administrative turnover provided inconsistency and in two cases, little or negative feedback from new administrators.

One school with a new administrator that continued to provide a positive leadership experience had a team in place. This team, which they referred to as a board, consisted of school administrators and teacher leaders who served as a voice between the school and district. They met regularly and created an on-going representation for the teachers at the school. They characterized the needs and strengths of the faculty at the school, as teachers and administrators were selected to participate. When the new principal joined the school, the board stayed in place, providing at least some consistency during the transition period. This allowed teacher professional development roles and learning to continue as the principal became one of many voices.

The board reported projects, initiatives, and general plans for school growth to the superintendent or the designee at district office. Working with a team approach, this provided a continuum of organizational knowledge when the new principal arrived. The principal, as one member of the board, brought suggestions and change, but also received

on-boarding training which resulted in knowledge of norms, school priorities and traditions. Impactful parts of the school's organizational structure such as administration, can inhibit forward growth if it changes often (Argyris & Schon, 1996). By protecting the social capital, which is expertise, relationships, and value that other staff members contribute (Stoll, 2009), the teacher leader in this school maintained a strong job satisfaction and described initiatives that continued despite changes in leadership.

One the other hand, two teachers of ten (20%) experienced principals who started at the schools and chose in part, different teachers to take over departmental leadership without conversations with previous leadership. Teacher leaders, including the STEM teacher leaders from this study, at those schools, were left unsure what their place and responsibilities were within the school. Their perceptions of their new roles were misaligned with that of the administrators' perceptions of the roles. In both cases the teachers cited a lack of communication and a willingness on the part of that principal to communicate.

Another condition promoting professional growth and development stemmed from the support of administrators for teachers to grow and gain knowledge beyond the walls of the school and the boundaries of the district. In these schools, the administrators supported the teachers' involvement in the Noyce program and some hosted sessions at their schools. They encouraged teachers to present and learn at conferences. In some cases, teachers shared that they appreciated when administrators shared professional growth opportunities with them.

Contrary to that, some teachers experienced disappointment and frustration when administrators denied them the opportunity to attend conferences or other professional

growth opportunities. They also had little to no interest when administrators brought in outside consultants unfamiliar with their schools and students. They preferred local experts or other teachers to provide the professional development.

Further Research

Based on the data gathered in this study, it is suggested that more research occur in rural schools concerning the job satisfaction of teacher leaders both prior to and after new administration start. The number of new principals in this study affected and limited the feedback we received from the administrators. However, using the information gathered from the STEM teacher leaders, the researcher gleaned that principal turnover interferes with perceived progress and growth among teachers. Likewise, additional research comparing the level of teacher involvement with their job satisfaction at different years of experience could further benefit schools seeking to move toward more distributed leadership. Schools interested in taking on a deeper level of distributed leadership, could collect data to see if the newer STEM teachers receiving meaningful opportunities for engagement stay at their school and if they do, the data might reflect whether or not those new STEM teachers continue increasing their leadership involvement. As schools then offer other opportunities to newer teachers, schools can then collect data to determine if STEM teacher leaders, then receive more opportunities to provide more professional development support teachers as a result of newer teachers taking on necessary roles outside of the classroom not pertaining to teacher support. The research might then determine if the increase in these roles for each group of teachers leads to job satisfaction and retention for both the STEM teacher leaders and new teachers.

Finally, further research into the type of professional development teachers prefer and deem as effective could drive how schools implement it in the future to create a more purposeful and effective outcome. One teacher mentioned that the only professional development she had this year was from a highly paid person from across the country. She mentioned it was intimidating for teachers because they did not understand what the person was talking about. She also mentioned the person had no connection to the community and did not know what it was like to teach there. So, why not encourage the high poverty rural schools to utilize knowledgeable and effective staff to provide the professional development and then see if that increased teaching efficacy and see if it left funds for teachers to go outside of the district for conferences or other opportunities they found useful to grow? Engaging teacher leaders to lead and support professional learning results in the teacher leaders exhibiting a higher motivation to collaborate and support co-workers because their expertise and support results in ongoing supported teaching and learning which leads to change that the teacher leaders created (Huang, 2016; Hunzicker, 2017).

Suggestions

On-boarding through a school-based leadership continuum. School administrators indirectly influence critical components of a school's success because they impact organizational culture through the effects on social networks and specific practices (Halligner & Heck, 1998). Farley-Ripple, Solano and McDuffie (2012) also established that when the complex multitude of roles maintained by a school administrator are interrupted when one administrator leaves and another arrives, the

employees lose trust in not only their leader, but in the purpose for initiatives that were established by the outgoing administrator.

Therefore, it is suggested that based on the findings from this study of rural STEM teacher leaders and their administrators, that districts create efficacious boards within each school. These boards should be comprised of teacher leaders and administrators and meet on a regular basis to not only discuss problems but to promote school and districts initiatives and to report on these to a designee at the district office.

With this model, the principal still develops autonomy but also receives the opportunity to develop relationships with other leaders in the school which is necessary for grow to continue occurring. This process also addresses the need for on-going professional development and support because the group decision process allows for the potential continuation of initiatives established the prior year.

The purpose of this is two-fold. First, this collaboration shows that initiatives and activities are acknowledged and valued by both the school and district therefore providing a focus and purpose for teachers. Second, with the principal as one member of the board, this provides an on-boarding team when a new principal arrives. Because the board is supported by the district, the principal would not be able to immediately change the leadership structure and norms of the school. This gives the principal time, especially if they are new to the school, to learn about the continuum already in place at the school. It gives time for professional relationships between teacher leaders and the new principal to grow. Once colleagues connect through common goals and values, and while individual practices are not ignored, a community of shared practice develops (Merrill & Dougherty, 2010). Not only does this potentially leave opportunity for trust to

grow between both groups, but this time on the board offers the opportunity for the new administrator to evaluate the strengths and weaknesses of each teacher leader before determining how to utilize them in potentially different ways throughout the school. Such a board creates continuity and an opportunity for relationships to develop when new administration arrives.

In addition to school districts, leadership organizations within the state, such as SCASA, the South Carolina Association of School Administrators, and national organizations could use this data to inform guidance to districts on the retention of teachers and teacher leaders during times of administrative turnover at the school level. Committees, or boards, such as these lead to a better chance of those teacher leaders staying, because they feel efficacious and not disposable. Teacher leaders maintain their identity as those who support teaching and learning beyond their own classrooms. Peer to peer support of teachers' learning serves as efficient and effective professional development within a school (Darling-Hamond, Hyler, Gardner & Espinoza, 2017). Support such as this has the potential to continue, without much disruption, when a board is in place. Perhaps, new principals would perceive a higher level of efficacy for connecting to staff and contributing to change with this strategy.

Distributed leadership beyond teacher leaders. Based on the data collected, the STEM teacher leaders felt most positive about their roles and purpose at school when they had multiple leadership responsibilities and other experiences that relied on their professional expertise. They preferred not to lead activities not directly related to their professional proficiencies. A next step to retain STEM teacher leaders and increase the efficacy of professional development is to develop an additional continuum of capacity

and teacher agency within the school. Crow, Hausman, and Scribner (2002) described distributed leadership as encompassing the practices of individuals and including them in the growth of the school. Furthermore, attrition causes a loss of momentum and consistency when the administrators leave (Lambert, 2002). An additional way to attempt to prevent teacher turnover, while also providing identified teacher leaders a more viable way to provide professional development support to teachers, would be to include newer teachers in other roles at school. With new teachers engaging in roles such as leading school events with the community, teacher leaders have more time to focus on developing and facilitating professional support and development for teachers. Distributed leadership provides a more sustainable means of constructing a professionally focused learning climate that characterizes high achieving schools (Heck & Hallinger, 2009). Research shows that newer teachers, especially those at high poverty, high minority schools, leave those schools much more frequently compared to teachers at higher income schools with lower rates of minority students because they are not able to make connections to the schools (Scafidi, Sjoquist, & Stinebrickner, 2007). Therefore, by offering new teachers purposeful roles through distributed leadership, they build a stronger connection to the school (Crow, Hausman, & Scribner, 2002). While STEM teacher leaders in this study desired to keep all their roles involving teacher support, some of them suggested that if they had to choose to release any of their responsibilities, it would be School Improvement Council, tutoring, or planning committees for events. These teachers also repeatedly reflected that their involvement and feeling of purpose kept them there. Therefore, engaging new teachers in some activities that engage families and students may create a connection to the school, a greater level of agency,

and result in those teachers staying longer. On the other hand, by offering those activities to new teachers, this frees up some time for the STEM teacher leaders to focus on supporting the professional development of teachers.

Singh and Billingsley provided a framework that suggested when teachers engaged in purposeful support within the school, they exhibited greater effort at their job and expressed a higher level of satisfaction (1998). Purposeful support is defined as support and leadership with teachers that the STEM teacher leaders know the teachers need. Comparatively, support in a non-purposeful manner for a teacher leader is something that administration expects from the teacher leaders, but that the STEM teacher leaders believe is not directly related to supporting teaching and learning. While an integral part of school culture, the teacher leaders in this study expressed that other teachers were capable of completing those tasks. Therefore, it is suggested that all teachers, or as many as possible, be given additional responsibilities in which to engage. However, as Timms, Graham, and Cottrell (2007) explained, those additional responsibilities need to match the strengths of the teachers facilitating them. It is also essential for support and appreciation for facilitating those duties to infiltrate the school culture.

