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A Multiple Case Study Exploring Communities of Practice Led by Rural Secondary School Science Teachers to Overcome Community Isolation in a Research-Science, Dually-Enrolled, Program of Studies

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Abstract

This multiple case study focused on a research science dually-enrolled program of study and the unique challenges rural school educators face due to a lack of human and social capital. Some geographically-isolated rural secondary schools strategically use dual-enrollment programs to develop stronger social capital networks and communities of practice. Participants included five science research educators from rural, geographically-isolated secondary schools. Each case was examined individually, which allowed the researcher to explore the phenomenon within the context of the rural school research science teaching and learning environment. A cross-case analysis was conducted across all five cases using the inductive framework. The following research question guided this study: How do geographically-isolated rural secondary school Science Research in the High School (SRHS) educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition? This research study provided insight into the mutually beneficial roles communities and schools have in developing the social and human capital available to them in their community. By establishing partnerships through purposeful planning, community members, practitioners, and leaders can successfully work to address the student equity issues, often plaguing geographical-isolated rural schools. The results of this study reveal and communicate identified best educational practices used by SRHS educators in establishing communities of practice within their geographically isolated secondary schools. The identified need to prepare our students for a more global, technology, knowledge-driven society upon their graduation from secondary schools makes this study valuable and timely.

Keywords: communities of practice, constructivist pedagogy, dual-enrollment, inquiry, programs of study, research science, rural schools, secondary schools

Dedication

This dissertation is dedicated to my family, especially my husband, Jim, who will finally be able to get relief from the housework and will be able to see the dining room table, my children- Dyl, Benny, & Moni, and Hunt for your continuous support and love, and my Mommy and Daddy, who were my first teachers, and above all, taught me about God's love.

To the research science teachers, who give so much of themselves to their students every day; thank you for welcoming me into your community of practice.

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As iron sharpens iron, so a friend sharpens a friend. Proverbs 27:17

Just as raising a child is a collective effort, completing a dissertation is a collective effort. No collective effort of this level could occur without the support and encouragement of others through a lifetime. It is with much gratitude and humbleness that I thank each and every person who has had a part in my educational journey through the years and a member of my community of practice during this pursuit of my goal. May we all continue to be curious and persist in our inquiry as lifelong learners, thank you for helping to instill that curiosity and love of learning within me. Thank you to my entire Taconic Hills school community, for your warm embrace of this endeavor and unwavering encouragement, specifically Dr. Neil L. Howard, Jr., who never doubted my completion of this process and Ms. Tonya Frickey, who helped me to move beyond chapter three, my most challenging chapter. Thank you to Dr. Chad Becker, dissertation chair, whose commitment to excellence and dedication to the process brought the best out in me. Once you helped me to find the narrow slice of the world, which I could impact with my dissertation, we made it happen. Dr. Leslie G. Loomis, committee member and mentor, thank you for always being in my court and recognizing strengths in me that I didn't realize in myself. I will always lead harder because of your mentorship. Dr. Edward H. Kim, committee member, thank you for serving on my committee, your time and dedication is much appreciated. Ms. Brittany Kallman Arneson, editor, thank you for believing in me and providing the support I needed when self-doubt crept in. Pollyanna Kabara, my trusted friend and fellow candidate, I know that you will always be the leader and teacher who models the walk of Jesus Christ, thank you for calling me to be in your community of faith. Finally, to the Concordia University–Portland faculty and staff, thank you for modeling your faith walk even during the most challenging of times.

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Chapter 1: Introduction

It is the supreme art of the teacher to awaken joy in creative expression and knowledge.

–Albert Einstein, Early Writings,1879–1955

Introduction to the Problem

Dual-enrollment secondary school programs of study potentially offer benefits for students in geographically-isolated rural areas. Educators encourage students to participate in dual-enrollment as it increases their likelihood of finishing high school, entering college, and completing a degree or certificate program (Zinth, 2014). Dual-enrollment is viewed as a means to address two current educational issues: (a) a need for increased rigor in secondary schools and (b) improving the connections both between secondary and postsecondary education and between secondary education and the employment sector (Wozniak & Louann, 2013). Addressing these issues through dually-enrolled programs of study is a trend believed to support the development of college and career readiness skill sets, which help students attain successful adult livelihoods and independence.

Demographic data from rural areas have historically reflected lower college-going and postsecondary attainment rates than data from nonrural suburban areas and have reflected similar college-going and postsecondary attainment rates as urban locales across all income structures (National Student Clearinghouse Research Center [NSCRC], 2014, 2017, 2018). When comparing income demographic data, rural, low-income high school students are even less likely to enroll in college than their low-income, high-minority, urban high school student counterparts (Zinth, 2014). However, despite this trend, matriculation of rural school students in dual-enrollment, college credit-bearing classes has increased by over 12% during the last decade

(Marken, Gray, & Lewis, 2013). This rapid growth suggests college readiness may also be shifting for rural students, creating a need for more data on how successful dual-enrollment programs of study support geographically-isolated rural secondary school students in their acquisition of the academic, intrapersonal, and interpersonal skills needed to build successful college and career readiness.

Geographically-isolated rural secondary educators face challenges in implementing high-quality dual-enrollment programming. These challenges center on resource availability including instructor expertise, program costs, experiential background, generational poverty, community-based organizational support, and geographic isolation (Flora & Flora, 2015). How these resources function together is defined as *social capital*. Coleman (1988) defined social capital as the relationship between multiple entities that have two characteristics in common; these characteristics "consist of some aspect of social structure, . . . and they facilitate certain actions of individuals who are within the structure" (p. S98). Communities of practice form to increase social capital through the knowledge-sharing and building process (Wenger & Snyder, 2000). Some geographically-isolated rural secondary schools strategically use dual-enrollment programs to develop stronger social capital networks and communities of practice. These geographically-isolated rural secondary schools and educators understand the valuable connections between human action, a community of practice, and social capital to advance students' skills and knowledge (human capital).

Through this qualitative multiple case study, I explored how geographically-isolated rural secondary school educators have provided instruction in a State University of New York (SUNY) University in the High School (UHS) SRHS dually-enrolled program of study. To

ensure confidentiality of the university in this study, I do not identify the location of the specific SUNY. The purpose of this research study is to reveal and communicate identified best educational practices of SRHS educators in establishing communities of practice within geographically-isolated rural secondary schools. This study of SRHS program of studies in rural geographically-isolated science research classrooms benefits other educators, specifically those teaching research-science programs of studies in geographically-isolated rural secondary schools. Ultimately, through this research study, my goal was to uncover how geographically-isolated rural secondary school educators leverage their resources and adjust their teaching and learning environments to build social capital and communities of practice, thus building their students' knowledge to compete socially and economically in a global economy.

Background, Context, History, and Conceptual Framework for the Problem

The SUNY SRHS is an advanced level, dual-enrollment, 3-year research course sequence meant to prepare students to enter a rigorous 4-year college program through the completion of an authentic scientific research study over three years. Early high school dual enrollment programs of studies are similar to two other career focused educational initiatives- career academies where students earn a career certificate while completing their high school diploma requirement and early college high schools where students earn a 2-year college degree along with or in place of their high school diploma (Castellano, Richardson, Sundell, & Stone, 2016). The SRHS program of studies is student self-selected and includes both the career elements and early college qualities identified by Castellano et al. (2016). The intention of the SUNY in the high school program is to provide a bridge program whereby "students begin to develop the skills and experience necessary for academic success in higher education" (SUNY, 2017, para.

9). SRHS is one of the educational experiences Northeastern United States rural school districts and educators are adopting as an initiative to address educational equity and college readiness in the scientific field of study for geographically-isolated rural secondary school students.

The traditional laboratory science coursework in the New York State Regents curriculum does not characteristically fully engage students in the scientific inquiry process. Instead, these courses contain a structure of content-specific curriculum meant to prepare students to perform well on a cumulative state examination upon completion of the course. Typically, most of the required laboratory experiments are guided, ending in a predictable result. Success on these experiments is determined by the student's ability to replicate a task skillfully enough to achieve a result comparable to the expected result. Students who enroll in the SRHS program of study hope to engage in the scientific inquiry and research processes not afforded in the traditional high school science New York State Regents curriculum.

Enrollment into the 3-year SRHS program does not automatically ensure completion of the 3-year program of study and acquisition of college readiness. In fact, the average attrition rate for most participating schools is around 50% over the 3-year program cycle, according to the SUNY SRHS program director (Program Administrator, personal communication, August 23, 2017). As geographically-isolated rural secondary school students proceed through the 3-year SRHS program of study sequence, it is valuable to identify what barriers they face and isolate the tools and strategies used by teachers to address and overcome these barriers. The participants in this study included educators who teach students enrolled in the SUNY SRHS program of study and who are from geographically-isolated rural secondary school districts.

The conceptual framework for this research study was the acquisition of knowledge through communities of practice, and the reciprocal relationships communities of practice have with social capital and human capital. This conceptual framework aligns with the research question I am seeking to explore; that is, how SRHS teachers utilize social capital and human action to establish, support, and facilitate the growth of communities of practice which support student knowledge acquisition. The conceptual framework of utilization of communities of practice for knowledge acquisition relates to the problem of geographically isolated rural schools and the marked absence of social capital and human capital.

Statement of the Problem

In the study, I sought to understand the problem that educators and students in geographically-isolated rural secondary schools do not have human, cultural, and community social capital networks that are equitable to those of their nonrural (which, for the purpose of this study, included both suburban and urban) counterparts. Many of the students in these rural environments do not have the human and cultural capital needed to succeed within the social and cultural context of college life (Zinth, 2014). Conley (2010) found that when individuals are socialized through community social capital, these individuals can build their human capital and cultural capital to skillfully navigate through a greater diversity of settings, including college environments.

Exploring the pedagogical expertise of geographically-isolated rural secondary school educators may guide professional development for other educators seeking to use and develop human capital, cultural capital, and community social capital resources. The pedagogical expertise of the participants in my study was grounded in social constructivist methodology and

open scientific inquiry methods. Because the problem I investigated is a deficit of human capital, cultural capital, and community social capital among geographically-isolated rural secondary schools, better awareness of how individual educators teaching in different geographically-isolated rural secondary schools overcome this problem can increase the understanding of the problem as a whole.

Purpose of the Study

The purpose of this study was to explore the challenges that SRHS teachers overcome in geographically-isolated, rural secondary schools due to an imbalance of social capital and the resulting lack of naturally-occurring communities of practice. The study focused on geographically-isolated rural secondary schools, as stakeholders often assume transference of programming from one educational environment to another, without consideration of differences in available resources including teacher, financial, social, academic, environmental, geographic, and technical resources. This isolation often creates a lack of capital resources for geographically-isolated rural secondary school students as compared to their nonrural peers, which may ultimately lead to successful completion of the 3-year course sequence and entrance into a high-quality, 4-year college or university program.

My qualitative research study helped me to better understand how geographically-isolated rural secondary school students enrolled in the SRHS program of studies are scaffolded and supported throughout the course sequence by their teachers, how their teachers are addressing the challenges of rural isolation and the resulting lack of social capital through this isolation, and how their students are growing in their preparedness for college success.

Ultimately, this study uncovered new insights that may benefit geographically-isolated rural secondary school practitioners and students.

Research Questions

The following primary research question guided this study:

How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?

The following secondary research questions serve to support the primary research question:

- How do the human actions of the educators compensate for a lack of social capital caused by geographic isolation?
- What are the human actions that allow the educators to enhance students' involvement and participation in the community of practice?
- What are the factors that allow a community of practice to harness limited social networks and resources to establish legitimization for the student member?
- How does social constructivist learning through communities of practice support the evolution of the student knowledge-acquisition process?

Rationale, Relevance, and Significance of the Study

This study adds to the current body of research on dual-enrollment programs of study. Taking dual-enrollment, college-level coursework has the potential to provide many benefits to students. These benefits center on the possibility of increasing students' knowledge acquisition, thus fostering students' growth in their human, cultural, and social capital which translates into a

higher rate of persistence and completion in both college and career success. The study specifically explored the SRHS SUNY UHS program of studies.

Traditionally, researchers have focused on learning-centered environments, including social constructivist and scientific inquiry, but demographics have rarely factored into these studies. In this study, I explored the teaching and learning environments of educators who teach geographically-isolated rural secondary students. My research focused on the specific context of the SRHS program of study, a program of study which is built upon social constructivist ideas and open scientific inquiry principles. Examining the relationships between human action, communities of practice, and social capital, as well as their ability to mediate the adverse effects of economic hardship on the achievement levels of geographically-isolated rural school students offers valuable insights that could benefit geographically-isolated rural school practitioners (see Byun, Meece, & Irvin, 2012; Turley, 2009).

Recent findings from researchers Hsu and Espinoza (2017) suggested that working with scientists in the social constructivist, open-inquiry learning environment is an effective way for students to learn authentic science. According to Hsu and Espinoza (2017), “The results of the study suggest that constructive learning environments encourage student agency and provide structures that allow students to learn science effectively” (p. 281). If this is true, studying how effective educators design their teaching and learning environment to support collaborative communities of practices through the utilization of community social capital networks offers the opportunity for the transference of best practices within the social constructivist methodology and methods of scientific inquiry.

Little research has been conducted to date on the perspective of educators teaching in geographically-isolated rural secondary schools within the context of a social constructivist, open inquiry science teacher-learning environment. Examining the SRHS program of studies from the educator perspective is essential as it may help to provide insight into social constructivist methodology and methods of scientific inquiry employed by these educators. I hope that my research offered insights into overcoming community social capital deficits through human action and communities of practice for the benefit of geographically-isolated rural secondary students.

Definition of Terms

For this study, I have the following definitions as they relate specifically to SUNY SRHS program of studies.

Communities of practice. A community of practice exists when a group of people sharing a concern or a passion for something. They interrelate with each other and learn from each other from their collaborative work (Wenger & Snyder, 2000). In the SRHS classroom, the shared passion is for knowledge discovery in a specific discipline, which seeks to collaboratively find an answer to the student member's inquiry question.

Communities of practice activities. The activities of a community of practice are led and engaged in by the members of the community of practice and include problem-solving, requests for information, authentic experiences, reuse of assets, coordination and sharing of resources, discussion of development, documentation and validation, knowledge mapping, and gap identification (Wenger-Trayner & Wenger-Trayner, 2015).

Cultural capital. Cultural capital is not economically related, rather cultural capital is the knowledge and skills that allow individuals to navigate the social complexities of their worlds (Bourdieu, 1992).

Human action. Human action is the purposeful behaviors of people and the causes of what happens due to this purposeful behavior. The human actions referred to in this research study are the behaviors of the educators within the social constructivist and scientific inquiry teaching-learning environment.

Human capital. Human capital skills and knowledge acquired by the individuals (Coleman, 1994).

Inquiry learning strategies. Students are supported by the teacher to explore academic content by posing questions, investigating the questions, and developing new meaning and understandings by answering questions (National Research Council, 2013; Paul, Lederman, & Groβ, 2016).

Knowledge acquisition. Knowledge acquisition in the context of research science is the ability to acquire knowledge and apply this knowledge to successfully research, collect data, and analyze data and publish results related to their open inquiry question(s).

Social capital. Social capital is the resulting return when social entities interact through social relationships to develop social networks (Coleman, 1994; Lin, 1999).

Social constructivist instructional methodologies. The process of constructing new meaning for a student through highly individualized, ongoing learning in an active, engaging teaching and learning environment (Danielson, 2007; Mogashoa, 2014).

Teaching and learning environments. Teachers have both direct and indirect influences on student learning, including the students' engagement, their motivation to learn, and their sense of well-being, belonging, and personal safety. These influences comprise the cultural characteristics of the teaching and learning environment (Danielson, 2007).

Assumptions, Delimitations, and Limitations

Assumptions. I began with several assumptions. I assumed that I would be able to secure at least three SRHS educators who were willing to participate in my study and provide truthful, reflective narratives and that the educators participating in the multiple case study have successfully established a social constructivist, scientific open inquiry-based teaching environment within a geographically-isolated rural school community. I also assumed that the geographically-isolated rural school communities studied are characterized by deficit community social capital and minimal naturally occurring communities of practice to support students' scientific knowledge acquisition. Finally, educator and school names and identifying characteristics were held with strict confidence.

Delimitations. The delimitations of this study are as follows. First, the population of schools to sample was finite, as there were only a few educators that qualified as participants. There was be only one teacher identified in each geographically-isolated rural school, and this teacher had course obligations beyond SRHS. Additionally, student enrollment in these geographically-isolated rural schools was relatively small, resulting in only one to two course sections per teacher. Other participants in the teaching and learning environment were not included in the interview process; thus, leaving out students, community members, administrators, and parents. This study likely had implications for SRHS teachers in

geographically-isolated rural schools. However, there may have been the transference of some of the discussion to broader educational settings.

Limitations. There were several limitations to this study. There is the possibility of researcher bias when considering the administrative programming responsibilities I have in the school district in which I am employed. The data collection process also may not be complete, due to the singular collection interval and time limitations of participants. The data analysis process needed to be ongoing, responsive, timely, and thorough. Finally, questions arose as I began the data analysis that I did not predict before beginning the research process.

Chapter 1 Summary

Geographically-isolated rural students are less likely to pursue and persist through postsecondary educational opportunities (Zinth, 2014). Yet, the need to be prepared to thrive in a global economy becomes more significant with each generation. Geographically-isolated rural students are at a disadvantage compared to their nonrural counterparts. Rural school educators are charged with the social responsibility of closing the gap in social capital resources that inhibit the likelihood of students successfully preparing for their future.

In this study, I examined how geographically-isolated rural school educators teaching in the SRHS program of studies overcome discrepant social capital resources and communities of practice. Previous research supports open scientific inquiry and social constructivist pedagogical approaches to increasing independent thinking within the learning environment (Hsu & Espinoza, 2017). Understanding how SRHS geographically-isolated rural school educators establish and support their students within their teaching and learning environment potentially benefits other geographically-isolated rural school educators and their students.

My research dissertation consists of five chapters. In Chapter 1, I introduced the topic, described the problem that I addressed, and provided an overview of the research for the reviewer. Chapter 2 includes an explanation of the conceptual framework, community social capital for my study. A comprehensive literature review supported the conceptual framework and proposal. In Chapter 3, I describe my methodology and the tools I used to support the data collection process. Chapter 4 is a presentation of the data as it relates to the identified themes and subthemes. Finally, Chapter 5 is an examination of the themes and what it means to educational practices specific to geographically isolated rural school educations and in general to all practitioners teaching dually-enrolled programs and/or science research classes to high school students.

Chapter 2: Literature Review

Introduction to the Literature Review

Opening. As a first-generation college student hailing from a small rural school and an educator who has dedicated her career to serving school populations throughout rural communities in New York State, I empathize with the challenges rural educators face when preparing students for the experiences they will encounter beyond their high school years. High schools in the United States, including rural high schools, are expected to educate students so they are prepared to enter into a global market economy (NAFSA, 2011; U.S. Department of Education, 2016). In today's economic and political climate, high schools are rated using outcome measures; these measures indicate how well they are doing with preparing their students for postsecondary college and career programs (NAFSA, 2011; U.S. Department of Education, 2016). This adjudication has unique challenges for geographically isolated rural schools, as evidenced by measures such as proportionately less postsecondary college and career-program student enrollment and completion percentages (Byun, Irvin, & Meece, 2015; Marré, 2014; USDA, 2017).

The challenges of preparing rural school students for their postsecondary pathways are not insurmountable, and rural school educators are addressing these challenges. However, rural communities are isolated from the extensive community resources and assets afforded to nonrural counterparts. These social resources and assets include higher education institutions, research associations, cultural galleries, business partnerships, and cross-generational learning opportunities. It is through social resources and assets that humans engage with each other for social learning purposes resulting in social networks and the establishment of social capital

(Shaheen, 2017). Social capital results when networks with shared norms, values, and understandings form in a manner which supports cooperation within and among groups (Shaheen, 2017). Without social networks and cooperative groups, geographically isolated rural schools and their students involuntarily experience restricted social capital (Kerstetter, Green, & Phillips, 2014). Geographically challenged rural school educators often find themselves in the unique position of channeling the social resources and networks available to their students within their community as well as reaching out and harnessing the social resources and networks beyond their rural school's geographic community. Through useful cultivation social resources and networks, educators can generate social and human capital for their students.

One intentional approach used by rural school educators to overcome deficits in social capital is to develop communities of practice. Communities of practice form when people share a concern or an enthusiasm for what they do or study; this affinity brings them together as a group that interacts regularly and learns through shared knowledge and inquiry (Wenger, McDermott, & Snyder, 2002a). This intergenerational knowledge sharing through communities of practice by creating community networks and support systems builds social capacity and grows social capital (Cumming-Potvin & MacCallum, 2010). Some geographically isolated rural schools have successfully collaborated with their communities to provide their students with learning experiences and opportunities that meet the goals of the students and educators as well as accomplishing community development (Harmon & Schafft, 2009). These learning experiences are often research supported contextualized, career-themed programs of study which have strong connections to postsecondary programs and may also be dual-enrollment programs of study with trade schools, colleges, and universities (Castellano et al., 2016; Conley, 2010; Harmon &

Schafft, 2009; Plank, 2001). Educators of these programs facilitate learning experiences by establishing communities of practice where learning occurs through the social interaction of students and expert learners.

Study topic. In this chapter, I discuss the matters of geographically isolated rural school communities, teacher efficacy, teaching methodologies within the context of social constructivist, inquiry-based Science, Technology, Engineering, Art & Agriculture, and Mathematics (STEAM), career and technical education (CTE), professional development, and dual-enrollment program of studies. In general, there is conformity that dual-enrollment STEAM/CTE programs of study help students to acquire the academic, soft skills, and technical skills needed to pursue their education for success in the career field they have chosen. This conformism is apparent for all socioeconomic levels (Lukes, 2014; Schneider, Kirst, & Hess, 2003; Vilorio, 2014). Understanding scientific vocabulary, practicing scientific inquiry, and possessing the mental ability to meet the challenges of college-level coursework are crucial skill sets required to attain persistence and success in college-level science coursework (Chittum & Jones, 2017). Unfortunately, university science faculty report that students are often unready for this level of rigor (Wilcox, Kruse, & Clough, 2015). For this reason, my research focused on how educators support their students through communities of practice in the procurement of immediate, but limited community resources as well as more remote resources, to establish social networks for the advancement of students' learning in STEAM/CTE skills and content. These strategies and resources, when working concurrently, have the opportunity to add to the expansion of the existing social capital of the students, school, and community (Kerstetter et al., 2014).

Context. Despite an increase in dual-enrollment programming, geographically isolated rural high schools still face inequities in preparing their students for college and careers. These inequities include insubstantial community social capital networks and scarce resources, which pale in comparison to their nonrural counterparts' sizable community social capital networks and robust resources (Byun, Meece, Irvin, & Hutchins, 2012). The challenge for geographically isolated rural educators is to impact student outcomes, with the goal of ultimately producing global ready citizens.

Rural school communities and practitioners must prepare their students to be globally competitive learners. This preparation includes a well-rounded education in the STEAM/CTE fields (Schneider et al., 2003; Vilorio, 2014). Rural schools must also develop the academic, soft skills, and technical skills needed for their students to become successful personally, socially, and economically beyond high school (Harmon & Schafft, 2009; U.S. Department of Education, 2016). Keeley (2007) defined human capital, "as the knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social, and economic well-being" (p. 29). Interpersonal and intrapersonal skills that promote successful executive functioning through personal, social, and professional life situations characterize human capital. Human capital develops through social capital (Kerstetter et al., 2014). Geographically isolated rural schools must be creative and flexible in their approach to secure social capital to meet the human capital development needs of all of their students (Aidman & Baray, 2016; White & Corbett, 2014). Our global economy necessitates that rural schools produce students with adequate human capital to be successful in their postsecondary experiences (NAFSA, 2011).

Communities of practice support the utilization of both social and human capital and help to develop additional social and human capital.

Significance. The results of this review are significant when used to inform future dual-enrollment programmatic decisions, specifically in STEAM/CTE programs of study. The results assist in the identification of the professional development necessary to support scientific research, dual-enrollment programs. Geographically isolated rural schools have unique challenges to address when preparing their students. Rural school populations lack the depth of place-based research afforded to nonrural populations (Lavalley, 2018). Examining the influence of communities of practice on mediating the adverse effect of geographic isolation on the achievement levels of rural school, science research students might offer significant insights to rural school practitioners (Byun et al., 2012; Turley, 2009). Wenger et al. (2002a) defined communities of practice as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (p. 4). Ultimately, this research study leads to the opportunity to share the identified use of social constructivist methodology and methods of scientific inquiry in developing communities of practice with other geographically isolated rural school educators.

Problem. Geographically isolated rural school systems lack community resources and social networks resulting in a lack of naturally occurring communities of practice, which support students and the school systems as compared to their nonrural counterparts. Rural populations are frequently isolated and left out of mainstream opportunities imparted to urban populations (Duncan, 2001; Lavalley, 2018). Rural school educators often need to build the communities of practice necessitated by students to scaffold their academic learning (Byun et al., 2012). Even

with rural school teacher encouragement of student achievement, the motivation of the geographically isolated rural student population is dampened by the rural community context and the outside nonacademic influences on students. Unfortunately, research has demonstrated the rural community context, and outside influences can often inhibit the development of naturally occurring social networks and communities of practice which lead to social capital development (Roscigno, Tomaskovic-Deey, & Crowley, 2006).

Additionally, geographically isolated rural school students tend to be located in high schools with less desirable learning environments, which might include fewer physical and learning resources and less qualified teachers (Lavalley, 2018; Pretlow & Wathington, 2013). Performance indexes have documented this disparity. All too often the most underprivileged, rural student populations in the United States are also located in schools with poor performance indexes (Tieken, 2016; USDA, 2017). These performance indexes indicate lower educational achievement levels and higher dropout rates than nonrural peers (Roscigno et al., 2006). Geographically isolated rural schools face challenges in implementing high-quality knowledge-building programming, which leads to overcoming low achievement levels and high dropout rates. These challenges center on social capital resource availability including instructor expertise, program costs, experiential background, generational poverty, and geographic isolation and can lead to a deficit of human capital (Byun et al., 2012; Tieken, 2014). The problem is geographically isolated rural school students do not have equitable social capital, human capital, and naturally occurring communities of practice to support learning and knowledge acquisition.

Organization. Following the introduction to the chapter, I began by considering the conceptual framework of communities of practice as it interacts with social capital and human action to advance community and educational achievement. The development of this chapter includes a structured literature review of current rural schools research as it relates to achievement and equity. I discuss the topics of dual-enrollment and college partnerships, social constructivist, inquiry-based science instruction, teacher efficacy, and professional development as these topics relate to the SRHS program of studies I am exploring. The SRHS program of studies is a dually-enrolled program of studies based upon social constructivist pedagogical teaching principals, and open inquiry-based science instruction. Teachers of the SRHS program of studies are likely to possess a high-level of teacher efficacy in order to maintain longevity in their tenure as an adjunct professor in the SRHS program of studies. SRSHS are likely to participate in ongoing professional development related to the SRHS program of studies. I included a review of the research and methodological literature and a review of methodological issues connected to these topics and the study. The chapter also includes a synthesis of the research findings, followed by a critique of previous research. A summary of the chapter completed this chapter.

Conceptual Framework

The conceptual framework underpinning my research study is the acquisition of knowledge through communities of practice, and the reciprocal relationships communities of practice have with social capital and human capital. Communities of practice are defined as informal groups of people who are bonded together to share knowledge, to heighten learning, and acquire additional knowledge (Wenger-Trayner & Wenger-Trayner, 2015). According to

Wenger et al. (2002a), “A community of practice itself can be viewed as a simple social system” (p. 1). Examining the relationship or simple social system between social capital, human action, and communities of practice is central to understanding the process of knowledge acquisition within the teaching-learning environment (Pyrko, Dörfler, & Eden, 2017). Additionally, the extent to which social capital is available and accessed by individuals and communities influence how social networks develop, which in turn, influence how humans interact, and how communities of practice arise (Abou-Zeid, 2007). Examining learning through the community of practice conceptual framework broadens the perspective by examining the relationships the social learner has with their social world, by looking beyond knowledge attainment purely within the individual. This conceptual framework aligns with the research question I am seeking to explore; that is, how SRHS teachers utilize social capital and human action to establish, support, and facilitate the growth of communities of practice which support student knowledge acquisition. The conceptual framework of utilization of communities of practice for knowledge acquisition relates to the problem of geographically isolated rural schools and the marked absence of social capital and human capital. The SRHS program of studies necessitates that students network beyond their immediate classroom learning environment with experts in specific fields of study. Students must first develop a working knowledge of the specific field through a thorough literature review process. Throughout the literature review, students converse with several experts and share their newly acquired knowledge with peers, their teacher, and community members. Ideally, as students pursue their inquiry, learning leads to a more in-depth knowledge base, and expert conversations become collaborative and cooperative, characterizing a community of practice. By virtue of geographic isolation, rural school SRHS educators and

students lack the social capital, human capital, and naturally occurring communities of practice that their nonrural counterparts have in their immediate environments. Therefore, the conceptual framework of knowledge acquisition through communities of practices supported my research study, where I examined rural, secondary school SRHS educators' pedagogical practices within their teaching-learning environments.

Relationships between social capital and human capital. Seminal researcher, Coleman, recognized the close interrelationship between social capital and human capital (Social Capital Research & Training, 2018). Social capital resources function to assist humans to achieve their interests and are especially vital to building human capital. Coleman (1994) primarily focused on researching the educational achievements of underprivileged students. "Social capital is the set of resources that inhere in family relations and community social organization and that are useful for the cognitive or social development of the child or young person" (Coleman, 1994, p. 300). Social capital can have a positive impact on knowledge acquisition, and the sharing and use of knowledge (Lesser & Prusak, 2000). The complex, reciprocal relationship between social capital, human capital, and communities of practice leads to the development and expansion of existing social capital and human capital (Manuti, Impedovo, & De Palma, 2017).

Development of social capital. Social capital allows one to access resources. It is up to the individual to access social capital. Rogošić and Baranović (2016) expanded upon Bourdieu's (1992) belief that the amount of social capital an individual holds is dependent upon how well the individual can navigate the social network to optimize the social capital held in the network. All types of capital, cultural, human, and social, are unevenly distributed, mobilized, utilized,

and transformed; capital in conditions where individuals do not have the ability to connect within networks is not likely to offer development opportunities for society (Wiesinger, 2007). In conditions where individuals can connect within their network, it is likely social capital is an asset. Studying successful access to capital and the development and acquisition of capital networks aids in the development of rural educational programming.

In order to build social capital, investments in social relations are made with expected returns whereby people learn from each other in a purposeful way to improve knowledge (Fullan, 2014). The benefits to the development of social capital include making a difference in societal cooperation, coordination, and collaboration, likely leading to economic wellness, political activeness, effective governance, increased health and wellness, and educational accomplishment. School leadership must invest in both social capital and human capital and the interactions between the two to develop resources that lead to schoolwide success (Fullan, 2014).

Community development of resources and social capital can be mutually supportive of each other (Jordan, Anil, & Munasib, 2010; Rogošić & Baranović, 2016). An assortment of economic benefits at the micro and macro level can be obtained by accessing social capital through cooperation, collaboration, and coordination (Jordan et al., 2010). My research is at the micro level. I am examining how educators utilize social capital, human action, and communities of practice to develop educational success for geographically isolated rural students within the scientific research environment.

Structuration model of social capital, human action, and communities of practice. Abou-Zeid (2007) introduced the structuration model of social capital, human action, and communities of practice; this research remains the authoritative source on this topic and is a

seminal work critical to any discussion of the model. Abou-Zeid's (2007) model demonstrates that communities of practice exist through human action; communities of practice are a result of human action and also provide a means for human action to occur.

Manuti et al. (2017) considered communities of practice as learning spaces, where individuals find full expression through a collective agency to manage their most precious capital, knowledge. The human action within the community of practice requires learning language through communication that might appear in different forms including apprenticeship, collaboration, and negotiation (Abou-Zeid, 2007; König, 2013). Communities of practice allow for a check and balance system to occur, which helps to facilitate and constrain human action. Social capital acclimatizes the community of practice and influences how human actions and relationships initiate and develop within the community of practice (Abou-Zeid, 2007; Lave & Wenger, 1991; Wenger & Snyder, 2000). The interaction of social capital and human action within the community of practice can lead to a net increase of social capital (Fullan, 2014; Pyrko et al., 2017), through the increased of knowledge (Manuti et al., 2017).