If purpose and engagement keep the STEM teacher leaders, it may keep more beginning teachers in the classroom. When new teachers experience purposeful opportunities outside of the classroom they develop a sense of efficacy for improving the school in a sense such as Lambert explained, “When leadership becomes a broadly inclusive culture concept” because the teachers can see themselves “participating in this learning work” with their colleagues (2003, p. 423). At the same time, by moving even a

limited amount of the non-instructional responsibilities to the newer teachers, the STEM teacher leaders might then have more time to provide informal and formal instructional support. By sharing in the leadership process, even as new teachers, newer teachers are able to reciprocate with other professionals in the learning community, therefore developing a purpose and connection to the learning community (Lambert, Walker, Zimmerman, Cooper, Lambert, Gardner, Ford-Slack, 1995). Teachers with opportunities within the school that give them a sense of purpose, exhibit greater job effort and involvement while being more likely to stay in their schools (Singh & Billingsley, 1998).

Following a model such as that in Figure 5.1, teachers should be introduced to supporting the school in a stepwise manner. Kardos, Johnson, Peske, and Kauffman suggested that new teachers stay at their jobs when they work in an environment supporting the development of shared responsibility for the school (2001). Not only does this benefit the school but, influences a sense of belonging and purpose as part of a distributed leadership framework (Lambert, 2002). By encouraging new teachers to participate in activities that build relationships with students, parents, and community members the teachers are more likely to build a connection to the school because of their involvement. A school as a distributed leadership learning community focuses all participants on the learning and growth for teachers as well as students (Merrill & Dougherty, 2010). The goal of a model where all teachers are engaged in improving teaching and learning is to build capacity within the school so that all members develop familiarity with the norms and values of the school community while improving the teaching and learning (Shaw, 1999). The model in Figure 5.1 also accounts for purposeful engagement for all levels of teachers to support the school through

responsibilities outside of the classroom. Kardos and Johnson (2007) established that when new teachers work in a school culture that supports and appreciates professionalism and engagement, teachers share a sense of shared accountability.

Based on the interview results, STEM teacher leaders provided insight on pedagogy, manipulatives, laboratories, and technology most often when supporting teachers. This support provided the STEM teacher leaders with a sense of purpose. Anderson (2006) suggested that distributed leadership, where many teachers take leadership roles to meet the needs of the school resulted in shared leadership, and a greater sense of connection to school. At the same time, the goal of the suggested model for distributed leadership (Figure 5.1) developed from this research study would be that professional support, especially in content, that the STEM teacher leaders offer would result in more successful and less frustrated teachers. Responsibilities in and of themselves will not provide a sense of purpose. Research on teacher leadership suggests that collaboration among educators, along with and shared interests and visions are essential to sustaining professional development leading to a change in teaching or learning (DuFour & Eaker, 1998; Lambert, 2002; Newmann & Wehlage, 1995; Schmoker, 1996; Spillane, Halverson, & Diamond, 2001). When teachers felt appreciated and valued by administrators and leaders, they were more likely meet or surpass expectations (Hulpia, & DeVose, 2010). As this study showed, when teacher efforts were ignored, teachers felt as if their efforts were unappreciated.

Without the communication and involvement of administrators, teachers and teacher leaders, a loss of growth and momentum occurs when administrators leave (Lambert, 2002). Therefore, creating a multi-tiered level of experience, learning, and

involvement creates a bridge to success that has the potential to continue when one or two members leave. When communication and support occur, collegially between new teachers, experienced teachers, teacher leaders, and administrators, this allows for a continuum of growth of teaching and learning within the school. Anderson (2006) suggested distributed leadership such as this, where many of teachers take leadership and expert roles to meet the needs of the school, led to transformation of teaching and learning over time. Shared decision making which includes administrators, teacher leaders, and teachers characterizes the epitome of distributed leadership (Anderson, 2006; Daresh, 2007; Spillane, 2005).

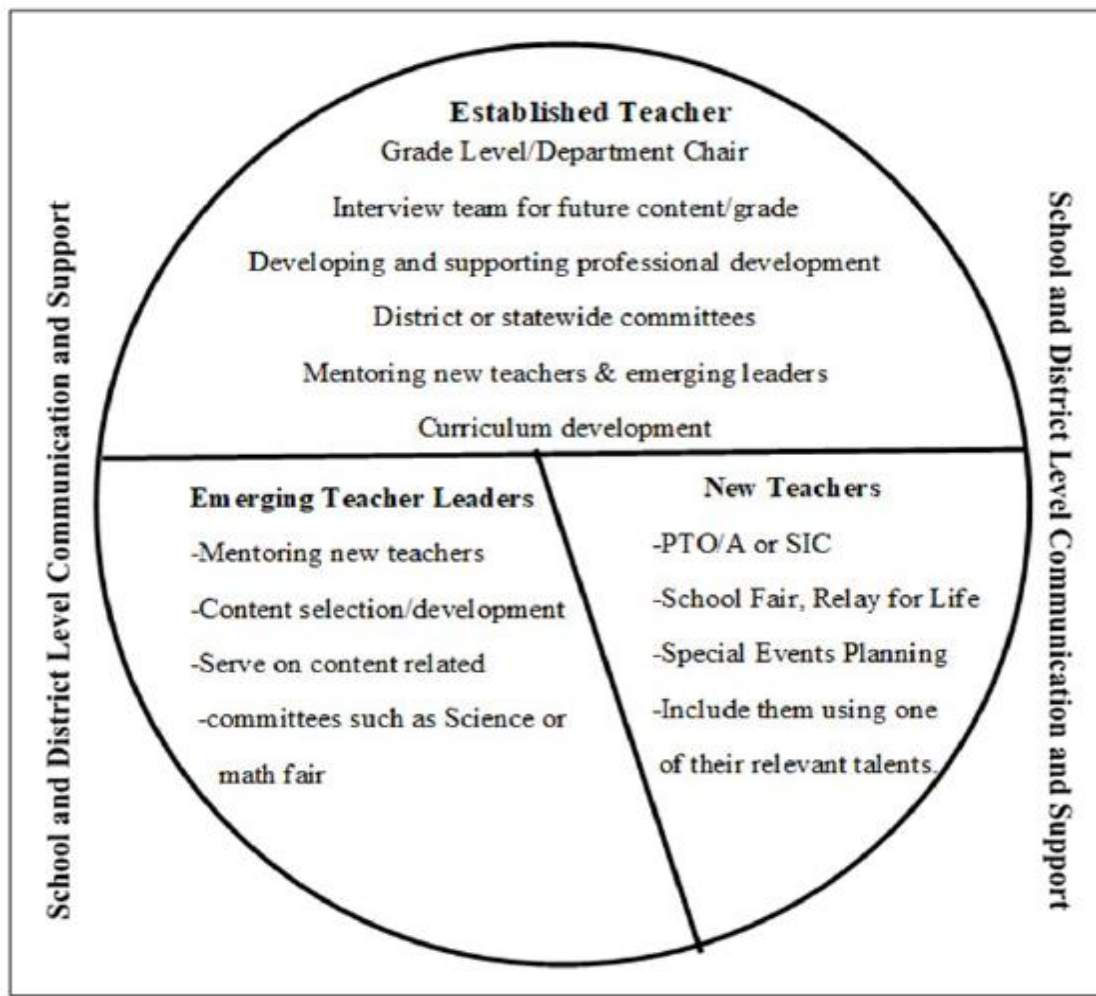


Figure 5.1. Suggested roles to increase distributed leadership.

Rural, high poverty schools struggle to provide for the needs of teachers and students. There is an untapped value in the ways that schools can use STEM teacher leaders. By distributing some of their responsibilities that are not connected to professional development, administrators have the opportunity to create a school culture where teacher leaders develop self-efficacy for supporting personal connections of all teachers, and therefore, also leading others' professional growth. Such an environment also develops sustained support for relevant and needed professional growth opportunities by the STEM teacher leaders.

Future Research. This study raised additional questions. How does school leadership turnover affect the job satisfaction of teacher leaders and other staff? The number of new administrators was not expected at the start of this research. In the education field and through media, schools express the need for recruiting and retaining teachers. However, the loss of administrators resets the vision, momentum, and at times, confidence of teachers and teacher leaders within the school. Supervisors serve as the key influence on employee turnover (Jauss & Dionne, 2004) and the resulting teacher turnover results in negative effects on school performance (Hanushek, Rikin, & Schiman, 2016). Since teachers make decisions based on their perceptions of job satisfaction, which in part, relies on whether or not they feel purposeful, additional research is necessary to examine administrator turnover and also what schools can do to lessen the negative effects an administrator leaving.