Characteristics of communities of practice. It is appropriate to characterize communities of practice as social learning systems because communities can develop for intentional or incidental learning reasons but this does not mean the community is a community of practice (König, 2013; Wenger-Trayner & Wenger-Trayner, 2015). A practical example of this may be a school district's board of education. The community establishes the board for the benefit of the school district and community, but it requires no knowledge base to become a member or sustain membership. Members of the board increase their knowledge base through purposeful and incidental learning. However, board members act intentionally through their

perspective and personal agendas, which may or may not align with the rest of the board members and the school district. Although a sense of community might exist among board members, there is rarely the development of a community of practice (see Wenger, McDermott, & Snyder, 2002b).

Wenger-Trayner and Wenger-Trayner (2015) identified three essential characteristics of a community of practice: the domain, the community, the practice. The domain constitutes the shared commitment and a level of expertise within the community of practice (Wenger-Trayner & Wenger-Trayner, 2015). Although the domain might not be recognizable to outsiders, it is known and valued by the members of the community of practice. Members of the community of practice share value for their collective competence and realize the social learning value they offer each other (Wenger-Trayner & Wenger-Trayner, 2015).

Within the community of practice, there needs to be a collaboration with one another. The social context of learning is based on John Dewey's early work, whereas learning only occurs within the context of social networks and relationships (Kapucu, 2012). Timetables do not define these social interactions; instead, members of the community of practice determine them (Kapucu, 2012). These interactions serve to assist members of the community of practice in supporting each other and with sharing information through activities and discussions (Wenger-Trayner & Wenger-Trayner, 2015). The interactions among the members of the community of practice are necessary for the advancement of knowledge.

Members of a community of practice are practitioners. Their work together is ongoing; through it, they develop a repertoire of resources (Wenger-Trayner & Wenger-Trayner, 2015). This characteristic of a community of practice is the value-added component and is an integral

part of the membership. Members of the community of practice would not be able to hone their practice to the level of expertise they envision without the support and combined wealth of knowledge they receive through the membership. The value lies within the collective membership and the explicit and implicit synergy, which outpours from the community of practice (Abou-Zeid, 2007; König, 2013). Developing these three characteristics together is what leads to the realization of a community of practice.

Communities of practice often participate in a variety of activities, which support the development of these characteristics or emerge in the presence of these characteristics. These activities include problem-solving, requests for information, authentic experiences, reuse of assets, coordination and sharing of resources, discussion of developments, documentation and validation, knowledge mapping, and gap identification (Wenger-Trayner & Wenger-Trayner, 2015) These activities are led and engaged in by the members of the community of practice, rather than led and initiated by an outsider.

Establishment of a community of practice through facilitative leadership. According to Kapucu (2012), "Before any community of practice can be created and functional, clear leadership should be established for the initiation and continuation of the process" (p. 587). The nature of communities of practice requires this leadership to be collaborative or shared in nature. Kapucu (2012) identified these main roles of a community of practice leader, to initiate, to develop, to manage, and to monitor; within these roles, it is critical to establish a community of practice that promotes safe risk-taking participation. Pilkington and Walker (2003) shared the importance of the guide's role in modeling techniques for critical inquiry and creating a safe environment where participants feel comfortable in engaging with one another. The process of

thinking together about real-life problems is what makes communities of practice succeed; it is about redeveloping knowledge through a sustained effort, rather than a transference of knowledge (Pyrko et al., 2017).

The facilitative guide of a community of practice has a pivotal role in establishing the community of practice through a shared, collaborative leadership philosophical approach. Through shared, collaborative leadership, educators have the opportunity to affect student achievement within the context of building human capital through increased networks of leadership capacity. Shared leadership potentially builds the interpersonal and intrapersonal skills of self-knowledge, social maturity, personal resiliency, and civic development within students (Lambert, 2002). Facilitative guides of communities of practice have the opportunity to successfully nurture and prepare high school students for their postsecondary experiences.

Learning within the focus of scientific communities of practice. The value of a community of practice's effectiveness is measured through the outgrowth of the learning that occurs. Wenger (2005) theorized learning in the context of social participation; individuals become involved in a community to engage in activities, which help to identify themselves as the learners and to interpret the world around them. Social learning provides a bridge between formal learning (one-way delivery of content) and informal practice (unstructured, hands-on activities) (Kapucu, 2012). Communities of practice share knowledge only in the manner that tactic knowledge is regenerated as the members of the community of practice discover one another's practices of knowledge, thus learning from each other, rather than being merely learned and reproduced (Pyrko et al., 2017). The social process of learning becomes inseparable from the process of learning when a community of practice is established.

Social interactions are fundamental elements in scientific learning. Scientists frequently work in communities of practice, observing scientific manners of thinking, talking, acting, and writing (Girod, Twyman, & Wojcikiewicz, 2010). A community of practice that focuses on scientific learning engages its members in the conventions and practices of the science community. The six composite attributes generally recognized as part of the conventions and practices of the learning science process are scientific learning is naturally inquiry-based (uses the scientific method), tentative (no absolute), developmental (builds on the findings of others), subjective, creative, and collaborative (Forbes & Skamp, 2013; Girod et al., 2010). In order for scientific learning to occur, students need to experience these six composite attributes within a community of practice that consists of current practitioners and intermediate and master scientific knowledge experts.

Review of Research Literature and Methodological Literature

Over the last two centuries, rural schools have undergone significant changes in oversight and structures through consolidation, desegregation, and closure movements. Characteristics of rural communities might include some or all of the identifiers named by White and Corbett (2014): geographic isolated, sparsely populated, distance from services, limited cultural diversity, low socioeconomic status, restricted access to resources, and transient populations. All these identifies can be indicators of decreased community social capital networks and create obstacles to cultivating communities of practice. Within these identifiers are embedded complicated relationships between the schools, their communities, and governing entities.

Education plays a vital role in rural development as well as a lack of education plays a vital role in rural underdevelopment (White & Corbett, 2014). Observing the rural school

identifiers named by White and Corbett (2014) is key when evaluating the transferability of practices; it is often difficult for teachers to recognize and understand these cultural practices, which might put their teaching practices in conflict with the norms, values, beliefs, expectations, and emotional responses of the students they are teaching.

Communities of practice in secondary educational programs. Studies examining the secondary high school classroom environment as a community of practice are minimal. However, studies that analyze communities of practice as professional development support for teachers (Fullan, 2014; Kapucu, 2012; Lesser & Prusak, 2000; Monaghan, 2011) and studies that examine undergraduate and graduate student communities of practice (Kapucu, 2012; König, 2013; Monaghan, 2011) are much more prevalent. These studies support the value-added benefits of learning within the social context; focusing on developing a community of learners who are solution-oriented, collaborative, inclusive, responsive to their environment, and desire to prompt positive change (Kapucu, 2012). Through their active membership in professional communities of practice, teachers have the opportunity to identify as a member of a profession and organization by paralleling their learning experiences through the facilitation of communities of practice within their classroom environments (Monaghan, 2011).

Most of the studies that investigate high school teachers leading and facilitating communities of practice in their classroom environments are often performance or project-based and focus in the areas of art/music and science. Hsu and Espinoza (2017) examined a partnership with high school students and university scientists where the experimental group of students was involved in a seven-month internship experience with the scientists. The model is built on the principles identified by Wenger and Snyder (2000) to develop a community of practice. The

students worked with two to three other students, the scientist, and university level students in a collaborative manner. The results indicated that the students who participated in the internship developed a stronger sense of autonomy in their learning. The researchers identified three design principles, which likely contributed to this sense of autonomy; students were able to complete open-inquiry projects with expert support, students were able to participate in co-generative dialogues to address concerns and share findings, and students were supported in sharing their scientific findings publicly (Hsu & Espinoza, 2017). The involvement of multiple members of the community in this initiative contributed to the success of this initiative.

Two other researcher pairs explored scientific argumentation within the classroom community of practice. Berland and McNeill (2010) defined scientific argumentation "as a social practice in which members of a community make sense of the phenomena under study proffering, evaluating, critiquing, challenging, and revising claims through discourse" (p. 192). They scientific argumentation entails three overlapping goals, to construct and explain claims, present arguments, and evaluate and critique the ideas of others while defending your own. Berland and McNeill (2010) found that as students became more entrenched into the scientific argumentation process, these goals became more fluid and aligned, resulting in only argumentative discussions, which led to an establishment of a community of practice among the student scientists.

González-Howard and McNeill (2016) studied the engagement of English-learning students in science argumentation practices; they suggested that a teacher must consider the importance of attending to certain aspects when facilitating a community of practice and the specific pedagogical shifts required when implementing a community of practice. Aspects that

required specific attention included the integration of new members into the community of practice, the value of student-peer modeling, and the benefits of temporary smaller grouping within the community of practice for construction and refinement of knowledge (González-Howard & McNeill, 2016). The pedagogical role of the teacher changes when establishing a community of practice learning classroom. The teacher is no longer the distributor of information; instead, they become the educational planner, the learning coordinator, of a multifaceted, supportive environment (Virkkula, 2016).

Rural school research. Rural America is vast, diverse, and stratified by race and class. Rural American students make up 20% of the United States of America's student population (Tieken, 2014). Two different myths often dominate the cultural suppositions of America's political affray. The first is about ignorance, backwardness, and lawlessness. The second is about uncomplicated simplicity and romantic nostalgia (Tieken, 2014). Neither is accurate, and both ignore the complexities and realities of rural life and education. These misunderstandings lead to a marginalization of rural schools and students through a perpetualization of overgeneralized political reforms based on unfounded or insufficiently researched problems (White & Corbett, 2014). Rural schools and communities have not benefited from solid, methodological research connected theoretically to the needs of its members (Schafft, 2016). Chittum and Jones (2017) cautioned that the generalization of results from students who vary significantly from the participants in a study is not advisable.

The research literature on rural schools and rural students is limited and varied in its claims. This limitation and variation are explained by the wide-ranged context of rural schools themselves, often referred to as a *sense of place*. It is this sense of place that gives rural schools

the ability to work within the context of their community and build social capital networks within their community to improve the educational processes (Bauch, 2001; Biddle & Azano, 2016; Eppley, 2015; Greenough & Nelson, 2015; Misra, Grimes, & Rogers, 2013). “Rural schools today face a unique blend of contextual strengths and challenges that differ from nonrural schools and significantly impact high-level educational opportunities and outcomes for students” (Parsley & Barton, 2015). This renewed sense of place provides researchers and educators the impetus to look more deeply past the nonrural school systems as models, and focus inwardly on the immediate community, which they serve. This continuous change and need to adapt is referred to as *the rural school problem* (Biddle & Azano, 2016).

The research literature supports several characteristics of the rural school problem. In general, rural region residents have less economic opportunities due to jobs offering lower wages and inferior benefit packages, smaller family income rates, and a higher poverty rate (Lavalley, 2018). Formal education markers such as achievement beyond high school, college entrance exams results, aspirations to attend college, and attainment of college degrees are all lower, although high school completion rates are higher (Bauch, 2001; Fink, Jenkins, & Yanagiura, 2017; Pierson & Hanson, 2015; Showalter, Klein, Johnson, & Hartman, 2017). Social connections tend to be stronger; though, relationships and connections with other people will often prevent migration (Sherman, 2006). Affinity within a community is relatively common, whether it be homogenous by race, religion, or socioeconomic status. However, economic and social stratification might be more visible in rural student populations (Future Ready Schools, 2017; Sherman, 2006; Wiesinger, 2007). Rural schools tend to have smaller enrollments and might have a relatively large transient population (Paik & Phillips, 2002). Finally, rural schools

often lack technology infrastructures, resources, and funding that is available to nonrural counterparts (Byun et al., 2012; Future Ready Schools, 2017; Herman, Huffman, Anderson, & Golden, 2013).

One of the overarching issues facing all rural schools is the matter of out-migration or *rural brain drain*, which directly conflicts with the inward focus on the rural community and building social capital networks (Petrin, Schafft, & Meece, 2014). Rural brain drain is the out-migration of the most academically talented youth with the highest educational aspirations; whereas, the youth left behind to tend to have fewer skills and less educational aspirations, ultimately leading to less income generation potential (Petrin et al., 2014). The ancillary impact of this *rural brain drain* can result in a localized devaluing of the educational system (Petrin et al., 2014). The experience of growing up rural compounds rural brain drain. Growing up rural emphasizes the importance of connectedness and personal relationships with friends and family (Sherman, 2006; Tieken, 2014). Rural school students tend to weigh their perceived conflicts of achieving postsecondary education, economic mobility, professional achievement, against their attachment to home and the rural community in which they grew up in (Petrin et al., 2014; Tieken, 2014). Rural brain drain is a significant problem facing geographically isolated rural schools.

The role of the rural school educator also takes on a different construct than their nonrural colleagues. Rural schools are challenged to attract stronger talent than nonrural schools, thus hiring teachers with less selective educational backgrounds (Hargreaves, Parsley, & Cox, 2015; Lavalley, 2018). Teacher candidates from rural school communities maintain very close community ties and are less likely to enroll in selective educational programs (Lavalley, 2018).

Often the *growing your own* system perpetuates the academic barrier gap problem (Lavalley, 2018). Additionally, rural schools tend to hire teachers who are younger, less experienced, lower paid, receive fewer benefits, and are more likely to take on second jobs (Lavalley, 2018). Retaining the best talent is also an issue. The most talented young teachers frequently build an experiential background and relocate to more attractive suburban opportunities where teachers can support and stimulate each other through more accessible social capital (Future Ready Schools, 2017; Hargreaves et al., 2015). Finally, retention practices supervised by rural school administrators might be less rigorous due to the lack of highly qualified candidates to fill vacant positions (Lavalley, 2018).

Conversely, there are more opportunities for relationships to develop among rural school educators and their students and families (Petrin et al., 2014). Rural school administrators need to recognize and build upon these relationship opportunities. New teachers will most likely be successful when the rural school administrator explicitly informs the new teacher of their teaching expectations and shares the social subtleties and expectations of the school community (Fry & Anderson, 2011). Coursework in place consciousness of rural conditions and student teaching experience in rural settings also helps to enhance overall satisfaction, effectiveness, and longevity of teacher retention in rural schools (Fry & Anderson, 2011).

Over the past half-century, rural schools have become more professionalized and centralized; nonetheless, resulting in distancing from the community they serve. This distancing has hampered the connections and scaffolding that occurs when experience, work, and education are functioning together (Kretzmann & McKnight, as cited in Miller, 1995, p. 164). Notwithstanding, the last decade has witnessed a shift in thinking regarding the role of the school

and community. Educators are viewing education in a more holistic framework with school professionals beginning to consider avenues to link their students with their communities including programs such as internships, mentorships, workforce development, dual-enrollment, early college programs. These initiatives join work experience with education. Rural school educators can build capacity and sustainability through the establishment of working partnerships with its local leaders and residents (Miller, 1995, p. 171). Collins, as cited in Eppley (2009) established that local community involvement reduces turnover in faculty, indicating rural districts should take a proactive role in developing the relationships that engage both students and faculty within school-community partnerships. Sustaining these changes and linkages in order to grow communities of practice within rural communities is the task of school and community leaders, researchers, and policymakers.

Dual-enrollment and college partnerships. For the purpose of this study, I defined dual-enrollment as simultaneous enrollment in high school and college coursework. Dual-enrollment courses might expand students' social networks because of access to more comprehensive community resources, specific exposure to a college or university system. Selsky and Parker (2010) defined cross-sector partnerships as two or more organizations contributing resources, which allows a task to be completed that could not have been as easily or likely completed by one of the organizations on its own. These resources include personnel, money, time, space, capabilities, and social networks. Increased academic rigor, academic choice, and financial savings gained through dual- enrollment programs provide social and human capital benefits to students. Dual-enrollment programs have grown in availability over the last decade, and educator usage has increased as an avenue to prepare students for college and careers

(Marken et al., 2013). As high schools strive to increase their rigor and improve the connections between secondary educational experiences and postsecondary programs, dual-enrollment programs assist in meeting these aspirations (Karp, Calcagno, Hughes, Jeong, & Bailey, 2007).

Multiple analyses indicated that dual-enrollment has benefits, which include reduced college costs, decreased need for remediation at the college-level, reduced time to degree completion, increased 2-year college matriculation, and increased securement of two degree/certificate programs (Lapan, Poynton, Marcotte, Marland, & Milam, 2017). An (2013) found "lower socioeconomic status students benefit from dual-enrollments as much as their high socioeconomic students" (p. 407). Greater attention towards providing students with extensive opportunities for simultaneous high school and college enrollment is driven by the goal to offer stronger academic rigor and provide high school students and their parents with more educational choices (Dodge, 2012).

Some researchers argue that dual-enrollment curriculums are often more rigorous than general high school curriculums and can lead to an increased high school retention rate while providing a buffer from the rising cost of tuition by shortening the time required to achieve a 4-year degree (Ganzert, 2014; Karp, Bailey, Hughes, & Fermin, 2005). An's (2015) study found "students who participated in dual-enrollment programs are more academically motivated and engaged than their nonparticipants" (p. 98). Additionally, An (2015) noted that students enrolled in mid-selective and very selective institutions were more likely to have higher first-year GPAs when they have completed dual-enrollment studies; he found no correlation between first-year GPAs and dual-enrollment status for students enrolled in highly selective institutions. Multiple studies sight data obtained through clearinghouses which have been statistically analyzed, as

yielding results that generally support dual-enrollment programs of study as being both academically and fiscally beneficial to lower socioeconomic families (An, 2013; Pretlow & Wathington, 2013). Ultimately, the students who enroll in and complete dual-enrollment programs of study more often complete high school, apply for and enter college, and finish their intended college degree programs, than their peers (Zinth, 2014).

However, research is limited on whether site-specific dual-enrollment programs provide the anticipated benefit of academic rigor. Ganzert (2014) also noted this concern by citing Krueger, who stated: "Conversely, researchers have questioned dual-enrollment standards, specifically concerning faculty selection, student competency, and the legitimacy of courses not offered on a college campus as part of a postsecondary curriculum" (p. 784). Programs, types of courses, specific courses are not evaluated; data are not collected and shared systemically and systematically.

One response to the disparity of college-going rates of rural low-income is to increase matriculation of rural school students in dual-enrollment, college programs. Theory exists that dual-enrollment programs can significantly benefit students from geographically isolated rural areas, when these areas are characterized by lower college entrance rates and postsecondary degree attainment rates (Zinth, 2014). There has been a marked increase over the past decade of mid-high to high poverty rural students enrolling in dual programs (Zinth, 2014). This rapid growth of rural student dual-enrollment in higher education coursework requires further evaluation of how successful dual-enrollment program educators support rural school students in their acquisition of the intrapersonal and interpersonal and readiness skills and academic content needed for college and the workforce.

Zinth (2014) recommended several implementation stratagems for dual-enrollment programming, two of which address instructor expertise. The first is to create statewide common approaches to standardizing and assuring transferability of the content and skills taught in the dual-enrollment courses through modularization (Fulton, Gianneschi, Blanco, & DeMaria, 2014). This approach enabled uniform placement at institutions receiving students who have completed dual-enrollment programs. The second recommendation is to invest in faculty professional development; it is crucial to spend time and resources into the development of adjunct faculty before initiating a dually-enrolled program of studies (Fulton et al., 2014; Lukes, 2014). Professional development prior to the start of a program of studies raises awareness of the common challenges experienced by colleagues and provide a support network for the dual-enrollment instructor, leading to an improvement in instructional consistency (Fulton et al., 2014; Lukes, 2014). There are rural schools who successfully implement the recommended strategies, aptly addressing the challenges of dual-enrollment programming and increasing their student enrollment in dual programs, resulting in productive and high-quality student completion (Fulton et al., 2014).

Social constructivist methodology in science education. Social constructivist is a teaching and learning theory, which involves social and human capital features including: the learners' cultural experiences, the learning context, the learners' level of literacy and language, the learners' interests and needs, the learners' personal experiences, the learners' interpretation of reality, as well as their application of knowledge (Mogashoa, 2014). The teacher/researcher can analyze these social and human capital features to determine their impact on teaching and learning processes.

Social constructivist is an influential pedagogical theory among practitioners in today's education profession. Social constructivist theory supports the proper scaffolding of the learner so that the individual can advance their use of learned strategies and concepts and extend this learning into analogous strategies and concepts in other contexts (Hiebert & Raphael, 2013). Recent attention to the evaluation of teacher expertise in the classroom has emphasized social constructivist pedagogical theory exhibition in the classroom (Krahenbuhl, 2016). According to Danielson (2007), "Social constructivist theory is now acknowledged by cognitive psychologists as providing the most powerful framework for understanding how children (and adults) learn" (p. 15). A majority of teachers use social constructivist methodology and scientific inquiry methods as a means of engaging their students within the learning environment on a daily basis.

Within the social constructivist classroom, educators emphasize the importance of engaging students through language to develop communities or practice. The educator facilitates engagement of the students in discussion, whether it has the form of teacher-directed, student-directed, small group, or large-group work. Social constructivist theory purports the active engagement of the student in the learning content and underscores the collaborative nature of the active involvement within the social context of the science-learning environment, connecting the essential co-development of thought and language (Vygotsky, 1978). Vygotsky (1978) stated that "learning awakens a variety of internal developmental processes that can operate only when a child is interacting with people in his environment and cooperation with his peers" (p. 90).

Hein (1991) initially identified guiding principles of social constructivist learning; these principles have been supported through the years in educational research. Social constructivist learning requires active engagement in the learning process (Hein, 1991; Masciotra, 2004).

Through this active engagement the learner to constructs meaning and systems of meaning; the learner's mind constructs meaning which is the crucial action (Masciotra, 2004; Taylor, 2014). Learning methods that allow physical activities and hands-on experiences are used as the means to engage the mind (Hein, 1991; Marra, 2005; Masciotra, 2004). Learning also requires language, and the language that we use is what influences the learning (Hein, 1991; Mogashoa, 2004). Our learning occurs through social interactions with others, transpiring in the context of what we already know and believe, and under the influence of our prejudices and fears (Marra, 2005; Mogashoa, 2014; Taylor, 2014). Learning builds upon our previous knowledge, involves time, and requires motivation (Hein, 1991; Mogashoa, 2014). These principles of social constructivist learning guide the pedagogical approaches taken by the social constructivist teacher. Social constructivist is not limited to one pedagogical approach. However, some pedagogical approaches do not lend themselves to the principles of social constructivist (Hein, 1991; Taylor, 2014).

Teachers that practice social constructivist provide autonomous learning opportunities for students. These practitioners aim to raise the learners' level of adaptation and autonomy in real-life situations, taking into consideration the learners' experience and prior knowledge. Lesson complexity needs designing, so it is appropriate to the learners' capacities to learn. Social constructivist theory centers on the learner but recognizes the role the learner's social environment plays in the advancing the learner's understandings and knowledge. Social constructivist pedagogical practices are characterized as including active, experiential learning situations, adapted differentiated learning to the learners' needs, and construction of structured, expanded and diversified learning opportunities (Mogashoa, 2014). Teachers and learners must

reflect on the action of learning. The perspectives of all learners are considered in a manner that advances the knowledge of all of the learners (Masciotra, 2004).

Of particular interest is Vygotsky's (1978) Zone of Proximal Development (ZPD), which assumes that cognitive growth first occurs on a social level and later on an individual level. ZPD helps us in understanding the role of teacher instructors as facilitators within social constructivist theory. The teacher is the facilitator and begins by providing support and help for the learners, and then the gradually decreases their support provided to the students (Taylor, 2014). We offer students the opportunity to express their thoughts and ideas through language and to test the viability of these thoughts and ideas with those of other students (Taylor, 2014). Learning with your peers can be a powerfully socializing process. It builds social capital by evoking deep emotional relationships with others, providing significant emotional ties (Taylor, 2014).

With social resources in collaborative learning, students develop social inquiry skills. These soft skills incorporate active and empathic listening, learning the give/take act of conversations, strategic problem-solving and critical analysis of issues, and negotiation of solutions and conclusions to scientific inquiries (Taylor, 2014). Social constructivist theory supports the utilization of social resources within the learning processes to bring about new learning to the student. The student can draw upon what they know and apply this knowledge to the context of the new learning. "The only good learning is that which is in advance of development" (Vygotsky, 1978, p. 89). The metacognitive skillsets of students develop through these reflective thinking processes. The facilitation of reflective thinking occurs when the teacher develops methods to encourage active contribution to classroom discussions and active listening to other students' questions and responses (Taylor, 2014). These processes support the learners

in developing an ability to self-assess the presuppositions of prior knowledge, reframing knowledge, and developing new concepts (Taylor, 2014).

Some opponents of social constructivist base their criticisms on the theory of objectivism. Objectivism advocates that we transfer the truth in a meaningful way to the individual and that truth exists independent of the learner (Krahenbuhl, 2016). Objectivism recognizes the difference between how a novice and expert learn, thus challenging the social constructivist pedagogical principle of building knowledge through language and thought, noting that novices lack the experience and background to construct new knowledge fully. This lack of experience and expertise can lead to inaccuracies and fallacies that end up being stored in long-term memory (Kirschner, Sweller, & Clark, 2006; Krahenbuhl, 2016). This school of thought is in line with Marzano's (2003) and Hattie's (2009) thinking, who purported there is value in direct instruction to build individualized background and expertise as part of the larger problem-solving process within the group setting. Direct instruction might be even more critical for students who lack the experiential base because they live in deep poverty and/or geographic-isolation. A child living in poverty often has the potential to manifest problems associated with poverty through their executive functioning skills; these executive functioning skills include the ability to plan, self-regulate, attend to tasks, and retrieve and store information over time, known as working memory (Budge & Parrett, 2018).

Today's educators must use their judgment as good pedagogues, recognizing the value of diverse practices. Using diverse approaches within the classroom context even with a social constructivist presupposition offers the practitioner the ability to equip their students to meet success. To the practicing social constructivist educator, learning is situation-specific and

context-bound (Liu & Matthews, 2005). Hmelo, Duncan, and Chinn (2007) responded to Kirschner et al. (2006) through demonstration of extensive scaffolding employed through problem-based learning and inquiry learning situates. Noting, social constructivist approaches to learning and best practices allow the practitioner to build upon content knowledge, confirm knowledge, and advance knowledge. While increasing the soft skills needed for college readiness, such as collaboration and self-directed learning (Hmelo et al., 2007). The argument continues regarding how to focus on the need to build college readiness characterized by increasing content skillsets, building knowledge, acquiring problem-solving skills, enhancing self-awareness, and developing critical thinking. The social constructivist learning methodology is aligned with this argument of how to create college readiness.

Inquiry-based science instruction. As noted previously some pedagogical approaches do lend themselves to social constructivist theory. Science is a field of study, which requires an integration of language with values, knowledge, and skills. Scientists study in communities of practice through reasoning and negotiating to reach accordance (Taylor, 2014). Inquiry-based science instruction is a pedagogical approach that matches well with the ZPD theorized by Vygotsky. Inquiry-based science instruction has received significant attention throughout the newly revised Next Generation Science Standards (NGSS Lead States, 2013). Inquiry methodology is a prominent instructional practice in science education (Paul et al., 2016).

Practitioners of teacher-directed inquiry generally define inquiry-based science on a continuum. “These four levels of inquiry continuum are confirmation inquiry, structured inquiry, guided inquiry, and open inquiry” (Bell et al., as cited in Gengarelly & Abrams, 2008, p. 74). At the confirmation end of the continuum, students understand the teacher provides the believed

outcome, the procedure, and question; as opposed to the other end of the continuum of inquiry where the inquiry is entirely student directed, through open inquiry (Gengarelly & Abrams, 2008). The student develops the research question, methods, conducts the experimentation to collect the data, interprets and shares the results and provides a discussion on what the results imply as far as a solution. Minner, Levy, and Century (2010) noted that the National Research Council and National Science Education Standards identified six core components essential to inquiry from the learner's standpoint, learners must question the scientific orientation, examine evidence, form explanations from the examination of evidence, evaluate explanations, consider alternative explanations, especially those that reflect greater scientific understandings, communicate and justify suggested explanations, and design and conduct investigations. Within each of these components, teachers can vary the degree of the direction they provide to their learners.

Rural environments offer rich, authentic environments for learning about science. Avery (2013) discussed the value of indigenous human ecological knowledge as having contextual specificity and complex connectivity, supporting the use of local rural knowledge to create meaningful science education. Avery (2013) recommended choosing teachers and local community individuals who are willing to consider alternative methods to teaching science and supporting discussions among individuals to develop social networks and develop partnerships with community organizations and other schools. Place-based/conscious science education in rural schools offers rural students a view into their rural community that respects and honors the rural lifestyle and its community members (Avery, 2013; Lyons & Quinn, 2012). In return, relationship building by networking rural school students with mentors in their immediate and

the broader community beyond their rural residence can have a dominant role on the aspirations of rural school students (Burgin & Sadler, 2016; Wettersten et al., 2005). According to Atwater (1996), "Social constructivist recognizes the importance of contextual values." Through the scientific inquiry process, teachers and students can evaluate scientific knowledge claims within the context of their rural social-cultural experiences, allowing the sense of *rural place* to enter within the discussion. Working with rural school students in the context of their environment in matters of rural ecosystems and agriculture enterprises has the opportunity to build personal relevance into scientific study.

One of the most prominent obstacles facing secondary science teachers' practical use of scientific inquiry is a lack of experience with the pedagogical practices. Secondary science teachers often experience content driven, direct instruction in college. This lack of experience as a learner in the scientific inquiry practices makes it challenging secondary science teachers to implement the practices of scientific inquiry within the constructivist classroom; findings also indicate, when supported by experts and resources, teachers can successfully integrate scientific inquiry into their high school curriculum (Gengarelly & Abrams, 2009). Advocates of direct instruction are unsupportive of the open inquiry, found at the far end of the scientific inquiry continuum. Ward et al. (2016) stated that "data still seem to be inconclusive on whether or not well-designed inquiry learning modules improve student learning of content over well-designed direct instruction modules" (p. 906). However, Ward et al. (2016) acknowledged that inquiry science might spark affective factors more naturally, which could promote a more positive attitude and stronger performance on scientific tasks and learning proficiency. According to Anderson (as cited in Paul et al., 2016), "With reference to inquiry learning, there is more

consensus regarding what students should learn about scientific inquiry than how they learn it or how teachers should instruct students" (p. 2370).

Teacher efficacy. Friedman and Kass (2002) defined teacher self-efficacy as "the teacher's perception of his or her ability to perform tasks and to regulate relations involved in the process of teaching and educating students (classroom efficacy)" (p. 21). This ability to perform tasks and regulate relationships supports the teacher to effectively become part of the school community and navigate the school community's political and social processes, referred to as organizational efficacy (Friedman & Kass, 2002). The second part of the definition characterizes social capital. The teacher uses their resources to get information and do their job better. Social capital is where the teacher gets, vets, and builds their knowledge. This knowledge "resides in the relationships among teachers, between teachers and principals, and even between teachers, parents, and other key actors in the community" (Leana & Frits, 2014, p. 1).

According to Siwatu (2011), "school contextual factors such as student demographic variables and the school setting [appear] to influence . . . teacher's self-efficacy appraisals" (p. 359). Organizational aspects of rural schools that affect self-efficacy include hiring and retaining issues for the smallest rural schools, below-average shares of highly qualified teachers, and an above-average percentage of non-Hispanic white teachers (Monk, 2007; Nagle, Hernandez, Embler, Mclaughlin, & Doh, 2006). Educators in rural schools are also less likely to graduate from top-ranked colleges and universities, and often have less educational attainment levels (Monk, 2007; Nagle et al., 2006; Tieken, 2016). Rural teachers typically report smaller class sizes, experience fewer discipline problems, are more likely to convey gratification towards their work experience, feel more profound autonomy, and provide stronger guidance into school

policy (Monk, 2007; Nelson, 2010; Schafft, 2016). Rural schools and educators are also often required to deal with a broader range of pupil needs, resulting in the need to have more differentiation in course content, face higher transportation costs, experience difficulty in engaging students and community members beyond the school day, and might be subjected to more frequent instances of change (Irvin, Meece, Soo-yong, Farmer, & Hutchins, 2011; Marré, 2014; Monk, 2007; Williams, 2010). Salaries of teachers in rural schools also tend to be lower (Monk, 2007; USDA, 2017). Some of these characteristics lead to overall favorable work experiences, while others can be unfavorable causing disheartening within the work experiences (Byun et al., 2015; Monk, 2007; Nelson, 2010; Schafft, 2016; Tieken, 2016).