What professional development activities and content do teachers and teacher leaders identify as most essential to their success in the classroom? While it is understood that professional development needs to be relevant, there is a need, through

research, to consider the specific and individual needs of each school community, teacher, or grade level instead of utilizing a larger general view or trend. In addition to the activities and content, it is suggested that research includes the most effective ways to facilitate that professional development throughout the year and whether utilizing teacher leaders for that facilitation leads to teachers perceiving more satisfactory professional development experiences. If administrators take this approach, it is suggested that they consider teachers want what they share to be relevant. If teachers are asked what they need, administrators should consider those needs as part of a future professional development effort.

To that end, how do responsibilities at school, outside of the classroom affect job satisfaction? How can schools alter current daily schedules and teacher roles to best allow for teacher leaders, especially those who teach STEM concepts, to have time to support teachers and how do schools allow for teachers to have time to prepare to implement new teacher learning? According to O'Connor and Boles, administrators need to do more than offer opportunities for teachers to lead. In order for teachers to effectively lead to create a change in teaching and learning, a restructuring of accountability, relationships, and organization needs to occur (1992). High poverty rural schools struggle with finite resources for staffing and may struggle to create time for STEM teacher leaders, those strong in content and pedagogy, to step away from the classroom to support other teachers. Boles and Troen suggested that teachers receive opportunities to engage in new roles on a regular basis to discover additional interests and strengths in which they might lead (1994). What are some alternative frameworks for utilizing teacher leaders for on-going professional development and support?

Identifying the answers to these questions will move districts to better understand how to engage teachers and keep momentum when school administrators leave. As such, the goal is to retain teachers, teacher leaders, and administrators to establish a continuum of purposeful instructional and pedagogical growth and improvement. With such a continuum, STEM teacher leaders support and collaborate with other teachers, on an on-going basis, throughout the school year and beyond to implement and perfect new content and pedagogy implementation (Figure 5.2).

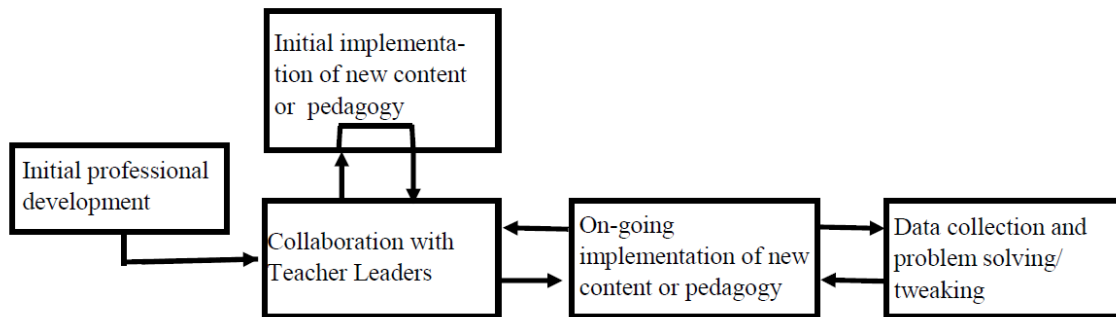


Figure 5.2. Continuum of professional development support for teachers.

REFERENCES

- Allen, C. D., & Penuel, W. R. (2015). Studying Teachers' Sensemaking to Investigate Teachers' Responses to Professional Development Focused on New Standards. *Journal of Teacher Education*, 66(2), 136-149. <https://doi.org/10.1177/002248711456064>
- Anderson, K. D. (spring 2008). Transformational teacher leadership in rural schools. *The Rural Educator*, 8-17.
- Angelle, P. S., & DeHart, C. A. (2011). Teacher perceptions of teacher leadership: Examining differences by experience, degree, and position. *NASSP Bulletin*, 95(2), 141-160.
- Avolio, B.J. (2007). Promoting more integrative strategies for leadership theory-building. *American Psychologist*, 62(1), 25-33.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.
- Banilower, E. R., Boyd, S. E., Pasley, J. D., & Weiss, I. R. (2006). *Lessons from a decade of mathematics and science reform a capstone report for the local systemic change through Teacher Enhancement Initiative* (pp. 1-90, Publication). Chapel Hill, NC: Horizon Research.
- Banilower, E. R., Heck, D. J., & Weiss, I. R. (2007). Can professional development make the vision of the standards a reality? The impact of the national science foundation's local systemic change through teacher enhancement

- initiative. *Journal of Research in Science Teaching*, 44(3), 375-395.
doi:10.1002/tea.20145
- Barth, R. S. (2001). Teacher leader. *Phi Delta Kappan*, 82(6), 443–449.
- Barton, A. C. (1998). Teaching science with homeless children: Pedagogy, representation, and identity. *Journal of Research in Science Teaching*, 35(4), 379-394. doi:10.1002/(sici)1098-2736(199804)35:4<379::aid-tea8>3.0.co;2-n
- Bennett, N., Wise, C., Woods, P., & Harvey, J. A. (2003). Distributed leadership. (Full report). Nottingham, UK: National College for School Leadership.
- Berg, B. L. (2009). *Qualitative research methods for the social sciences (7th Ed.)*. Boston, MA: Allyn & Bacon.
- Berry, B., & Farris-Berg, K. (2016, June/July). Leadership for teaching and learning: How teacher-powered schools work and why they matter. Retrieved June 3, 2016, from http://www.aft.org/sites/default/files/ae-summer2016berry_and_farris-berg.pdf
- Biddle, C., & Azano, A. P. (2016). Constructing and Reconstructing the “Rural School Problem”. *Review of Research in Education*, 40(1), 298-325.
doi:10.3102/0091732x16667700
- Bill & Melinda Gates Foundation (Ed.). (2014). Teacher knows best: teachers' views on professional development. Retrieved July 15, 2016, from <https://s3.amazonaws.com/edtech-production/reports/Gates-PDMarketResearch-Dec5.pdf>
- Black, S. (2007). A line item for achievement. *American School Board Journal*, 194(3), 43 – 45.

- Blanton, R. E., & Harmon, H. L. (2005). Building Capacity for Continuous improvement of math and science education in rural schools. *Rural Educator*, 26(2), 6-11.
- Bogler, R., & Somech, A. (2004). Influence of teacher empowerment on teachers' organizational commitment, professional commitment and organizational citizenship behavior in schools. *Teaching and Teacher Education*, 20, 277–289
- Boles, K., & Troen, V. (1994). Teacher leadership in professional development schools. *Paper prepared for the 1994 AERA Conference in New Orleans*(pp. 1-31). Retrieved from <https://files.eric.ed.gov/fulltext/ED375103.pdf>.
- Bolman, L. G., & Deal, T. E. (1984). *Modern approaches to understanding and managing organizations*. San Francisco: Josey-Bass.
- Borasi, R., & Fonzi, J. (2002). *Foundations: a monograph for professionals in science, mathematics, and technology education: Professional development that supports school mathematics reform* (Vol. 3). Arlington, VA: National Science Foundation
- Borko, H. (2004, November). Professional Development and Teacher Learning: Mapping the Terrain. *Educational Researcher*, 33(8), 3-15.
doi:10.3102/0013189x033008003
- Boyd, D., Grossman, P., Ing, M., Lankford, H., Loeb, S., & Wyckoff, J. (2011). The Influence of School Administrators on Teacher Retention Decisions. *American Educational Research Journal*, 48(2), 303–333.
<https://doi.org/10.3102/0002831210380788>
- Bray-Clark, N., & Bates, R. (2003). Self-efficacy beliefs and teacher effectiveness: Implications for professional development. *The Professional Educator*, XXVI(1), 13-22.

- Bruce, C., & Ross, J. (2008). A Model for Increasing Reform Implementation and Teacher Efficacy: Teacher Peer Coaching in Grades 3 and 6 Mathematics. *Canadian Journal of Education / Revue Canadienne De L'éducation*, 31(2), 346-370. Retrieved from <http://www.jstor.org/stable/20466705>
- Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, 44(8), 1187–1218. doi:10.1002/tea.20237
- Carspecken, F. P. (1996). *Critical Ethnography in Educational Research: A Theoretical and Practical Guide*. London: Routledge.
- Carver, C. L. (2016). Transforming identities: The transition from teacher to leader during teacher leader preparation. *Journal of Research on Leadership Education*, 11(2), 158-180.
- CERRA (Center for Educator Recruitment, Retention, and Advancement) (Ed.). (2019). *CERRA annual report 2017-18 (Rep.)*. Rock Hill, SC: CERRA.
- Charteris, J., & Smardon, D. (2014). Dialogic peer coaching as teacher leadership for professional inquiry. *International Journal of Mentoring and Coaching in Education*, 3(2), 108-124. Retrieved from <https://doi.org/10.1108/IJMCE-03-2013-0022>.
- Cherkowski, S., & Shellert, L. (2017). Exploring teacher leadership in a rural, secondary school: Reciprocal learning teams as a catalyst for emergent leadership. *International Journal of Teacher Leadership*, 8(1), 1-21.