Because self-efficacy beliefs relate to attitudes and actions, research within rural schools must consider the factors that might affect teachers' self-efficacy. Programs that support cultural understanding and approach rural education from a multi-culturally sensitive standpoint could potentially help rookie teachers become more active and connected to the rural school and its community (Williams, 2010). Teacher professional development regarding the responsibilities and roles of educators in the rural community will assist the teachers in coping with and balancing the diverse and numerous political, social, and economic pressures present in rural life (Edmondson & Butler, as cited in Eppley, 2015). This cultural understanding will enable the rural school educators to recognize all of their multiple duties and develop self-efficacy through cultural understanding.

One study conducted by Ajayi (2014) examined place-based teacher preparation in the rural school context. This study found that place-based student teaching experiences help student teachers to develop practice that empowers the specific student population they are working with

by creating a link between what is learned and the students' own lives, which is much more powerful than meeting state and national standards-based curricular mandates (Ajayi, 2014, p. 265). These attributes, in turn, allow teachers to build their self-efficacy by expanding their knowledge base, deepening their toolbox of practice, and making connections to community and cultural resources within their instructional practice (Edmondson, 2003; Friedman & Kass, 2002; Smith, as cited in Ajayi, 2014).

Finally, teacher self-efficacy correlates with high levels of personal persistence and resilience (Ashton & Webb, 1986; Budge & Parrett, 2018; Guskey, 1988). Shoulders and Krei (2015) noted that education and experience seem to correlate with more effective classroom management and instructional practices profile. The teachers who have high self-efficacy are willing to overcome the challenges they face. They believe in their students and regard each one positively, looking for the most innovative approaches to effectively meeting the needs of their students (Ashton & Webb, 1986; Budge & Parrett, 2018; Guskey, 1988). This higher level of teacher self-efficacy all leads to higher overall student achievement (Ashton & Webb, 1986; Budge & Parrett, 2018; Guskey, 1988).

Teacher professional development and personal reflection. Teacher efficacy develops through professional development support and personal reflection. By the definition of self-efficacy, it is important to provide professional development in the relationships a teacher develops among their students, colleagues, and administration. Howley and Howley (2005) identified three principles that support expanded organizational capacity through professional development; the principles are learning must be situational, learning requires open and sustained dialog among members of the organization after the initial acquisition of knowledge,

and learning is dependent upon the reflection process of organizational data, which is an indicator of the learning. Rural school educators typically struggle with access to high-quality professional development rendering these principles challenging to reach (Lavalley, 2018). Situational professional development becomes challenging just by geographic location. Two barriers to providing access to high-quality professional development include physical distance from universities, other outside providers, and a lack of appropriate programming (Lavalley, 2018). The design and delivery of generic professional development is often based on nonrural needs. Rural educators generally might regard this professional development as inapplicable for rural schools and communities (Johnson & Howley, 2015). It is crucial to develop organizational awareness of processes so that educators can deal with the social situations within and outside of the organization that impacts their capacity to perform in their teaching role (Friedman & Kass, 2002; Schreiner, Noel, Anderson, & Cantwell, 2011; Shoulders & Krei, 2015). A one size fits all model in mostly ineffective when seeking to implement high-quality professional development within each rural school organization (Eppley, 2015).

Rural educators are required to assume many roles simultaneously. These roles might include classroom instruction and curricula responsibilities, supervision and administration of athletics and extra-curricular activities, facilities management, clerical tasks, oversight of multiple schools (Lavalley, 2018). Providing relevant professional development for all of the roles rural educators assume is a challenge for most rural schools (Lavalley, 2018). However, when all educators in a school environment become collaborative learners by sharing what they know and learning from each other, a reflective inquiry culture develops (Howley & Howley, 2005). Devoting the time to establish a reflective inquiry culture will aid in sustaining engaging,

meaningful conversations, which strengthens the learning from the professional development. Hackman (2005) identified three reasons self-reflection is necessary to build social capital within the classroom: it exposes our social identities, which often lead to passiveness and powerlessness, it keeps our minds open to other possibilities, and it provides us positions to take action. Personal and collaborative reflection reminds teachers to be introspective practitioners, and in turn, teachers will ask their students to be reflective scholars.

The reflection process on organizational data is grounded in strategic, quality management practices. With standards to guide our work as educators, we establish benchmarks and measure these benchmarks. This practice involves teachers in a systematic examination of their instructional practices (Howley & Howley, 2005). This process helps to impede two common dynamics that plague rural school cultures. These dynamics are professional isolation and a likely propensity to analyze professional behaviors reluctantly (Howley & Howley, 2005). Rural school communities do face challenges in developing their professional learning community; to overcome these challenges, we must employ a local, sustained, reflective, and collaborative effort.

Review of Methodological Issues

After reviewing the research methods and literature reviews regarding studies that focus on rural schools, I found that there are many different methodological approaches to researching the educational, social, and cultural issues facing rural schools and within rural school environments. This variation is in part due to the many limitations inherent in operationalizing social dynamics quantitatively through empirical research (Vryonides, 2007). Although there is a breadth of methodological approaches used, the primary issue faced in rural school research is a

lack of depth into the site-based issues sought to be understood. Qualitative methods and mixed methods offer the researcher more opportunities to fully probe "for details into the practices, habits, beliefs, and attitudes of individuals are seen as having powerful exploratory and explanatory potentials to address these limitations" (Vryonides, 2007, p. 867).

Quantitative methods. Quantitative research methods are either descriptive or experimental (Hoy, 2010). Most of the quantitative research in this literature review primarily focused on descriptive analyses, through the establishment of relationships or associations between variables amid descriptive or inferential questions (Almeida, Faria, & Queirós, 2017; Hoy, 2010). Several of the researchers used publicly available data through census reporting and data warehouses, analyzing this data through correlational statistics and multivariant analysis. Others used data collected through surveys, simulations, and field experiments. Szyjka (2012) stated that quantitative research is often valued for its credibility by administrators, policy makers, and individual organizations for funding programs or related follow-up inquiry research projects.

Quantitative descriptive studies. Data analysis varied within the quantitative descriptive studies. Some researchers examined the data through a nondirectional hypothesis, by not predicting a comparison and just examined the results, this is known as correlational analysis (Almeida et al., 2017). Pretlow and Wathington (2013) examined dual- enrollment and a Virginia state policy shift to descriptively assess whether that the policy shift did have a positive impact on dual-enrollment; their findings did indicate a positive policy impact, including an expansion of offerings to high school students in rural areas that were previously underrepresented. Pretlow and Wathington (2013) identified several limitations to the study including access only to

publicly available data resulting in the inability to account for multiple dual-enrollment courses and the causal factors of the policy change.

Pierson and Hanson (2015), to influence accountability policy in the state of Oregon, conducted another descriptive correlational study; this study included data from four large databases. Pierson and Hanson's (2015) goal was to identify the gaps between groups of students' willingness to further inquiry their inquiry-based studies. Pierson and Hanson (2015) found patterns of enrollment and persistence did differ from rural students and their nonrural counterparts, with less likelihood of rural students to enroll in postsecondary educational opportunities as well as a lesser probability of persisting in postsecondary schooling opportunities. Pierson's and Hanson's (2015) study was limited by the type of data banked in the database and standardization among the databases of definitions including what constitutes rural and nonrural school students. One of the challenges noted by Pierson and Hanson (2015) is the largeness of the sample size; a large sample size might lead to a higher, by chance likelihood of finding statically significant results.

Frequently, researchers added mediating or moderating variables into their studies; these researchers formed questions (predictions) about the expected outcome(s), based on their prior knowledge or suppositions about rural schools, rural students, dual-enrollment programs, and STEAM/CTE programming. For example, college entrance scores will be lower for students in geographically isolated rural schools than their nonrural counterparts. This analysis occurs by using detailed questions and is known as multivariate analysis. Multivariate analysis is completed when there are several measurements available for each sample or object (Almeida et

al., 2017). These techniques apply in a wide range of situations; however, they require a degree of statistical sophistication.

Descriptive, inferential questions supported the research examined when considering the demographic variables applicable to rural students. An example of a multivariate study which included descriptive, inferential questions is from Fisher and Waldrip (1999); these researchers examined students' achievement level (grades) in science class and their perception of congruence/equity in the classroom. The detailed question of student perception of congruence/equity focused on the moderating variable of grades. An (2012) examined the influence of dual-enrollment on academic performance and college readiness while moderating for social, economic differences. An (2012) then turned the question around and examined whether participation in dual-enrollment led to reduced gaps of socially economically disadvantaged students in academic performance and college readiness.

When using descriptive, inferential questions, the researcher specifies the independent variable in the first part of the question, the dependent variable in the second part and the controlled variable in the third (Hoy, 2010). An example of an inferential question from the research reviewed is, how do the two variables, situational interest and perceived usefulness, influence student achievement? (Chittum & Jones, 2017). This question is an inferential question relating two independent variables to the dependent variable, student achievement. By using descriptive statistics to answer the research questions, the researchers arranged and organized data in a manner that allowed the researchers to compare groups. Descriptive statistics only make statements about the data set that is analyzed (Mordkoff, 2016). The limitation of these studies is in the transference to other populations or specific populations.

Quantitative experimental studies. True experiments must have at least three attributes, which are, an experimental group and a control group, a dependent variable and an independent variable that varies, and two or more randomly assigned groups to compare (Check & Schutt, 2012). Additionally, two other attributes help to validate the experimental design; these are the identification of the causal mechanism, and control over the context of an experiment (Check & Schutt, 2012). These attributes provide the researcher and reader with assurance in the validity and reliability of the experimental research design. Specific programs are often validated using quantitative experimental designs. One well-designed experiment examined the program, *Air Toxins Under the Big Sky*; this experiment demonstrated an increased understanding of the scientific processes and a stronger interest in scientific careers among students in geographically isolated rural schools throughout the United States (Ward et al., 2016). Although quantitative experimental designs help practitioners to evaluate programs, they are limited to evaluating the nuances of social and human/cultural capital (Vryonides, 2007).

Qualitative methods. Operationalizing the required attributes of experimental research designs is a challenge for researchers. Qualitative methods are more likely to support the researcher when exploring the subtleties of social behaviors, social influences, within the social-cultural context (Vryonides, 2007). Qualitative research uses three kinds of data collection methods, interviews, direct observations and artifact/document review (Patton, 2002). The nature of this data collection typically requires fieldwork. The literature review included several strong examples of studies, which utilized all three data collection methods. There were themes, patterns, understandings, and insights that developed through the examination of these studies (Patton, 2002).

Qualitative research allows the researcher to reveal the authenticity of the rural community (Tieken, 2014). The qualitative studies I examined explored the unions that rural schools have with their students, educators, and the community. Reformers and lawmakers (Lavalley, 2018; Tieken, 2014) often ignore this association. Ignoring the connections between rural schools and their communities leads to endangerment of effective implementation initiatives and possible unintended consequences (Tieken, 2014). These qualitative studies allow us to consider the complex, situational issues facing rural education today.

Tieken (2014) conducted a comparative case study of two rural schools, providing detailed information about two different mid-high to high poverty school districts. Yin (2014) noted that case studies explore real-life experience within the context of the experience. Data collection occurred using interviews, observations, and document/artifact analysis. Through this comparative analysis, Tieken (2014) was able to document the uniqueness of place-based rural education and the tight relationship links between the rural school and its community. The flexibility of a case study research enabled Tieken (2014) to move around her subjects, adjusting her questioning, and flexing how she utilized her research time (Merriam & Tisdell, 2016). Tieken's (2014) work was a value-laden ethnographic study, where she provided a detailed accounting of a culture-sharing group; this detailed account of two rural schools in the state of Alabama provided a comprehensive understanding of the values, behaviors, beliefs, and language of these rural school communities (Merriam & Tisdell, 2016).

Another qualitative study I examined explored the social and cultural understandings of individual learners and educators faced when engaging with scientific technology, *Biology Student Workbench*, as part of the scientific inquiry process (Waight & Abd-El-Khalick, 2011).

Researchers Waight and Abd-El-Khalick (2011) acknowledged that the *Biology Student Workbench* program they studied might have faced dismissal as a fruitless technology program endeavor, however with a further qualitative examination of the events and efforts involved, the researchers were able to share several valuable insights. Of primary interest to my research is the researchers' identification of the community of practice that evolved among the learners, science educators, and scientists engaged as subjects in the study (Waight & Abd-El-Khalick, 2011). Qualitative research requires researchers to examine what people do, how they do it, and the interactions that occur among people with other people, and people and objects (Aurini, Heath, & Howells, 2016).

Mixed methods. There are many forms of mixed methods research designs. Mixed methods allow researchers to meet the purpose of the research study by tailoring the chosen methodologies to the inquiry. These methodologies should complement each other by adding to or strengthening the results gleaned from the study (Merriam & Tisdell, 2016).

Many of the studies examined used mixed methods, combining quantitative and qualitative approaches. Mariage and Garmon (2003) conducted a 5-year study that used descriptive statistics and action research to improve student achievement through a school-university partnership. This research allowed the detail to evolve through the interpretive questions, which then prompted intervention actions, and were recorded throughout the observations and interviews. This process led to the identification of six factors that increase sustained use of research-validated practices, which are the feasibility of classroom application, ongoing opportunity to communicate purpose and principles, professional development networks, the need to link changes to student learning, management of scope and magnitude, and technical assistance. All

factors that can be researched in isolation but become much more meaningful to the researcher and practitioner when supported through mixed methods study.

Kapucu (2012) shared research on communities of practice in which he utilized mixed methods. The first tool used was surveys obtained pre- and post-study, descriptive network analysis was completed, which included a friendship network and an advice network (Kapucu, 2012). The second method used was a qualitative analysis of the second survey data. Often, one form of data is more core than the other forms of data in a mixed methods approach (Merriam & Tisdell, 2016). Kapucu's (2012) network analysis using both pre- and post-surveys is an example of the core data analysis; the qualitative analysis of the responses to the second survey was an outgrowth of the core descriptive method. Kapucu's (2012) combination of methods supported his research, as he identified many insights that might not be available by using only one method, allowing for design flexibility and situational responsiveness, thus increasing methodological rigor (Butin, 2010; Patton, 2002).

Mixed methods studies allow researchers to expand their knowledge base. However, there are limitations. To effectively implement a mixed methods study, the researcher needs to have an understanding of both quantitative and qualitative methods; these studies also usually require a strong implementation understanding on the multiple methods, possibly making the multiple methods more challenging to maneuver concurrently (Doyle, Brady, & Byrne, 2009). Studies employing mixed methods typically take much longer (Doyle et al., 2009). Mixed methods offer the researcher another approach to their research methodology, but also have constraints.

Synthesis of Research Findings

According to Creswell (2014), "A theory might appear in a research study as an argument, a discussion, a figure, or a rationale, and it helps to explain (or predict) phenomena that occur in the world" (p. 86). An overarching theme emerged through the examination of the literature. Researchers of rural school communities consistently indicate a lack of resources and limited social capital and human capital. This limitation correlates with achievement gaps. These gaps are represented through generalized statistical achievement data comparing geographically isolated rural students to their nonrural peers. Most often, the studies used data sources in a holistic manner, which supported the development of characteristics of rural students and rural schools in a general sense, not in an applied or school-site based function.

Showalter et al. (2017) shared one of the most recent studies that built upon this theme. Showalter et al. (2017) offered an updated classification of what is rural based on the 2010 Census data. This reclassification resulted in a slight decline in the number of schools classified as rural and a decline in overall enrollment numbers of rural school students. Showalter et al. (2017) identified five indications to describe rural schools in each state; these indicators focused on "(1) Importance of rural education in the state, (2) Diversity of rural students and their families, (3) Educational Policy Context impacting rural schools, (4) Educational Outcomes of rural students, and (5) College Readiness of students in rural schools" (p. 2). Although this research is updated biennially, this is the first time the college readiness measure was included. This indicator was included due to the global economic challenges all schools face. The researchers found that college preparation, specifically in STEM-related fields, remains a significant issue for rural schools.

Complex relationships. Communities of practice focus on exploring the complex relationships and patterns of social learning. The emphasis is not on the individual learner and their activities; it is on the connections the learner has with their community and the patterns of participation in the community (Abou-Zeid, 2007; Barab & Duffy, 2000; Kapucu, 2012). Education is often viewed as a preparation for a later activity, not as a meaningful activity itself (Barab & Duffy, 2000). Dewey argued for us to consider education as a process of living now, not as a process for living in the future. Communities of practice allow us to frame the everyday learning of the collaborative community. Exploring the complex relationships between social capital, human action, and communities of practice provides insights into the process of creating and sharing knowledge within geographically isolated rural school communities (Abou-Zeid, 2007).

The literature review on rural school research revealed the complex relationship that typifies the rural school and the community or communities) associated with the rural school. This complex relationship lends itself to empirical research methods including qualitative, quantitative, and mixed methods of study. Eppley (2015) researched this phenomenon as place-consciousness concerning teacher preparation. Eppley (2015) discovered, "Goals and wishes of rural school parents, teachers, and community members are complex and contradictory at times, precluding a possibility of a one size fits all model" (p. 67). This one size does not fit all notion, supports Tieken's (2014) assertion, that educational research often ignores rural schools and communities in deference to research on urban schools.

Dual-enrollment. In this literature review, I examined literature about one of the strategies used by rural schools to address college and career readiness, and dual-enrollment,

specifically in the STEAM/CTE fields of study. "Dual-enrollment classes offer high school students the opportunity to experience college science in a more supportive environment, allowing them to adjust to the different academic and social demands of a college learning environment" (Lukes, 2014, p. 17). However, researchers agree that the opportunities for dual-enrollment are not equitable. Dual-enrollment opportunities are dependent on financial resources, teacher expertise, and administrative support. These are all characteristics that vary from school to school and are highly dependent upon social-economic conditions (Pretlow & Wathington, 2013).

Researchers also identified a need to monitor dual-enrollment programs more closely. Dual-enrollment coursework provides advantageous opportunities for rural students, but there should be consistency in monitoring this practice. Researchers noted there is a lack of consistency in following the federal and state guidelines for dual-enrollment coursework. Lack of consistent measurement leads to concerns about the quality level of the courses. There should be a common practice for dual-enrollment; our United States practice of free market economy in the postsecondary market might be the lead cause to this inequity (Dodge, 2012; Fink et al., 2017). It begs the question, how is Biology 101 different in a community college versus a top-ranked university? In turn, how is this different from a dually-enrolled Biology 101 at the high school level?

The work of An (2013) accounted for factors that most of the research does not, therefore leading to greater validity that the hypothesis of dual-enrollment leading to college readiness is valid. An (2013) found half of the observed student differences in success for early enrollment can be attributed to academic tracking and socioeconomic status, even with this factored in, dual-

enrollment does lead to higher GPAs and less remediation. Research supports dual-enrollment as a viable stratagem to overcome the achievement disparity between geographically isolated rural students and their nonrural contemporaries (Paik & Phillips, 2002).

STEAM/CTE fields of study. In addition to using dual-enrollment as a postsecondary readiness strategy in the literature review process, I researched dual-enrollment coursework specific to the STEAM/CTE fields of study. The studies reviewed through this lens were mostly qualitative featuring case studies, interviews, and quantitative opinion survey questions that were analyzed through descriptive statistics. "Teaching strategies that actively engage students in the learning process through scientific investigations are more likely to increase conceptual understandings than teaching strategies that rely on more passive techniques, which are often necessary for the current standardized-assessment laden educational environment" (Minner et al., 2010, p. 474). According to Paul et al. (2016), "The majority of high school students indicated that they had an increased understanding of different applications of the scientific method as well as an increased interest in doing scientific research" (p. 171). This argument is supported by the work of Ward et al. (2016), who stated: "Students who have the opportunity to conduct authentic research of their design, from the ground up, do indeed develop a deeper understanding of the processes of science compared to their counterparts" (p. 914). Open and authentic inquiry through experimental research needs to be included in science lessons at school (Paul et al., 2016; Ward et al., 2016). Students involved in research opportunities such as this will be more likely to develop an interest in a science career pathway.

Plank (2001) sought to understand the relationship between Career and Technical Education (CTE) coursework and academic course enrollment, and academic achievement and

academic persistence. CTE coursework tends to be closely linked to the content of STEAM. A ratio of three CTE credits to every four academic credits were found to lead to the highest persistence rate (Plank, 2001). Castellano et al. (2016) supported the value of STEAM coursework. Researchers claimed STEAM/CTE programs of study do have a significant impact on academic achievement levels and college readiness. Vilorio (2014) recommended educating students about careers in STEAM fields would help them to make choices that will provide them with fulfillment and monetary stability. Schools should offer contextualized, central-themed programs of study in STEAM/CTE with transferrable links to postsecondary educational opportunities and places of work (Castellano et al., 2016; Plank, 2001; Vilorio, 2014). These researchers imply STEAM/CTE programs establish opportunities and connections, which had better equip schools to meet the developmental needs of their communities.

Social constructivist methodology in the learning environment. Many researchers and educators support the social constructivist learning philosophy of educating students, including rural students. Wilcox et al. (2015) noted that "teaching science through inquiry refers to the pedagogical decisions and actions that teachers make to promote scientific practices such as asking testable questions, creating and carrying out investigations, analyzing and interpreting data, drawing warranted conclusions, and constructing explanations." These pedagogical decisions and actions that the educator facilitates enable students to gain profound theoretical understandings of foundational scientific concepts (Wilcox et al., 2015). Social constructivist learning environments typify the use of learning strategies, which include modeling, coaching, and scaffolding. Technology often heavily supports social constructivist learning environments.

Most importantly, social constructivist learning environments present authentic problems for students to examine and learn from (Marra, 2005; Wilcox et al., 2015).

Not all the researchers agree with the social constructivist approach, favoring a more direct approach to instruction, including some stand and deliver pedagogical methods. Kirschner et al. (2006) argued that research studies support direct instructional approaches with significant guidance, rather than minimally guided approaches when instructing novice and intermediate level learners. Whereas Hmelo et al. (2007) countered, problem-based learning and inquiry learning are not minimally guided instructional approaches; these approaches provide extensive scaffolding and guidance to the student learners while making sure the students are engaged and active in their learning experiences. Burgin and Sadler (2016) shared their research regarding apprenticeship programs finding that instructional support of authentic experiences allows students to deepen their understanding of the scientific processes.

Relationships through teacher self-efficacy. Additional studies supported the dominant role of establishing positive relationships between teacher and student on the rural high school students' school and work attitudes. These relationship influences include parent-child/teacher-student relationships (Wettersten et al., 2005). In order to develop strong teacher-student-parent relationships, teachers need to be prepared to meet the challenges of rural schools and communities. In order to strategically approach parents, teachers must first consider the context in which they are establishing of these relationships (Siwatu, 2011).

Teacher efficacy extends beyond the classroom into the organization and the community (Friedman & Kass, 2002). Educators with high teacher efficacy are dedicated to making a difference in the lives of their students. Schreiner et al. (2011) recommended educators devote

time to writing personal mission statements that openly express and communicate the difference they plan to make in their students' lives. This personal mission supports the educator in taking the initiative needed with students and directs the investment of the educators' time, generating the support and energy needed to make these connections (Schreiner et al., 2011).

Research indicates that rural educators are often unprepared for this; high quality, relevant professional development is imperative for teacher self-efficacy growth. Professional development supports self-efficacy. Teacher self-efficacy can be broken down into two interrelated tenets, organizational and classroom (Friedman & Kass, 2002). The organizational tenet requires the teacher to function beyond the classroom with colleagues, administration, and the wider school community (Friedman & Kass, 2002; Tieken, 2014). Tieken (2014) summarized it, "I couldn't separate the rural from teaching, that teaching here was completely and utterly tied to this very particular place" (p. 6). The second interrelated tenet the activities and relationships with the classroom. In this tenet, the teacher is the facilitator of the learning, providing leadership to their students. Shoulders and Krei (2015) concluded that when teachers have high levels of self-efficacy student outcomes tend to be higher.

Continued investigation into the supports that foster teacher self-efficacy needs exploring. Professional learning communities a form of communities of practice support teacher self-efficacy (Kapucu, 2012). Kerstetter et al. (2014) found that "organizations that provide support for individuals' aspirations, while also exposing and addressing the procedural and structural barriers that prevent the realization of these goals, can contribute to individual, household, and community wellbeing" (p. 257). Professional development must be place-based, ongoing and collaborative as well as linked to each rural communities' attributes.

Critique of Previous Research

The research reviewed included quantitative, qualitative, and mixed-method studies, as well as, theoretical studies, which examined and analyzed research that the writers then synthesized for more comprehensive understanding and unanimity. Many of the initial studies I examined focused on aggregate data trends, using descriptive statistics (Dodge, 2012; Showalter et al., 2017; White & Corbett, 2014). These aggregate data trends allowed me to understand the *rural school issues* and to determine where to direct my literature review.

However, these quantitative studies were not solution oriented. Even though their work focuses on the big picture of rural schools in the United States, Showalter et al., (2017), warned: "We must not lose sight of the fact that every number represents a collection of actual students, each with their own story, struggles, dreams, and potential" (p. 31). Therefore, it might be best to consider a mixed-methodology when studying the complex characteristics of rural schools under the lens of social capital. Creswell (2014) noted that "mixed-methods purpose statements contain the overall intent of the study, information about the quantitative and qualitative strands of the study, and a rationale of incorporating both strands to study the research problem" (p. 6). Mixed methods allow researchers to examine demographic factors that might influence qualitative analysis when considering a problem.

Research in the rural environment. "Researchers probably should consider how the demographics of their selected group of school or districts compare in race/ethnicity, family income (poverty), enrollment trends, and other characteristics to all schools or to other categorizations of rural schools" (Greenough & Nelson, 2015, p. 332). This consideration allows the reader to contextualize the research. Too often, this information is not available within the

literature. Researching a rural environment is different from nonrural environments. Rural schooling, rural education, and rural communities need to have researchers value their needs and differences. By examining these types of factors, a researcher lends credence to the sense of *rural place*.

We need to be more perceptive to the developmental needs of rural students and schools. Miller (1995) suggested researchers should become more responsive to the developmental requirements of rural schools and their communities. We need to recognize the individuality and variety among rural schools. Rural school isolation leads to a lack of resources including social capital constraints. Social capital and human capital are intangible; therefore, it is best examined and analyzed from within and is not easily quantifiable (Abrar-uh-haq, Akram, Muhammad, & Farooq, 2015). There is a qualitative aspect of social and human capital that the researcher explores when looking at the relationships that support the development of social and human capital. Although, it might be possible to gauge social capital and human capital through trend or qualitative descriptive analysis, such as looking towards the betterment or worsening of livelihoods, examining how people access the social capital, or determining the depth of access to social systems. Tieken's (2014) study offered an outstanding example of a mixed-methods case study by providing a parallel comparison of how two rural school systems adjust to changing social and human capital.

Knowledge building in rural schools. The research examined regarding dual-enrollment focused on college readiness, explicitly validating the achievement levels of those enrolled in dual-enrollment programming compared to their academic counterparts. The research is fairly conclusive that dual-enrollment programs are a useful tool used by rural and nonrural

schools to prepare students for postsecondary experiences. However, research studies, which examine specific program models, are slight. These site-specific studies, which focus on the learning environment, allow the researcher to study pedagogical practices in an interpretive manner while examining perception. Site-specific studies defend the development of an understanding of the learning environment with the purpose of transference. As noted by Tieken (2014) and Byun et al. (2012), rural schools face many challenges related to resource availability, studying how effective rural schools overcome resource constraints might provide models for rural schools also facing resource scarcity.

Researchers have established self-efficacy is situational and variable, as well as correlated with teacher persistence and resilience. Ashton and Webb (1986), Budge and Parrett (2018), and Guskey (1988) validated that higher teacher self-efficacy lead to higher overall student achievement. High levels of teacher efficacy lead to higher utilization of social capital (Friedman & Kass, 2002; Schreiner et al., 2011; Shoulders & Krei, 2015). Few studies have been done on teacher self-efficacy and rural school educator success (Johnson & Howley, 2015). Current research does not explicitly identify critical issues facing rural teacher self-efficacy, nor does it provide significant guidance in place-based, situational professional development. Making research informed pedagogical improvements are critical to all educators when looking to cultivate educators with a high degree of self-efficacy (Guerriero, 2017).

Social constructivist and scientific inquiry-based learning are all well researched pedagogical, learning environment theories. While there may be a researcher that objects to these theories, this disagreement is more often a manner of misinterpreting the methodologies attached to the theory or a disagreement on the science of how children learn (Hmelo et al., 2007;

Kirschner et al., 2006). Studying the application of these theories brought greater insight into the scientific, open, inquiry-based teaching-learning practices rural school educators employ to facilitate communities of practice within their learning environments.

Chapter 2 Summary

Despite being a significant portion of the student population in the United States, the mid-high to high poverty rural students have been subjected to policy and practices that do not consistently meet their needs (Lavalley, 2018). Little attention has been paid to the lack of community social capital and human capital that characterizes geographically-isolated rural schools and their students. Chapter two is a review of the literature, which is based on the conceptual framework of communities of practice. This conceptual framework of communities of practice allowed examination of the literature through the lens of equity and knowledge building in rural schools. Geographically-isolated rural schools lack the resources to develop the social capital and human capital through communities of practice that are available to nonrural schools. Geographically-isolated rural schools, are at the same time, compared to their nonrural peers and must prepare their students to enter the same postsecondary experiences as nonrural students enter.

Part of the difficulty that arises when studying rural is that there is no universal definition of rural; rural populations vary significantly from one another. Rural is a "socially constructed space with competing and layered conceptions of its meaning and value" (Cloke, as cited in Roberts, 2014, p. 143). Fisher and Waldrip (1999) acknowledged that students come from communities with different cultural practices. As an American society, we need to commit to our geographically-isolated communities and citizens by developing inclusive community

institutions. These inclusive institutions will in-turn establish, nurture, and sustain community-level social capital, building from within (Duncan, 2001). Schools are one of these inclusive institutions and must be culturally sensitive. Effective learning processes characterize culturally sensitive schools, including knowing the community demographically and personally, connecting the culture to the curriculum, and understanding how existing influences affect the educational programming and policies (Dhindsa, 2005). The value of research in rural school communities is our understandings of how cultural milieu affects the acquisition of social and human capital of the students within our rural school classrooms.

There is an expectation that all high schools must prepare students to compete in a global economy. This expectation is counter-intuitive at times and conflicts with the *sense of place* that is part of the make-up of the rural school social and human capital. This literature review examined the strategies of dual-enrollment, STEAM/CTE course content, social constructivist learning philosophies, scientific inquiry-based learning, and teacher self-efficacy in preparing students to pursue postsecondary goals. There is sufficient reason to believe that an investigation examining the role of the rural school educator in facilitating communities of practice within the dually-enrolled, scientific-inquiry, SRHS classroom yielded significant findings.

Chapter 3: Methodology

Introduction to the Methodology

In this chapter, I provide a detailed description of the design utilized for a qualitative multiple case study. The purpose of this study was to explore the challenges that SRHS teachers face in geographically-isolated, rural secondary schools due to an imbalance of social capital and resulting lack of naturally occurring communities of practice (Bauch, 2001; Byun et al., 2012; Herman et al., 2013). Research has shown that, in general, rural educators are supportive of their students achieving and exceeding expectations (Byun et al., 2012). However, geographically-isolated, rural educators and students lack the community social capital and communities of practice to assist in student achievement, as compared to their nonrural peers (Williams, 2010). This exploratory multiple case study was designed to gain insight into the best strategies to facilitate communities of practice employed by geographically-isolated, rural secondary school educators who teach the SRHS dually-enrolled program of studies.

This study was specific to the SRHS dually-enrolled program of studies, which empowers students to conduct authentic scientific research of the students' choosing. The teaching and learning environments of these educators are characterized as having an open-inquiry, social constructivist pedagogical approach. The design of my study was exploratory. I sought to uncover the actions of the educators (human action) and their use of instructional tools and resources (social capital) to foster communities of practice. I investigated the open-inquiry science teaching practices and social constructivist teaching pedagogy employed by SRHS teachers within their teaching and learning environment to access and generate communities of practice and increase net social capital.