- Choo, C.W. (1998). *The knowing organization: How organizations use information to construct meaning, create knowledge, and make decisions*. New York: Oxford University Press.
- Christensen, Clayton M.; Jeff Dyer; Hal Gregersen (2011). *The innovator's DNA: Mastering the five skills of disruptive innovators*. Harvard Business Review Press. Kindle Edition
- Cohen, D. K., & Ball, D. L. (1998). Instruction, capacity, and improvement. [CPRE Research Report Series, RR-42]. Philadelphia: University of Pennsylvania, CPRE.
- Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory in to Practice*, 39(3), 124-130.
- Criswell, B. A., Rushton, G. T., McDonald, S. P., & Gul, T. (2017). A Clearer Vision: Creating and Evolving a Model to Support the Development of Science Teacher Leaders. *Research in Science Education*. doi:10.1007/s11165-016-9588-9.
- Criswell, B. A., Rushton, G. T., Nachtigall, D., Staggs, S., Alemdar, M., & Capelli, C. J. (May 2018). Strengthening the vision: Examining the understanding of a framework for teacher leadership development by experienced science teachers. *Science Teacher Education*, 1265-1287.
- Crow, G., Hausman, C. S., & Scribner, J. P. (2002). Reshaping the principalship. In J. Murphy (Ed.), *The educational leadership challenge* (pp. 189-210).
- Daly, A. J., Finnigan, K. S., & Liou, Y. (2016). *Thinking and acting systemically: Improving school districts under pressure*. Washington, DC: American Educational Research Association. Chicago: University of Chicago Press.

- Dancy, M., & Henderson, C. (2008). *Barriers and promises in STEM reform*(pp. 1-17, Publication) <http://www.the-aps.org/APS-Storage/APS-Education/Teaching-Resources/Dancy-Henderson.pdf.aspx>.
- Daresh, J. (2007). *Supervision as proactive leadership*. Waveland Press Inc., Long Grove, IL.
- Darling-Hammond L. (2003). Keeping good teachers: Why it matters, what leaders can do. *Educational Leadership*, 86, 42–51.
- Darling-Hammond, L. (2013). *Getting teacher evaluation right: What really matters for effectiveness and improvement*. New York, NY: Teachers College Press.
- Darling-Hammond, L., & Berry, B. (2006). Highly Qualified Teachers for All. *Educational Leadership*, 64(3), 14-20.
- Darling-Hammond, L., Hyler, M. E., Gardner, M., & Espinoza, D. (2017). *Effective teacher professional development* (Rep.). Retrieved from https://learningpolicyinstitute.org/sites/default/files/product-files/Effective_Teacher_Professional_Development_REPORT.pdf
- Darling-Hammond, L., & Richardson, N. (2009). Teacher learning: What matters? *Educational Leadership*, 66(5), 46-53.
- Danielson, C. (2007). The many faces of leadership. *Educational Leadership*, 65(1), 14-19.
- DeHart, C. A. (2011). *A Comparison of four frameworks of teacher leadership for model fit*. University of Tennessee, Knoxville.
- Dempsey, R. (1992). Teachers as leaders: towards a conceptual framework. *Teaching Education*, 5(1), 113–120

- Devaney, K. (1987, March). The lead teacher: Ways to begin (Paper prepared for the Task Force on Teaching as a Profession, Carnegie Forum on Education and the Economy.) Berkeley, CA: Author.
- Donaldson, G. A. (2007). What do teachers bring to leadership? *Educational Leadership*, 65(1), 26–29
- Donnelly, H., & Linn, J. (2014, April). Critical thinking skills fire up teacher learning. *JSD, the Learning Forward Journal*, 35(2), 40-45.
- Dou, D., Devos, G., & Valcke, M. (2017). The relationships between school autonomy gap, principal leadership, teachers' job satisfaction and organizational commitment. *Educational Management Administration & Leadership*, 45(6), 959–977. <https://doi.org/10.1177/1741143216653975>
- DuFour, R., & Eaker, R. (1998). Professional learning communities at work: Best practices for enhancing student achievement. Bloomington, IN: National Educational Service.
- Elmore, R. (2002). *Bridging the gap between standards and achievement: The imperative for professional development in education*. Washington, DC: Albert Shanker Institute.
- Fayer, S., Lacey, A., & Watson, A. (2017, January). STEM Occupations: Past, Present, And Future. Retrieved from <https://www.bing.com/cr?IG=E0D07B3E47004040A5E5945DAB96C739&CID=0B30982BE24F678A032493F0E3E06659&rd=1&h=SLhzhsRbQhzNJpNRHWK7FALbmHVKzlzaSu1kpc5hRTw&v=1&r=https://www.bls.gov/spotlight/2017/science-technology-engineering-and-mathematics-stem-occupations-past-present->

- and-future/pdf/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future.pdf&p=DevEx.LB.1,5524.1
- Firestone, W. A. (1996). Leadership roles or functions? In K. Leithwood, J. Chapman, D. Corson, P. Hallinger, & A. Hart (Eds.), *International handbook of educational leadership and administration* (Vol. 2, pp. 395-418). Dordrecht, The Netherlands: Kluwer.
- Firestone, W.A., & Pennell, J.R. (1993). Teacher commitment, working conditions and differential incentive policies. *Review of Educational Research*, 63, 489–525.
- Fishman, B. J., Marx, R. W., Best, S., & Tal, R. T. (2003). Linking teacher and student learning to improve professional development in systemic reform. *Teaching and Teacher Education*, 19(6), 643-658. doi:10.1016/s0742-051x(03)00059-3
- Foltos, L. (2015, February). Principals Boost Coach's Impact. *JSD, the Learning Forward Journal*, 36(1), 48-61.
- Franklin, M. (2012). Wide open opportunities. *Learning Forward*, 30(6), 28-31.
- Fraser-Abder, P. (2013). *Professional Development in Science Teacher Education: Local Insight with Lessons for the Global Community*. Oxfordshire, England: Routledge.
- Fullan, M. (2007). *The new meaning of educational change*, 4th edition, 35. New York City, NY: Teachers College, Columbia University.
- Fullan, M. (2011). *Six Secrets of Change: What the best leaders do to help their organizations Survive and Thrive*. Hoboken, NJ: John Wiley & Sons. Retrieved from <http://www.ebrary.com>

- Fullan, M. (2014). *The principal: Three keys to maximizing impact*. San Francisco, CA: Jossey-Bass.
- Garand, K. S. (2016) Teacher leaders' perceptions of their influence on the distributed leadership process at a middle school". *All Theses and Dissertations*. 53.
<http://Stern.une.edu/theses/53>.
- Ghaith, G., & Yaghi, H. (1997). Relationships among experience, teacher efficacy, and attitudes toward the implementation of instructional innovation. *Teaching and Teacher Education*, 13(4), 451-458. doi:10.1016/s0742-051x(96)00045-5
- Giroux, H. (1991). *Postmodernism, feminist and cultural politics*. Albany: SUNY Press.
- Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.
- Glesne, C. (2016). *Becoming qualitative researchers: An introduction*. Boston: Pearson.
- Goodpaster, K. P., Odedokun, O. A., & Weaver, G. C. (2012). Teachers' Perceptions of Rural STEM Teaching: Implications for Rural Teacher Retention. *Rural Educator*, 33(3), 9-22.
- Gore, J. (1993). *The struggle for pedagogies: Critical and feminist discourse as regimes of truth*. New York: Routledge.
- Grissom, J. A. (2011). Can good principals keep teachers in disadvantaged schools? Linking principal effectiveness to teacher satisfaction and turnover in hard-to-staff environments. *Teachers College Record*, 113, 2552–2585.

- Guskey, T. R. & Gates, S. L. (1986). Synthesis of research on the effects of mastery learning in elementary and secondary classrooms. *Educational Leadership*, 43(8), 73-80.
- Hanover Research Group. (Ed.). (2015). *Onboarding for administrators* (Publication). Arlington, VA: Hanover Research.
- Hanushek, E. A., Rivkin, S. G., & Schiman, J. C. (2016). Dynamic effects of teacher turnover on the quality of instruction. *Economics of Education Review*, 55, 132–148.
- Harris, A. (2003). Teacher leadership as distributed leadership: Heresy, fantasy or possibility? *School Leadership & Management*, 23(3), 313-324
- Harris, A., & Muijs, D. (2002). Teacher leadership: A review of the research. Retrieved February 10, 2010, from www.ncsl.org.uk/researchpublications
- Harris, D. N., Rutledge, S. A., Ingle, W. K., & Thompson, C. C. (2010). Mix and match: What principals really look for when hiring teachers. *Education Finance and Policy*, 5, 228-246.
- Henson, K. T. (1996). Teachers as researchers. In J. Sikula, T. J. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (pp. 53-64). New York: Macmillan.
- Hirsch E., Emerick S. (with Church K., Fuller E.). (2007). Teacher working conditions are student learning conditions: A report on the 2006 North Carolina teacher working conditions survey. Hillsborough, NC: Center for Teaching Quality. Retrieved July 10, 2010, from <http://ncteachingconditions.org/sites/default/files/attachments/twcnc2006.pdf>.