The problem I investigated was the lack of community social capital, human capital, and communities of practice available to geographically-isolated, rural secondary school teachers and students. Through this study, I explored how geographically-isolated educators effectively support their students in the SRHS dual-enrollment program of studies to overcome the lack of community social capital and facilitate communities of practice. This was significant as rural SRHS students compete with their nonrural counterparts for additional, but limited, social capital and economic resources, such as prestigious nonmonetary and monetary awards, scholarships, and university entrance. The central research question guided the multiple case study research design.

In this chapter, I describe the purpose and research design I chose. I discuss the context of the study as it relates to the research questions, including the boundaries, which I defined by the following variables: time, place, activity, context, and definition (Baxter & Jack, 2008). Additionally, I share the data collection methods and data analyses procedures I utilized. I discuss the limitations in the research design. Finally, I identify potential ethical issues and describe my predicted findings.

Research Questions

According to Stake (2006), a multiple case study is usually organized around at least one research question, which focuses on the conceptual framework that holds the cases together. The critical, overall question that focused this study was:

How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?

Research subquestions. Multiple case studies most often have additional research questions to support the primary research question (Merriam & Tisdell, 2016; Stake, 2006). Secondary research questions supported this study, allowing me to delve deeper into understanding each case in the multiple case study and supporting me through the reflection and triangulation process of the study (Stake, 2006). Additionally, these secondary research questions helped me to facilitate a deeper understanding of possible promising best practices used within the teaching and learning environment to overcome lack of community social capital and naturally occurring communities of practice.

Aurini et al. (2016) advised circumventing language of causation when conducting qualitative research by avoiding using terms that imply causation, instead phrasing questions so they speak to the theoretical approach and topic. According to Aurini et al. (2016), "Qualitative researchers develop propositions rather than hypotheses" (p. 41), developing process-oriented questions rather than causation-oriented ones. I used this type of process-oriented research question to guide my analysis of the "workings or connections" between data points after the data collection process (Aurini et al., 2016, p. 41). My secondary research questions were as follows:

- How do the human actions of the educators compensate for a lack of social capital caused by geographic isolation?
- What are the human actions that allow the educators to enhance students' involvement and participation in the community of practice?
- What are the factors that allow a community of practice to harness limited social networks and resources to establish legitimization for the student member?

- How does social constructivist learning through communities of practice support the evolution of the student knowledge-acquisition process?

Purpose and Design of the Study

In this study, I explored the teaching and learning environment of geographically-isolated, rural secondary school educators through the conceptual framework of acquisition of knowledge through communities of practice and the reciprocal relationships of communities of practice, social capital, and human capital. This study is important because research indicates geographically-isolated, rural secondary schools are challenged in overcoming a lack of community social capital and do not have well developed, naturally occurring communities of practice (Bauch, 2001; Byun et al., 2012; Herman et al., 2013).

Purpose of the study. The purpose of this research study was to identify best educational practices of geographically-isolated rural educators in their SRHS program of studies teaching and learning environment for the benefit of other educators teaching research-science programs of studies in geographically-isolated, rural secondary schools. The results of this research may be valuable to geographically-isolated, rural secondary school educators within the context of their teaching and learning environments. The study of geographically-isolated rural secondary school educators' teaching and learning practices and environments was justified due to those communities' lack of community social capital, caused in part by globalization (Wiesinger, 2007). Therefore, in this study, I sought to discover how experienced, geographically-isolated, SRHS rural secondary school educators use tools and resources, employ specific teaching practices and strategies, and adjust to their students' needs to overcome poorly-connected and diminishing community social capital to support their teaching and learning environments.

Constructivist learning and scientific inquiry are instructional methods often used by science educators who design their teaching and learning environments to both build technical skills and develop interpersonal skills. These instructional frameworks support the development of the interpersonal skills often needed to be successful in postsecondary employment and studies (Lukes, 2014). Dually-enrolled, inquiry, and constructivist programs of studies scaffold students by supporting the development of technical and interpersonal skills, while at the same time exposing the students to the rigor of college-level instruction (Wilcox et al., 2015). The findings from this study may contribute to the educational community by supporting educators who are striving to facilitate communities of practice within their teaching and learning environments.

Additionally, educators who lack self-efficacy are less likely to engage in the human actions needed to overcome limited access to community social capital, which is necessary to enhance teaching and learning environments (Budge & Parrett, 2018). Geographically-isolated, rural secondary school educators who are poorly connected need scaffolding and support to build social capital networks (Byun, Meece, & Irvin, 2012; Wiesinger, 2007). Through this multiple case study, I uncovered resource acquisitions, pedagogical methodologies, and several adjustments employed by geographically-isolated, rural secondary school SRHS educators to build communities of practice and overcome the lack of social and human capital common in these types of communities. The information assembled through this exploratory research provided valuable pedagogical insight for novice, geographically-isolated, rural secondary school SRHS educators teaching the SRHS program of studies for the first time. The results of the study are pertinent to both novice educators and students enrolled in the SRHS program of

studies by providing exemplar teaching practices that novice educators may be able to replicate in their own teaching and learning environment. Additionally, this study may influence future programming in similar dual-enrollment programs of study.

The study is significant because it assists geographically-isolated, rural secondary schools and educators in identifying and sharing effective teaching and learning best practices that promote the acquisition of skill and content knowledge as well as the interpersonal skills needed to succeed beyond high school. Administrators may use the results to guide research-science programs of study and assist teachers in the development of the curriculum. The study results may also help teachers strengthen their teaching and learning environment while supporting the attainment and utilization of social capital resources by their students. As the researcher, I was able to uncover critical areas within the research-science educational process that have not been previously explored. Ultimately, the purpose of this study was to understand how geographically-isolated, rural secondary school educators leverage their resources and adjust the teaching and learning environment to overcome a deficiency of community social capital and human capital to extend student knowledge acquisition through communities of practice, thus preparing geographically-isolated, rural students to compete socially and economically in a global economy.

Design of the study. An inquiry-based, exploratory study is well suited to a multiple case study approach (Stake, 2006). Case study approaches support the exploration of the phenomenon within its context (Baxter & Jack, 2008). In this multiple case study, I studied the teaching and learning environment and promising best practices of educators in the SRHS dually-enrolled program of studies classrooms. The phenomenon for this study was how geographically-isolated,

rural secondary school SRHS educators overcome the lack of available local social capital through the facilitation of communities of practice, as compared to their nonrural colleagues. The context of the study was the teaching-learning environment of the SRHS educators. There was no clear boundary between the phenomenon of and the context of this study, signifying a case study was appropriate (Baxter & Jack, 2008; Stake, 2006).

Case studies are most valuable when studying a problem-based situation, where the researcher has no control over the research environment (Baxter & Jack, 2008; Yin, 2014). I studied each SRHS educators' unique teaching and learning environment and the promising best practices these teachers use. As the researcher, I did not have any control over the SRHS classroom teaching and learning environment. Through this multiple case study, I explored the SRHS educators' teaching pedagogy within the context of their teaching and learning environment using the pre-determined demographic criterion.

Qualitative case studies typically provide the researcher with an abundance of information about only a few people and cases (Patton, 2002). This multiple case study resulted in a deeper understanding of how geographically-isolated, rural secondary school educators adapt their teacher-learning environments. Studying only one case reduces the transferability of the study (Patton, 2002). Therefore, using multiple cases in this study supported transferability.

The participants in this study all taught at different geographically-isolated, rural secondary schools. There was only one educator teaching the course in each geographically-isolated, rural secondary school. A multiple case study permitted me to query each participant as an individual as well as explore the data across cases. Multiple case study designs allow researchers to analyze the data within each case as well as among cases (Merriam & Tisdell,

2016; Stake, 2006). Because the problem I investigated was a deficit of community social capital, human capital, and naturally occurring communities of practice among geographically-isolated, rural secondary schools, it was reasonable to study how individual educators teaching in different geographically-isolated, rural secondary schools overcome this problem. Multiple case studies result in a standard description across cases, where researchers formulate conceptualizations (Merriam & Tisdell, 2016). A multiple case study provided me with the content needed to more fully understand the phenomenon and to formulate transferability across the teaching and learning environments.

For the purpose of the research, I studied several teachers in geographically-isolated rural secondary school districts. The SRHS dually-enrolled program of studies did have a required framework established by the UHS. However, within the framework, there was considerable school and educator autonomy to design their on-site, dually-enrolled program of studies. The educators' decision-making skills are developed and used within each of their teaching and learning environments (Baxter & Jack, 2008). The power of this multiple case study was in the attention I was able to give each local situation (Stake, 2006), which is the main reason I differentiated between a case study and a multiple case study. During my inquiry, I documented and triangulated the similarities and differences across the multiple cases as they related to each school and educator.

Research Population and Sampling Method

I identified the target population by generating a list of secondary schools currently offering an approved program of studies with instructors who were directly engaged in the SRHS program of studies. This list was available through the University's public website, and I cross

checked it with the University Program Director for accuracy and completion. The University was one of 13 SUNY undergraduate teaching, research, and advanced degree-granting institutions located in New York State. From the University's list, I identified nine secondary schools with rural school status using the New York State Center for Rural School's designation of school locale types. Five of the schools were classified as *rural fringe*. Three of the schools were classified as *rural distant*. One of the schools meets the definition of *rural remote*. For this multiple case study, I did not include secondary schools that had towns located within the school district, even if these schools were classified as remote.

After generating the list of nine potential educators from the University website, I worked with the University Program Director to determine if the educators in these secondary schools had taught in the SRHS program of studies for a minimum of three consecutive years. The intent was to include three to five minimally experienced, geographically-isolated, rural secondary school educators as participants in this multiple case study. This minimum level of experience ensured that these educators had worked through the SRHS dually-enrolled program of studies with at least one cohort for the 3-year sequence. Maintaining the requirement of a minimum of three years of teaching experience helped to confirm context-dependent knowledge and experience, which, according to Flyvbjerg (2006), "are at the very heart of experienced activity" and "lie at the center of the case study" (p. 222). Additionally, all of the high school educators participating in this study were required to be approved volunteer, adjunct professors in order to teach any of the courses associated with the SRHS program of studies. This approval process included completion of a weeklong University provided training, submission of SRHS curricula, and a review of the educator's resume, transcript, and certifications. All educators approved for

the SRHS program of studies retained a Master of Science degree in Education or Science. This approval process helped to safeguard a minimum level of context-dependent knowledge.

The sampling method I chose for this multiple case study was nonprobability, purposeful, convenience sampling. Nonprobability, purposeful, convenience sampling is appropriate for studies where the researcher seeks to solve qualitative problems through the process of detailing occurrences, noting the implications of what occurs, and describing the relationships that ensue from these occurrences (Merriam & Tisdell, 2016). I sought to discover, detail, understand, and gain insight into the phenomenon of experienced, geographically-isolated, rural secondary school educators teaching the SRHS program of studies while they overcome the lack of local social capital available to their student population, as compared to their nonrural colleagues, through the facilitation of communities of practice. Purposeful sampling involves selecting participants based on their knowledge and experience in a given area (Aurini et al., 2016). Participant educators were approved SRHS University instructors in the program of study and had taught in the program of study for at least three years. This sampling method ensured rural school classification and assumed a selection of educators who had the time to develop a higher level of self-efficacy through knowledge- and experience-building events. Convenience sampling was appropriate in this research study because there were only finite numbers of secondary school programs available that met the boundaries of the research design. The finite number of schools that met the boundary of geographically-isolated rural school identification was nine.

Merriam and Tisdell (2016) specified that case studies must be intrinsically bounded and allow for finite data collection. I chose to bind the multiple case study by the setting, using the New York State Center for Rural School's designation of school locale types: *rural fringe*, *rural*

distant, and *rural remote*. However, teacher knowledge, teacher experience, teacher pedagogical approaches, and location were unique to each case. According to many practitioners, this uniqueness is what leads to the individuality of each classroom's teaching and learning environment (Danielson, 2007). One rationale for using multiple cases is that each case is distinctive in its teaching and learning environment, allowing for richer data overall. Each case was differentiated by location and had only one educator teaching the SRHS course.

I chose the participants based on who responded favorably to the recruitment communications. Archibald and Munce (2015) advised that, when selecting participants, it is imperative for researchers to consider the challenges and obstacles they are likely to encounter as well as the potential impact of the research on participants. First, I emailed all of the potential participants, explained my research study, my purpose for conducting the research, and the measures I planned to take to ensure confidentiality (see Appendix A). When a favorable response occurred, I emailed permission to participate forms as well as Concordia University's site-permission forms to the potential participants. Once I received the required permission forms, I requested a convenient time for a phone conversation and then conducted the phone-based structured interview. I was able to obtain five willing participants. Patton (2002) noted that researchers should determine a minimum sample size, basing this decision on what sample size is needed to cover the phenomenon and the purpose of the study adequately. Securing five qualified and willing participants was adequate for the purpose of my study.

I was prepared to narrow my participants through additional nonprobability, purposeful sampling, as I realized that at some point, new information would no longer surface in the data collection and analysis process; therefore, I chose the sample size cut-off of five, which allowed

for maximum variability to be attained and probably approached saturation of the data collection (Merriam & Tisdell, 2016). After completing the structured, phone-based interviews, I decided to include all five cases in my study. Often, a researcher uses a second set of criteria to purposefully determine which potential participants might be most appropriate to interview and observe as well as to identify what documents are most beneficial for analysis (Merriam & Tisdell, 2016). Through the phone-based structured interview, I was able to identify educators who met the criteria and had the potential to offer rich data sets as the study proceeded. These participants were enthusiastic about their SRHD program of studies.

The phone-based structured interview process helped me to make strategic, purposeful sampling choices, enabling me to identify participants who provided the data that best met the purpose of my in-depth multiple case study. This second set of criteria was based on the extent of each participant's qualifications, the potential participant's agreement with the classification of their school as a geographically-isolated, rural secondary school, how willing the participant was to host me as a researcher in their school environment, and the participant's availability for follow-up data review and consultation. The phone-based structured interviews had pre-determined established questions (see Appendix B). During the phone conversation, I explained more about the purpose of the study, went over the participation eligibility criteria, and completed the first interview. In this phone-based structured interview, I identified educators who tentatively appeared likely to offer robust, informative data sets as the study proceeds. I verified that the participant had the qualifications and experience levels identified through the binding process.

The phone-based structured interview process helped me to make strategic, purposeful sampling choices, enabling me to identify the participants who provided the data that best met the purpose of my in-depth multiple case study. I explained to each of the participants the expected commitment and obligations throughout the study, including an anticipated timetable for completion of the study. I made sure that the educator and school district were willing and able to host me for the day, asked about their willingness to complete follow-up check-ins and cross checks, and verified that the anticipated timetable would work for the SRHS educator. The first phone-based structured interview question verified the potential participant's years of experience, whether the participant had a Master of Science degree in Education or Science, whether they had completed the one-week mandatory training, if they had filed a curriculum with the University, and if they had been approved as a voluntary, adjunct professor with the University. I also asked the educator to confirm that the secondary school was part of a geographically-isolated rural school district. I defined terminology specific to this study during the initial contact. Finally, I identified and addressed any other concerns that the participant raised and assessed (a) whether the individual was a good fit for the study and (b) whether the individual was interested in continuing as a participant in the study (Archibald & Munce, 2015). Upon completion of these phone-based structured screening interviews, I determined that all five participants were suitable. I believe that I successfully recruited the best participants based on their receptiveness, self-identification as educators in rural secondary schools and confirmation of years of SRHS teaching experience and qualifications.

Instrumentation

In this qualitative multiple case study, I collected, analyzed, and interpreted the data as I explored this phenomenon. As a researcher, it was my task to provide a framework so that the participants in this qualitative study could respond to and accurately represent the best practices within their teaching and learning environment (Patton, 2002). Through this representation, I gained insight into how geographically-isolated rural secondary school educators facilitate the growth of communities of practice within the constraints of limited social and human capital. The instruments used were in-person semistructured interviews, in-person observations, and artifact and document collection.

Semistructured interviews. Upon determining the participants, I continued with semistructured interviews (see Appendix C). An interview guide provided the researcher with a questioning framework; the interviewer developed questions, sequenced those questions, and made decisions regarding follow-up and additional programming by using a questioning framework (Patton, 2002). As is typical in a semistructured interview, the guide for this study started with direct questions and moved into more interpretive questions. The interview guide ended with questions that foster closure. Interview guides help to develop a rapport and build trust between the researcher and participant (Aurini et al., 2016; Patton, 2002).