- Hoachlander, G. (December 2014/January 2015). Integrating S, T, E, and M. *Educational Leadership*, 72(4), 74-78.
- Holtz, R. (2004). Group cohesion, attitude projection, and opinion certainty: beyond interaction. *Group Dynamics: Theory, Research and Practice*, 8, 112–125.
- Howley, A., & Howley, C. B. (2004). Small by default and the pressures to consolidate. Paper presented at the annual conference of the International Society of Educational Planning. Washington, DC
- Howley, A., & Howley, C. (2005). High-Quality teaching: providing for rural teachers' professional development. *The Rural Educator*, 26(2), 1-5.
- Hoy, W., Hannum, J., & Tschannen-Moran, M. (1998). Organizational climate and student achievement: A parsimonious and longitudinal view. *Journal of School Leadership*, 8(4), 336-359.
- Hsieh, H., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288.
- Huang, T. (2016). Linking the private and public: Teacher leadership and teacher education in the reflexive modernity. *European Journal of Teacher Education*, 39(2), 222-237.
- Hughes (2012) Teacher retention: Teacher characteristics, school characteristics, organizational characteristics, and teacher efficacy, *The Journal of Educational Research*, 105:4, 245-255, DOI: [10.1080/00220671.2011.584922](https://doi.org/10.1080/00220671.2011.584922)
- Hulpia, H., & DeVos, G. (2010). How distributed leadership can make a difference in teachers' organizational commitment? *Teaching and Teacher Education*, 26(3), 565-575.

- Hulpia , Devos & Rosseel (2009) The relationship between the perception of distributed leadership in secondary schools and teachers' and teacher leaders' job satisfaction and organizational commitment, *School Effectiveness and School Improvement*, 20:3, 291-317, DOI: 10.1080/09243450902909840
- Hunzicker, J. L. (2014). Informal teacher leadership in Action: Indicators and illustrations. *Scholar-Practitioner Quarterly*, 7(4), 391-415.
- Hunzicker, J. L. (2017). From teacher to teacher leader: A conceptual framework. *International Journal of Teacher Leadership*, 8(2), 20-46.
- Hunzicker, J., Badiali, B. J., Cosenza, M., & Burns, R. W. (2019, February 16). *Teacher leadership in professional development schools*. Lecture presented at National Professional Development Schools Conference in GA, Atlanta.
- Ingersoll R. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal*, 38, 499–534.
- Jao, L., & McDougall, D. (2015). The collaborative teacher inquiry project: A purposeful professional development initiative. *Canadian Journal of Education*, 38(1), 1-20.
- Jaussi , K.S., & Dionne, S. (2004). Unconventional leader behavior, subordinate satisfaction, effort, and perception of leader effectiveness. *Journal of Leadership and Organizational Studies*, 10(3), 15-26.
- Jeanpierre, B., Oberhauser, K., & Freeman, C. (2005). Characteristics of professional development that effect change in secondary science teachers' classroom practices. *J. Res. Sci. Teach. Journal of Research in Science Teaching*, 42(6), 668-690. doi:10.1002/tea.20069

- Jimerson, L. (2004). Teachers and teaching conditions in rural New Mexico. Retrieved from The Rural School and Community Trust website:
http://www.ruraledu.org/user_upload/file/teachers_newmexico.pdf
- Johnson, R. L., & Morgan, G. B. (2016). *Survey scales: A guide to development, analysis, and reporting*. New York, NY: The Guilford Press.
- Jones, M.G., & Eick, C.J. (2007). Implementing inquiry kit curriculum: Obstacles, adaptations and practical knowledge development in two middle school science teachers. *Science Education*, 91, 492–513.
- Joyce, B. and Showers, B. (1982) The coaching of teaching. *Educational Leadership*, 40 (1), 4–10.
- Kardos, S., & Johnson, S. (2007). On Their Own and Presumed Expert: New Teachers' Experience with Their Colleagues. *Teachers College Record*, 109(9), 2083-2106.
- Kardos, S., Johnson, S., Peske, H., Kauffman, D., & Liu, E. (2001). Counting on Colleagues: New Teachers Encounter the Professional Cultures of Their Schools. *Educational Administration Quarterly*, 37(2), 250-290.
- Kelley, T.R. & Knowles, J.G. *IJ STEM Ed* (2016) 3: 11. <https://doi.org/10.1186/s40594-016-0046-z>
 Kelley, T.R. & Knowles, J.G. *IJ STEM Ed* (2016) 3: 11.
<https://doi.org/10.1186/s40594-016-0046-z>
- Kise, J. A. (2006). *Differentiated coaching: A framework for helping teachers change*. Thousand Oaks, CA: Corwin Press.
- Kannapel, P. J., Clements, S. K., Taylor, D., & Hibpshman, T. (2005). *Inside the Black Box of High-Performing High-Poverty Schools* (Publication). Lexington, KY: Prichard Committee for Academic Excellence Katzenmeyer, M., & Moller, G.

- (2001). *Awakening the sleeping giant: Helping teachers develop as leaders* (2nd ed.). Thousand Oaks, CA: Corwin Press.
- Kraft, M. A., Blazar, D., & Hogan, D. (2018). The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence. *Review of Educational Research*, 88(4), 547-588. doi:DOI: 10.3102/0034654318759268
- Kraft, M. A., Marinell, W. H., & Yee, D. (2016). School organizational contexts, teacher turnover, and student achievement: Evidence from panel data. *American Educational Research Journal*, 53, 1411–1449
- Lambert, L. (2002). A framework for shared leadership. *Educational Leadership*, 59(8), 37-40.
- Lambert, L. (2003). Leadership capacity for lasting school improvement. Alexandria, VA: Association for Supervision and Curriculum Development
- Lambert, L. (2003). Leadership redefined: An evocative context for teacher leadership. *School Leadership & Management*, 23(4), 421-430.
doi:10.1080/1363243032000150953
- Lambert L, Walker D, Zimmerman D, Cooper J, Gardner M, Lambert MD & Ford-Slack PJ (1995) *The Constructivist Leader*, New York: Teachers College Press.
- Lave, J. (1991). Situating learning in communities of practice. In L.B. Resnick, J.M. Levine & S.D. Teasley (Eds.), *Perspectives on socially shared cognition*. Washington, DC: American Psychological Association.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

- Lee, H. (2004). Developing a professional development program model based on teachers' needs. *The Professional Educator*, XXVII (1&2), fall 2004 & spring 2005, 39-49.
- LegisBrief* (2017)(40th ed., Vol. 25) (USA, National Conference of State Legislatures). Washington, DC.
- Lemke, J.L. (1990). Talking science: Language learning and values. Westport, CT: Ablex Publishing
- Lieberman, A., (1988). Teachers and principals: Turf, tensions, and new tasks. *Phi Delta Kappan*, 69, 648-653.
- Lieberman, A., & Friedrich, L. (2007). *Changing teaching from within: Teachers as leaders*. Manuscript, Carnegie Foundation for the Advancement of Teaching, Chicago, IL.
- Lieberman, A., Saxl, E. R., & Miles, M. B. (1988). Teacher leadership: Ideology and practice. In A. Lieberman (Ed.), *Building a professional culture in schools* (pp. 148–166). New York, NY: Teachers College Press.
- Lincoln, Y.S., Guba, E.G. (1985) *Naturalistic Inquiry*. Sage Publications, Newbury Park CA
- Lom, E. and Sullenger, K. (2010), “Informal spaces in collaborations: exploring the edges/boundaries of professional development”, *Professional Development in Education*, Vol. 37 No. 1, pp. 1-20.
- Loucks-Horsley, S. 2001. Foreword. In *Professional development: Planning and design*, eds. J. Rhoton and P. Bowers. Arlington, VA: National Science Teachers Association.

- Lotter, C., Harwood, W. S., & Bonner, J. J. (2007). The influence of core teaching conceptions on teachers use of inquiry teaching practices. *Journal of Research in Science Teaching*, 44(9), 1318-1347. doi:10.1002/tea.20191
- Lotter, C., Yow, J. A., & Peters, T. T. (2014, February). Building a community of practice around inquiry instruction through a professional development program. *Int J of Sci and Math Educ International Journal of Science and Mathematics Education*, 12(1), 1-23. doi:10.1007/s10763-012-9391-7
- Loucks-Horsley, S., Stiles, K., Mundry, S., Love, N., Hewson. (2010). *Designing professional development for teachers of science and mathematics* (Third ed.). Thousand Oaks, CA: Corwin Press.
- Luehmann, A. L. (2007). Identity development as a lens to science teacher preparation. *Science Education*, 91(5), 822-839.
- Maclean, M. S. & Mohr, M. M. (1999). *Teacher researchers at work*. U.S.: National Writing Project.
- Masumoto, M., & Brown-Welty, S. (2009). Case study of leadership practices and school-community interrelationships in high-performing, high-poverty, rural California high schools. *Journal of Research in Rural Education*, 24(1), 1-18.
- March, J. G., & Simon, H. A. (1958). *Organizations*. New York: Wiley.
- Matthes, W., & Carlson, R. (1987). Why do teachers choose rural schools? *Education Digest*, 52, 27-28.
- Maxwell, J. A. (2013). *Qualitative research design: An interactive approach*. Thousand Oaks, CA: SAGE Publications.

- McGarvey, B., & Marriott, S. (1997). The role of the core subject coordinator in supporting differentiation in Northern Ireland primary schools. *School Leadership and Management*, 17, 375–386.
- Mckinney, S. E., Haberman, M., Stafford-Johnson, D., & Robinson, J. (2008). Developing Teachers for High-Poverty Schools. *Urban Education*, 43(1), 68-82.
doi:10.1177/0042085907305200
- Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco, CA: Jossey-Bass.
- Merriam, S. (2009). *Qualitative research: A guide to design and implementation*. Hoboken, NJ: Jossey-Bass Publications
- Merrill, C., & Daugherty, J. (2010). STEM education and leadership: A mathematics and science partnership approach. *Journal of Technology Education*, 21(2), 21-34.
- Miller, A. (2009). *Principal turnover, student achievement and teacher retention*. Princeton University, Princeton, NJ.
- Mollenkopf, D. L. (2009). Creating highly qualified teachers: Maximizing university resources to provide professional development in rural areas. *The Rural Educator*, 30(3).
- Monk, D. H. (2007). Recruiting and Retaining high-quality teachers in rural areas. *Future of Children*, 17(1), 155-174.
- Moore, D. S., Notz, W., & Fligner, M. A. (2015). *The basic practice of statistics*. New York: W.H. Freeman and Company.
- Morgan, G. (1986). *Images of organizations*. Beverly Hills, CA: Sage.

- Moses, R.P. and Cobb, C.E. (2001). *Radical equations: Math literacy and civil rights*.
Boston: Beacon Press
- Muijs, D., & Harris, A. (2003). Teacher leadership: Improvement or empowerment? An overview of the literature *Educational Leadership and Management*, 31(4), 437-448.
- Murphy, P. J. & Angelski, K. (1997). Rural teacher mobility: A report from British Columbia. *Rural Educator*, 18(2), 5-11
- Murphy, J. & Shipman, N. (1999). The interstate School Leaders Licensure consortium: A standards-based approach to strengthening educational leadership. *Journal of Personnel Evaluation in Education*, 13(3), 1-19.
- Nadelson, L., Seifert, A., Moll, A., & Coats, B. (2012). i-STEM summer institute: an integrated approach to teacher professional development in STEM. *Journal of STEM Education*, 13(2), 69–83.
- National Academies of Sciences, Engineering, and Medicine, Division of Behavioral and Social Sciences and Education, Board on Science Education, Teacher Advisory Council, & Committee on Strengthening Science Education through a Teacher Learning Continuum (2015). *Science teachers learning: enhancing opportunities, creating supportive contexts*. Washington, DC: The National Academies Press.
doi: <https://doi.org/10.17226/21836>
- National Center for Education Statistics. (2013, May). The status of rural education.
Retrieved July 25, 2017, from https://nces.ed.gov/programs/coe/indicator_tla.asp

- National Center for Education Statistics (2013, May) Home Page, part of the U.S. Department of Education. Retrieved April 24, 2018. Retrieved from <http://nces.ed.gov/>
- National Commission on Teaching and America's Future. (1996). What matters most: Teaching for America's future. U.S. Dept. of Educ. Washington, DC.
- National Council for Teachers of Mathematics. (2010, November 30). Goals of professional development. Retrieved from <https://www.nctm.org/Research-and-Advocacy/Research-Brief-and-Clips/Goals-of-Professional-Development/>
- National Education Association (2017). Teacher leader model standards. Retrieved from <http://www.nea.org/home/43946.htm>
- National Science Education Standards: Observe, interact, change, learn.* (1996). Washington, DC: National Academy Press.
- Newmann, R. M., & Wehlage, G. G. (1995). Successful school restructuring: A report of the public and educators by the Center on Organization and Restructuring of Schools. Madison, WI: Center on Organization and Restructuring of Schools.
- Northouse, P. (2012). Leadership: Theory and practice. SAGE Publications. Kindle Edition.
- Nguyen, T. D., & Hunter, S. (2018). Towards an understanding of dynamics among teachers, teacher leaders, and administrators in a teacher-led school reform. *Journal of Educational Change*, 19(4), 539-565. doi:10.1007/s10833-017-9316-x

- O'Connor, K., & Boles, K. (1992). Assessing the needs of teacher leaders in Massachusetts. *American Educational Research Association (San Francisco, CA, April 20-24, 1992)*(pp. 1-27).
- Office of Management and Budget (2000). Standards for Defining Metropolitan and Micropolitan Statistical Areas; Notice. *Federal Register* (65) No. 249.
- Pappas, C. (1997). Making “collaboration” problematic in collaborative school-university research: Studying with urban teacher researchers to transform literacy curriculum genres. In J. Flood, S. B. Heath, & D. Lapp (Eds.), *Handbook of research on teaching literacy through the communicative and visual arts* (pp. 215-231). New York: Macmillan.
- Partnership for 21st Century Learning. (2014, August). *Battelle for Kids*. Retrieved from <http://www.battelleforkids.org/networks/p21>
- Peercy, M., Martin-Beltrán, M., Silverman, R. & Daniel, S. (2015) Curricular design and implementation as a site of teacher expertise and learning, *Teachers and Teaching*, 21:7, 867-893, DOI: 10.1080/13540602.2014.995486
- Peters-Burton, E. E. (2014). Is there a “nature of stem”? *School Science and Mathematics*, 114(3), 99-101.
- Poekert, P., Alexandrou, A., & Shannon, D. (2016). How teachers become leaders: An internationally validated theoretical model of teacher leadership development. *Research in Post-Compulsory Education*, 21(4), 307-329.
- Polio, H, Henley, T & Thompson, C 1997, *The phenomenology of everyday life*, Cambridge University Press, Cambridge.

- Pounder, D. G. (1998). Teacher teams: Redesigning teachers' work for collaboration. In D. G. Pounder (Ed.), *Restructuring schools for collaboration: Promises and pitfalls* (pp. 65-88). Albany, NY: SUNY Press.
- Redding, H., & Walberg, H. J. (2012). *Promoting learning in rural schools* (Publication). Lincoln, IL: Academic Development Institute.
- Reeves, D. B. (2010). *Transforming professional development into student results*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Rosenholtz, S. (1989). *Teachers' workplace: The social organization of schools*. New York: Longman.
- Rossmann, G. B., & Rallis, S. F. (2003). *Learning in the field: An introduction to qualitative research*. Thousand Oaks: SAGE.
- Russo, A. (2011, November 8). Whatever Happened to School Funding Gaps? *This Week in Education*. Downloaded on June 6, 2015: <http://scholasticadministrator.typepad.com/thisweekineducation/2011/11/the-much-ignored-school-funding-gap.html#.VXWh4mRViko>
- Ryan, S. (1999, April). Principals and teachers leading together. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Quebec, Canada.
- Sadler, D. (2009) Situated learning in science education: socio-scientific issues as contexts for practice, *Studies in Science Education*, 45:1, 1-42, DOI: 10.1080/03057260802681839
- Saldana, J. (2013). *The coding manual for qualitative researchers*. Los Angeles (California): Sage.

- Scafidi, B., Sjoquist, D., & Stinebrickner, T. R. (2007). Race, poverty, and teacher mobility. *Economics of Education*, 26(2), 145-159.
- Schein, E. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass
- Schein, E. H. (1988). *Organizational culture and leadership*. San Francisco: Jossey-Bass.
- Schlager, M. S., & Fusco, J. (2003). Teacher professional development, technology, and communities of practice: Are we putting the cart before the horse? *The Information Society*, 19(3), 203-220. doi:10.1080/01972240309464
- Schlechty, P. C. (1990). *Schools for the twenty-first century: Leadership imperatives for educational reform*. San Francisco: Jossey-Bass.
- Schmoker, M. (1996). *Results: The key to continuous school improvement*. Alexandria, VA: ASCD.
- Scribner, J. P., Sawyer, R. K., Watson, S. T., & Myers, V. L. (2007). Teacher Teams and Distributed Leadership: A Study of Group Discourse and Collaboration. *Educational Administration Quarterly*, 43(1), 67-100. doi:10.1177/0013161x06293631
- Self, J. (2015, December 26). With too few teachers, SC schools look overseas to fill classrooms. *The State*. Retrieved March 2, 2019, from <https://www.thestate.com/news/politics-government/politics-columns-blogs/the-buzz/article51720675.html>
- Seltzer, D. A., & Himley, O. T. (1995). A model for professional development and school improvement in rural schools. *Journal of Research in Rural Education*, 11(1), 36-44.

- Senge, P.M. (1994). *The fifth discipline: The art and practice of the learning organization*. New York: Doubleday.
- Shaw, P. (1999). Purpose and process in effective learning communities. (pp. 149-170). In J. Retallick, B. Cocklin, & K. Coombe (Eds.). *Learning communities in education: Issues, strategies and contexts*. London: Routledge.
- Shearby, L., & Shaddix, L. (2008). Growing teacher leaders in a culture of excellence. *The Professional Educator*, 32(1).
- Shields, C. M. (2010). Transformative leadership: Working for equity in diverse contexts. *Educational Administration Quarterly*, 46(4), 558-589.
- Showalter, D., Ph.D., Klein, R., Ph.D., Johnson, J., Ed.D., & Hartman, S., Ph.D. (2017). *Why rural matters 2015-2016: Understanding the Changing Landscape*(Publication). Rural School and Community Trust.
- Siegle, D. (2015, October 11). Educational research basics. Retrieved from <https://researchbasics.education.uconn.edu/>
- Singer, T. W., & Easton, L. B. (2015). *Opening doors to equity: A practical guide to observation-based professional learning*. Thousand Oaks, CA: Corwin/Learning Forward.
- Singh, Kusum & Billingsley, Bonnie. (1998). Professional Support and Its Effects on Teachers' Commitment. *Journal of Educational Research*.
- Smylie, M., & Brownlee-Conyers, J. (1992). Teacher leaders and their principals: Exploring the development of new working relationships. *Educational Administration Quarterly*, 38(2), 150-184.

- Smylie, M. A., Conley, S. and Marks, H. M. (2002), Exploring New Approaches to Teacher Leadership for School Improvement. *Yearbook of the National Society for the Study of Education*, 101: 162-188. doi:10.1111/j.1744-7984.2002.tb00008.x
- Smylie, M. A., & Denny, J. W. (1990). Teacher leadership: tensions and ambiguities in organizational perspective. *Educational Administration Quarterly*, 26(3), 235-259. doi:10.1177/0013161x90026003003
- Smulyan, L. (2016). Stepping into their power: The development of a teacher leadership stance. *Schools: Studies in Education*, 13(1), 8-28.
- Snyder, M. (1987). *Public appearances /private realities*. New York: Freeman.
- Sousa, D. (2014). Validation in Qualitative Research: General Aspects and Specificities of the Descrip Sousa, D. (2014). Validation in Qualitative Research: General Aspects and Specificities of the Descriptive Phenomenological Method. *Qualitative Research in Psychology*, 11(2), 211-227. doi:10.1080/14780887.2013.853855
- Sousa Santos, B 1987, *Um discurso sobre as ciências*, Edições Afrontamento, Porto.
- South Carolina Department of Education. (n.d.). Retrieved from <https://ed.sc.gov/districts-schools/nutrition/meal-programs/national-school-lunch-program/e-rate-free-and-reduced-meal-eligibility-data/>
- Spillane, J. (2005, Winter). Distributed Leadership. *The Educational Forum*, 69, 143-150.

- Spillane, J., Halverson, R., & Diamond, J. (2001). Investigating school leadership practice: A distributed perspective (Research news and comment). *Educational Researcher*, 30(3), 23–28.
- Stake, R. E. (2006). *Multiple case study analysis*. New York, NY: The Guilford Press.
- Sterrett, W. (2016). *Igniting teacher leadership: How do I empower my teachers to lead and learn?* Alexandria, VA: Association for Supervision and Curriculum Development.
- Stigler J. M. & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York, NY: Free Press.
- Stoll, L. (2011), “Leading professional learning communities”, in Robertson, J. and Timperley, H. (Eds), *Leadership and Learning*, Sage, London, pp. 103-117.
- Sudha, K. S., Shahnawaz, M. G., & Farhat, A. (2016). Leadership Styles, Leader’s Effectiveness and Well-being: Exploring Collective Efficacy as a Mediator. *Vision: The Journal of Business Perspective*, 20(2), 111-120.
doi:10.1177/0972262916637260
- Supovitz, J. A., & Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom culture. *J. Res. Sci. Teach. Journal of Research in Science Teaching*, 37(9), 963-980. doi:10.1002/1098-2736(200011)37:93.0.co;2-0
- Thompson, C.L., & Zeuli, J.S. (1999). The frame and the tapestry: Standards-based reformed professional development. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession. Handbook of policy and practice* (pp. 341-375). San Francisco: Jossey-Bass

- Timms, C., Graham, D., & Cottrell, D. (2007). I just want to teach: Queensland independent school teachers and their workload. *Journal of Educational Administration*,45(5), 569-586.
- Uribe-Flórez, L. J., Al-Rawashdeh, A., & Morales, S. (2014). Perceptions about teacher leadership: Do teacher leaders and administrators share a common ground? *Journal of International Education and Leadership*,4(1), 1-15.
- van Driel, J. H., Beijaard, D. and Verloop, N. (2001), Professional development and reform in science education: The role of teachers' practical knowledge. *J. Res. Sci. Teach.*, 38: 137-158. doi:10.1002/1098-2736(200102)38:2<137::AID-TEA1001>3.0.CO;2-U
- Vilorio, D. (2014, Spring). *STEM 101: Intro to tomorrow's jobs* (Rep.). Retrieved <https://www.bls.gov/careeroutlook/2014/spring/art01.pdf>
- Wasley, P. A. (1991). *Teachers who lead: The rhetoric of reform and the realities of practice*. New York, NY: Teachers College Press.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identify*. New York: Cambridge University Press.
- Wenger, E., McDermott, R. A., & Snyder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston, MA: Harvard Business Press.
- Wenner, J. A., & Campbell, T. (2017). The Theoretical and Empirical Basis of Teacher Leadership. *Review of Educational Research*,87(1), 134-171.
doi:10.3102/0034654316653478
- Wenner, J. A., & Campbell, T. (2018). Thick and Thin: Variations in teacher leader identity. *International Journal of Teacher Leadership*,9(2), 1-18.

- Williams, D. T. (2012). Supporting rural teachers. *Principal*. Retrieved from <https://www.naesp.org/principal-novdec-2012-stem-issue/supporting-rural-teachers>
- Wilson, S. M., Schweingruber, H. A., & Nielsen, N. (2015). *Science teachers' learning enhancing opportunities, creating supportive contexts*. National Academy of Sciences. Retrieved May 31, 2016, from http://www.ianas.org/books/books_2015/science_education/science-teachers-learning.pdf
- Wong, K., & Lee, J. (1998). Interstate variation in the achievement gap among racial and social groups: Considering the effects of school resources and classroom practices. Paper presented at the annual meeting of the American Educational Research Association, San Diego
- Yin, R. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, CA: SAGE.
- York-Barr, J., & Duke, K. (2004). What do we know about teacher leadership? Findings from two decades of scholarship. *Review of Educational Research*, 74(3), 255–316.
- Yow, J. A., & Lotter, C. (2014). Teacher learning in a mathematics and science inquiry professional development program: first steps in emergent teacher leadership. *Professional Development in Education*, 42(2), 325-351.
doi:10.1080/19415257.2014.960593

- Yow, J. A., Morton, C. H., & Cook, D. (2013, September). Lessons learned from a community math project: Ethnomathematical games & opportunities for teacher leadership. *Journal of Mathematics and Culture*, 7(1), 98-139.
- Yukl, G. (1998). *Leadership in organizations* (4th ed.). Upper Saddle River, NJ: Prentice Hall.
- Zwart, R.C., Wubbels, T, Bergen, T.M. & Bolhuis, S, (2007) Experienced teacher learning within the context of reciprocal peer coaching, *Teachers and Teaching*, 13:2, 165-187, DOI: 10.1080/13540600601152520

APPENDIX A
PARTICIPATION LETTER

Dear STEM Teacher Leaders and Administrators,

As a Ph.D. candidate in the School of Education at the University of South Carolina, I am conducting research as part of my degree requirements. The purpose of my research is to examine how STEM Teacher Leaders and their administrators perceive how those teachers spend their time supporting other teachers and students.

As part of the NOYCE program, or as an administrator to a teacher in the NOYCE program, I am inviting you to respond to questions regarding your perceptions of STEM teacher leaders and the roles they serve at school. No personal identifying information will be shared. Please respond to the survey in the next 7 days. Following that we will set up a time to meet either face to face or via an online platform to conduct the interview portion of the research. The survey should take between ten and fifteen minutes to complete. The interview will take approximately sixty to ninety minutes.

Taking part in the study is your decision. You do not have to be in this study if you do not want to. You may also quit being in the study at any time or decide not to answer any question you are not comfortable answering.

I will be happy to answer any questions you have about the study. You may contact me at 803-351-0929 or jzeis@email.sc.edu if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7095.

Sincerely,

Jodi Zeis, Ph.D. Candidate
University of South Carolina,
School of Education

APPENDIX B

STEM TEACHER SURVEY

STEM Teacher Perceptions of Leadership Opportunities

Please complete each question. Participants will not be identified in order to maintain confidentiality. This information is being collected to compare STEM teacher leaders' perception of leadership opportunities to that of administrators. Taking part in the study is your decision. You do not have to be in this study if you do not want to. You may also quit being in the study at any time or decide not to answer any question you are not comfortable answering.

I will be happy to answer any questions you have about the study. You may contact me at 803-351-0929 or jzeis@email.sc.edu if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7095.

* 1. What additional responsibilities do you have at school in your role as a teacher leader? These can be in or out of school hours. These may be paid or unpaid, official titles or non-official titles. (check all that apply)

- | | |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Provide support/professional development to staff during school | <input type="checkbox"/> Serve on a leadership team such as school improvement, school safety, etc. |
| <input type="checkbox"/> Lead a team or committee that supports teachers - (ex: technology committee, data committee,) | <input type="checkbox"/> Serve as department or grade level chair |
| <input type="checkbox"/> Lead a school sponsored program/sport for students | |

* 2. If there are other responsibilities you have above and beyond typical teaching duties, please list them here. If none, type none.

* 3. For the answers that you gave above please list specifics for each. For instance if you are a coach, please list for what. If you are a chair, please list for what.

* 4. Referring to the tasks you listed in the first and second questions, which are tasks you would like others to take on instead of you? List them in order from the first one you would like to give away to the last.

* 5. What teacher leadership responsibilities do you NOT have that you would like, that would support teachers? (If none, put n/a).

6. On a scale of 1 to 4, how much time do you feel you spend supporting teachers, outside of your regular teaching duties? The number 1 represents hardly any time supporting, 2 represents a little time supporting, 3 represents sufficient time reporting, and four represents too much time supporting.

1 4

7. On a scale of 1 to 4, rate how you feel your administration support you as a STEM teacher leader, with 1 representing no support, two representing a little support, 3 representing sufficient support, 4 representing almost always support.

1 4

* 8. What is your name?

* 9. What is the name of the school where you work?

* 10. What is your primary role at the school?

APPENDIX C

ADMINISTRATOR SURVEY

STEM Teacher Perceptions of Leadership Opportunities- Administrator Survey

Please complete each question. Participants will not be identified in order to maintain confidentiality. This information is being collected to compare STEM teacher leaders' perception of leadership opportunities to that of administrators.

Taking part in the study is your decision. You do not have to be in this study if you do not want to. You may also quit being in the study at any time or decide not to answer any question you are not comfortable answering.

I will be happy to answer any questions you have about the study. You may contact me at 803-351-0929 or jzeis@email.sc.edu if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7095.

* 1. What additional responsibilities does this teacher have at school in the role of teacher leader? This can be during or beyond school hours. These may be paid or unpaid, official titles or non-official titles. (check all that apply)

- | | |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Provide support/professional development to staff during school | <input type="checkbox"/> Serve on a leadership team such as school improvement, school safety, etc. |
| <input type="checkbox"/> Lead a team or committee that supports teachers - (ex: technology committee, data committee.) | <input type="checkbox"/> Serve as department or grade level chair |
| <input type="checkbox"/> Lead a school sponsored program/sport for students | |

* 2. If there are other responsibilities this teacher has above and beyond typical teaching duties, please list them here. If none, type none.

* 3. For the answers that you gave above please list specifics for each. For instance if the teacher is a coach, please list for what. If the teacher is a chair, please list for what.

* 4. Referring to the tasks you listed in the first and second questions, which are tasks you think might be assigned to others so that teacher leaders can spend time supporting teacher growth? List them in order from the first one you would like to give away to the last.

APPENDIX D

STEM TEACHER LEADER INTERVIEW

Interview Protocol: The researcher will meet with each NOYCE Teacher face to face either in person or via an electronic device and interview NOYCE teachers using the questions below. Participants may add as much or little detail as they wish. The researcher may ask the participants to further explain some answers if necessary. Taking part in the study is your decision. You do not have to be in this study if you do not want to. You may also quit being in the study at any time or decide not to answer any question you are not comfortable answering.

I will be happy to answer any questions you have about the study. You may contact me at 803-351-0929 or jzeis@email.sc.edu if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7095.

1. How long have you been a teacher at this school? Tell me about how your responsibilities have changed as a teacher since you started NOYCE.
2. What are some ways your school level administrators show that they support or do not support your involvement in a teacher leadership program?
3. Describe the teacher leader responsibilities you had before starting NOYCE.
4. (Interviewer will remind the interviewee of responsibilities they listed in question 1 and 2 of the survey. Interviewee will receive a sheet from the interviewer ahead of time with the choices the interviewee selected and listed.) Describe the teacher leader responsibilities you have received after starting NOYCE.

Example: Team leader _____ (want to do) _____ (importance) _____ (beneficial)....—with the stuff in () based on original survey.

5. What responsibilities in #4 did you volunteer for?
6. What responsibilities in #4 were you assigned without volunteering?
7. How confident do you feel about these various roles? Explain.

8. How efficacious do you feel about these various roles? Explain
9. Based on the answers you gave in your survey for question 1 and 2, please rank them from the least amount of time you take on them to the most time.
10. Based on the answers you gave in your survey for question 1 and 2, please rank them from the responsibilities you enjoy the least to the responsibilities you enjoy the most.
11. What impact do these responsibilities have on your job satisfaction?
12. Describe the time you spend on duties other than teaching each week. Include the time spent and tasks you do. Why do you divide your tasks this way?
13. What formal opportunities have you had since joining NOYCE to support, provide, or sustain professional development of other teachers?
14. Talk about how you feel about these opportunities—not just list them—do these opportunities empower you or lead you to feeling burnt out? Why?
15. What informal opportunities have you had since joining NOYCE to support, provide, or sustain professional development of other teachers? Describe.
16. What prevents teachers in your school from implementing professional development long term?
17. What encourages teachers to implement professional development long term?
18. How do you think your role as teacher leader is perceived at school? What examples support this? What differences do you see between teachers in your content or grade level compared to other teachers? What about with administrators?
19. Given any resource, what would you choose to do as a teacher leader? Why is this important to you and your job satisfaction?
20. How do you grow professionally in addition to participating in NOYCE?
21. How do other teachers at your school grow professionally through your leadership?
22. What are the benefits of a teacher serving as a teacher leader in a rural school or district?
23. What are the drawbacks of serving as a teacher leader in a rural school or district?

24. Do the opportunities to lead at school encourage or discourage you from staying at your school? Please provide an explanation.
25. What do you perceive keeps you at this school—(other supports or structures (colleagues, team planning, etc.)?)
26. Who conducts the school professional development?
27. What value do you find value in the professional development?
28. Do you feel you could provide professional development that would better meet the needs of the teachers at your school? If so, what do you need to do this? If not, why not?

APPENDIX E

ADMINISTRATOR INTERVIEW

Interview Protocol: The researcher will meet with each NOYCE Teacher face to face either in person or via an electronic device and interview NOYCE teachers using the questions below. Participants may add as much or little detail as they wish. The researcher may ask the participants to further explain some answers if necessary. Taking part in the study is your decision. You do not have to be in this study if you do not want to. You may also quit being in the study at any time or decide not to answer any question you are not comfortable answering.

I will be happy to answer any questions you have about the study. You may contact me at 803-351-0929 or jzeis@email.sc.edu if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7095.

1. How long have you been a principal at this school? Tell me about how your Noyce teacher leader contributes to your school.
2. What are some ways you show that you support or do not support your involvement in a teacher leadership program?
3. Describe the teacher leader responsibilities these teachers had before starting NOYCE about four years ago.
4. (Interviewer will remind the interviewee of responsibilities they listed in question 1 and 2 of the survey. Interviewee will receive a sheet from the interviewer ahead of time with the choices the interviewee selected and listed.) Describe the teacher leader responsibilities this teacher has received after starting NOYCE.

Example: Team leader _____ (want to do) _____ (importance) _____ (beneficial)...—with the stuff in () based on original survey.

5. What responsibilities in #4 did the teacher leader volunteer for?
6. What responsibilities in #4 was assigned to the teacher leader without volunteering?
7. How confident do you think the teacher leader feels in these various roles? Explain.

8. How efficacious do you feel the teacher leader is in these various roles?
Explain
9. Based on the answers you gave in your survey for question 1 and 2, please rank them from the least amount of time you perceive the teacher takes on them to the most time.
10. Based on the answers you gave in your survey for question 1 and 2, please rank them from the responsibilities you perceive the teacher to enjoy the least to the responsibilities you enjoy the most.
11. What impact do these responsibilities have on the teacher's job satisfaction?
12. Describe the time the teacher leader spends on duties other than teaching each week. Include the time spent and tasks they do. Why do they divide their time that way? (Is it choice, requirement, etc.)
13. What formal opportunities has the teacher leader participated in since joining NOYCE, to support, provide, or sustain professional development of other teachers?
14. Talk about how you feel about these opportunities to have the teacher lead them—not just list them—do these opportunities empower teacher leaders or lead you to feeling as though you still have work to do? Why?
15. What informal opportunities are you aware of that the teacher has participated in since joining NOYCE to support, provide, or sustain professional development of other teachers? Describe.
16. What prevents teachers in your school from implementing professional development long term?
17. What encourages teachers to implement professional development long term?
18. How do you think the role of teacher leader is perceived at school? What examples support this? What differences do you see between teachers in your content or grade level compared to other teachers? What about with administrators?
19. Given any resource, what would you choose for this teacher leader to do? Why is this important to the school and the success of your school?
20. How does your teacher leader grow professionally in addition to participating in NOYCE?
21. How do other teachers at your school grow professionally through this teacher leader's leadership?

22. What are the benefits of a teacher serving as a teacher leader in a rural school or district?
23. What are the drawbacks of a teacher serving as a teacher leader in a rural school or district?
24. Do the opportunities to lead at school encourage or discourage teacher leaders from staying at your school? Please provide an explanation.
25. What do you perceive keeps this teacher leader at this school—(other supports or structures (colleagues, team planning, etc))?
26. Who conducts the school professional development?
27. What value do teachers find in the professional development?
28. Do you feel this stem teacher leader could provide professional development that would better meet the needs of the teachers at your school? If so, what do you need to do this? If not, why not?