The interview began with an opening statement included in the interview protocol, which disclosed the purpose of the study and outlined the confidentiality measures, and ended with a closing statement. A semistructured interview format included a mixture of predetermined questions and open-ended questions. This mixture of questioning assured the researcher obtained the required data from all the participants. The interview protocol for this study included the

statements and structured questions used, with the understanding that I would determine additional follow-up, open-ended questions. I did ask "on the spot" follow-up questions based on my instincts. Jacob and Furgerson (2012) advised that the researcher should be willing to adjust their interview questioning and allow for flexibility in the interview process as the researcher may unearth valuable information not initially expected. Predetermined questions made up the majority of the questions in the interview protocol for this study (Merriam & Tisdell, 2016). I then clarified these predetermined questions with open-ended questions based on the participants' responses; there was a degree of researcher judgment involved in the questioning process (Butin, 2010; Merriam & Tisdell, 2016). I used the open-ended questions flexibly; as I had anticipated, the order in which I asked questions did change slightly (Butin, 2010; Merriam & Tisdell, 2016). This flexibility led to a more natural conversation between me and the participant, creating an environment where the participant was more open to sharing, and allowed me to probe and expand upon the participant's responses (Alshenqeeti, 2014). The semistructured interview design also allows the researcher to seek clarification when needed and to explore data not fully uncovered in the predetermined questioning process (Merriam & Tisdell, 2016).

The interview protocol elicits an ethnographic point of view of the educator in a structured yet authentic manner. This authentic manner is valuable because of uniqueness in each classroom culture an educator establishes within their teaching and learning environment. Obtaining a rich, descriptive accounting through the interview process allowed me to explore and collect information. From the information gathered, I pulled a summary of characteristics of the

best practices of rural, geographically-isolated SRHS educators' teaching and learning environments.

Observation protocol. I completed only one classroom observation at four of the five sites; at the other site I completed two classroom observations. Typically, geographically-isolated, rural secondary schools have only one educator assigned to the SRHS course. This educator is likely to have one to two sections of SRHS classes. The site with two observations had two sections, whereas the other sites had one section. All sections included a mixture of one-, two-, and three-year students. The University recommends mixed classes that include representation of one-, two-, and three-year students.

The observer protocol is included in Appendix D. I took notes during the observation and recorded my initial reflections using the protocol form. The observation protocol was designed to capture the multiple activities and interactions between the educator and students within the teaching and learning environment. I found evidence of social capital resources available to educators and students, and the use of these resources in the classroom. This possible evidence included room layout, technology availability and usage, and workspaces, as well as evidence of outside social capital influences. I captured the human actions that took place within the classroom, which added to the body of research on the classroom as a community of practice as well as students' research-centered, knowledge-building communities of practice.

Artifacts and documents collection protocol. Appendix E contains the protocol I developed to examine the artifacts collected. The collection of artifacts and documents supported the assemblage of data that was not readily available through the interview and observation sampling methods. Artifacts and documents support the researcher in corroborating evidence

gathered using other methods (Tellis, 1997). The artifacts and documents collected for this case study included curricula vitarum, symposium programs, timelines, rubrics, web pages, student journals and lab notebooks, student posters, and graphic organizers. Reviewing curricula vitarum and these other artifacts and documents created by the educators helped me to identify the development and facilitation of communities of practice within the educator's teaching and learning environment.

This additional data collection technique strengthened the triangulation process of interpreting the data. Collecting artifacts and documents provides for unobtrusive access to data and adds to the database (Tellis, 1997). The protocol that I developed strengthened the database and supported the triangulation process.

Data Collection

Aurini et al. (2016) advised in-depth data collection in a case study approach. The protocols I developed enabled me to do an in-depth collection of data. Most of the data collection occurred within a singular on-site visit to the educator's classroom. I shadowed the educator for a partial day, which created the opportunity to conduct the semistructured interview and collect artifacts and documents during the non-instructional times. During the SRHS instructional times, I performed the observations. I purposefully did not observe the teacher during non SRHS instructional times, as I wanted to restrict my researcher perspective to the SRHS environment.

As the researcher, I used three means of data collection: interviews, observations, and artifact/document review. Collecting data by using multiple methods allows a researcher to identify lines of inquiry as they converged (Yin, 2014). I needed to attend to details when collecting the data; the protocols assisted in this work. Harrison, Birks, Franklin, and Mills

(2017) encouraged the use of multiple methods to collect and analyze data, as these methods work together to provide a more comprehensive and interactive representation of the problem being researched. The multiple methods of data collection led to a more complete, more inclusive, and richer representation of the best practices used by the educators in the study. Using multiple instruments and a variety of data types contributes to methodological rigor (Patton, 2002, p. 68). Using these multiple collection techniques assisted in my development of a meaningful explanation of the phenomena explored through the research questions.

Semistructured interviews. I chose the semistructured interview format as my primary data collection tool. Semistructured interviews allowed me to ask a standard set of questions that align with my research questions while allowing for flexibility and spontaneity in response with open-ended follow-up questions. Semistructured interviews allow for comparisons between participants through systemic data analysis. The researcher also may note how the participants responded to the structured and unstructured questions. According to Aurini et al. (2016), "semistructured interviews add additional data points, by aiding researchers in the analysis of how participants respond to questions" (p. 82). This ability to make comparisons is valuable in a multiple case study analysis.

The semistructured interviews took place at each of the schools, in the classrooms of the SRHS educators. The interviews took place during non-instructional time so that the educator and I were able to give full attention to the interview. With the exception of one case, I asked questions in a single 40-minute one-to-one session, with follow-up and clarification questions asked as time allowed based on the other instructional obligations of the teacher. In one case, the interview was split during two different time periods, as there were several unanticipated

interruptions during the first time period and I did not complete the questioning. This one-to-one session with the participant allowed me, as the researcher, to standardize the interview process with the participant while capturing each educator's unique teaching and learning environment. I recorded each interview on a form and included notations on my reflections. I also used an audio recorder to record the interview in order to refine my notes.

The interview questions allowed me to ask specific questions that capture how communities of practice develop within each of the participants' teaching and learning environments. These questions focused on the educator's actions, the students' actions, and the social capital networks and resources used by the educator and students. I sought to capture the educator's viewpoint on social capital availability and determine how the educator uses social capital to benefit students. I included questions regarding typical human actions of the educator and student. The final set of questions focused specifically on communities of practice; it was my intent to encapsulate the essence of the phenomenon of how communities of practice serve the geographically-isolated rural secondary school SRHS teaching and learning environment.

There are several benefits to conducting interviews in person. For this study, I conducted the interviews on-site. On-site interviews enabled me to conduct a visual survey of the community and the rural secondary schools as well as to solicit information in the physical surroundings of the educators. According to Aurini et al. (2016), "The ability to hear and see participants also allows [the researcher] to witness conscious and unconscious forms of nonverbal communication, including a participant's physical and emotional response to [the researcher's] questions" (p. 85). I took notes during and after the interview. I also recorded the interviews for further examination upon receiving permission from the participant.

Observations. I performed direct observations of the educators working with their science research students. Patton (2002) noted that, in qualitative inquiry, observations are particularly useful when the phenomenon is being studied where it occurs naturally. Merriam and Tisdell (2016) shared a checklist of elements to observe and questions to answer during research observations. The elements in the checklist include the physical setting, the participants, activities and interactions, conversations, subtle factors, and the researcher's behavior. I adapted my protocol to include these elements. Using this protocol enabled me to record as much detail as possible in the form of descriptions, direct quotations, and observer comments. This detail supported a more in-depth analysis and triangulation of the data.

Observations help to support the researchers in deepening the data collection process and works well when used with other methods. Through observations, I was able to collect spatial and visual representations to enhance the meaning of data collected through the interview process (Onwuegbuzie, Leech, & Collins, 2010). I was able to capture data in real time using the observation protocol (Tellis, 1997). Upon completion of the observation, a conversation regarding what was observed ensued between the researcher and the participant, which is known as *member checking* (Merriam & Tisdell, 2016). Member checking is an important strategy to ensure internal validity in the data collection process of the observation (Merriam & Tisdell, 2016).

Artifacts and document collection. Throughout the interview and observation data collection, I asked the research participants to provide me with artifacts/documents that would enhance the data collection process. These artifacts/documents helped me explore the phenomenon deeply, leading to a more thorough corroboration of findings from the interviews

and observations. These documents included scoring rubrics, milestone timelines, student/parent communications, abstracts, programs, student work, and exemplars. I also included in the collection process photographs of the tools and resources used in the classrooms. Additionally, when possible, I examined the SRHS teachers' websites as part of the artifacts collection process. I achieved consistent mining of data from the collected artifacts and documents by using the protocol I developed based on the work of Merriam and Tisdell and Miller as cited in Patton (2002). Miller (as cited in Patton, 2002) noted, "Researchers are uniquely positioned to study these texts by analyzing the practical social contexts of everyday life within which they are constructed and used" (p. 498). I recorded each artifact or document on a separate form.

Identification of Attributes

Through this study, I endeavored to understand how educators in geographically-isolated rural secondary school districts overcome a lack of community social capital required to support students through the open-inquiry SRHS dually-enrolled program of studies. The design of my study was exploratory. I successfully studied how teachers compensate for lack of social capital in a program of study that requires accessing social capital, thus empowering students to compete with their suburban and urban counterparts successfully. I sought to uncover the resource acquisitions, teaching methodologies, and differentiated instruction teachers employ to overcome a lack of social capital characteristic of high poverty, rural secondary schools, and their geographically connected communities. The attributes identified in this study are social capital, social constructivist instructional methodologies, inquiry learning strategies, best educational practices, and teaching and learning environments.

Operational definitions. I have identified the following operational definitions for the purpose of this study.

***Social capital*.** Lin (1999) offered this simple definition of social capital, "investment in social relations with expected returns." This definition works well for this study. The educators support their students through interactions and networking in order to produce an end product, the research paper.

***Human capital*.** Keeley (2007) defined human capital, "as the knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social, and economic well-being" (p. 29).

***Communities of practice*.** Wenger (2005) defined communities of practice as, "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (p. 1).

Structuration model of social capital, human action, and communities of practice. Abou-Zeid (2007) theorized the structuration model of social capital, human action, and communities of practice; noting that communities of practice and social capital are interconnected whereas social capital influences human action, human action and communities of practice provide reciprocal developmental benefits, and communities of practice develop additional social capital.

***Social constructivist instructional methodologies*.** In a social constructivist classroom, the teacher and student see knowledge as ever-changing and developing. This process of constructing meaning through learning is an ongoing process and highly individualized. This evidenced-based instructional methodology is action orientated, not passive. In social

constructivist, teaching and learning environments are characterized by collaborative interactions among peers that are structured and facilitated by the educator (Danielson, 2007; Mogashoa, 2014).

***Inquiry learning strategies*.** Inquiry learning is congruent with social constructivism. The defining difference is in the autonomy given to the learners by the educator. Inquiry learning ranges from structured to guided, to open learning environments. The flexibility in inquiry learning is in the educator's autonomy to adjust the teaching and learning environment along the continuum of the teacher as the facilitator and the teacher as the guide (Zion & Mendelovici, 2012).

***Best educational practices*.** The Educational Opportunities Association (EOA) National Best Practices Center (2018) defined best educational practices as "the wide range of individual activities, policies, and programmatic approaches to achieve positive changes in student attitudes or academic behaviors" (para. 3). This definition is further expanded to designate the varying levels of evidence supporting practices and levels of complexity.

Promising education practice. A requirement of identifying a promising educational practice is to provide detailed information about the practice and how it is implemented. However, a rigorous and thorough evaluation has not been completed yet (EOA National Best Practices Center, 2018).

Evidence-based (validated) education practice. An evidence-based or validated educational practice has undergone a rigorous and thorough evaluation in one educational setting and has documented positive student outcomes (EOA National Best Practices Center, 2018).

Exemplary education practice. Exemplary educational practice is validated through multiple replications in multiple settings and has a demonstrated positive student outcomes record with similar results (EOA National Best Practices Center, 2018).

Best education practice activities. Best education practice activities are actions or behaviors implemented by educators to make a positive impact on student learning behaviors (EOA National Best Practices Center, 2018).

Best education practice programs. Best education programs are coordinated collections of best practice activities (EOA National Best Practices Center, 2018).

Teaching and learning environments. Teaching and learning environments have both direct and indirect influences on student learning, including the students' engagement in what is taught, their motivation to learn, and their sense of well-being, belonging, and personal safety (Danielson, 2007). There are components that the teacher has influence over and there are components that the teacher has no control over (Great Schools Partnership, 2014). The attributes that this study focused on are those components that the SRHS educator has control over or the ability to manipulate.

Data Analysis Procedures

According to Patton (2002), "Qualitative analysis transforms data into findings" (p. 432). As the researcher, I needed to examine my data with an open-minded approach by looking at it in multiple ways to determine the transformation process of raw data into knowledge (Patton, 2002). This analysis began as early as the first interview, continued through the semistructured interview, observation, and document/artifact collection. Merriam and Tisdell (2016) noted that "data collection and analysis are simultaneous activities in qualitative research" (p. 191). As I

began the data collection process, I gained insights that were worth further exploration. These insights allowed me to re-align and adjust questioning and guided evidence gathering through an interactive approach. The rigor of my study comes from this interactive approach, as I fully developed descriptions, probed participants, interpreted perceptions, and triangulated the data collected (Merriam & Tisdell, 2016). As I described in the data collection section above, the collected data of this study consisted of recordings of teacher interviews, observation notes, and artifacts and documents review. In the following section, I describe how I underwent this ongoing data analysis process.

Inductive analysis framework. I analyzed the data using the inductive framework outlined by Hatch (2002). The inductive framework seeks to develop a new theory which emerges from the data collection process, rather than testing a theory or hypothesis (Hatch, 2002). Inductive thinking supported my specific thinking about distinctive data points that began with the initial data collection process. My thinking evolved to become more general as the research process proceeded (Hatch, 2002). Data analysis occurred at the start through initial coding within individual interviews, observations, and artifacts/documents of each case. As each case is analyzed, commonalities came to the forefront, and common statements about the phenomena developed (Hatch, 2002). I then compared these statements through focused coding among the multiple cases. In the multiple case study analysis process, I searched for patterns through focused coding, and the codification process developed as I identified frames and domains within each case. Focused coding is more iterative and thematic than initial coding (Aurini et al., 2016). Using the inductive framework supported theory development in my multiple case study to answer the research questions I had developed.

Hatch (2002) developed nine steps for conducting an inductive analysis. The first step is to read the data every time I add to it, before I begin collecting more data. As I did this, I asked myself, “What will be my frames of analysis?” (Hatch, 2002, p. 163). By asking this question repeatedly, I began to see multiple frames of analysis emerge which led to levels of specificity when examining the data by (Hatch, 2002). These frames supported the next step, which was creating domains.

Domains are created based on semantic relations. Hatch (2002) cautioned the researcher not to predetermine the semantic relationships of the domains too early in the study. Based on this advice, I examined all of the available evidence to see all of the different kinds of semantic relationships. When I finished identifying multiple domains through various semantic relationships, the next step was to decide which domains might be the most important for answering my research questions (Hatch, 2002). To keep track of the identified domains most appropriate to my study, I developed a coding system. This step resulted in domain sheets with categories that offered further data analysis exploration (Hatch, 2002). As new data are added, it was essential to continue to update this process through re-reading, identifying examples, adding terms, and re-assessing salient domains with supporting data and counterevidence (Hatch, 2002).

The next step “is to study the data . . . in ways that allow the discovery of new links, new relationships, new domains” (Hatch, 2002, p. 172). It is during this step in the process that the complexity of the data and the relationships linking the data developed. This analysis allowed me as the researcher to more richly and deeply examine the data. After studying the links between the data domains, it is essential to look at the connections between the domains through frequency and comparison coding (Aurini et al., 2016). As a researcher, I needed to determine

how the domains fit together as a whole to create new meaning. At this stage, I was looking for themes to develop. These themes focused on the social environment of the SRHS geographically-isolated rural teaching and learning environment. These steps led to the formation of a master outline of themes, which influenced the discussion of results (Hatch, 2002).

The last step was to find evidence from the data to support the themes identified in the outline (Hatch, 2002). The inductive analysis approach allowed me to retrieve the information garnered from interviews, observations, artifacts, and documents. I organized and analyzed the data in a process that is representative of the geographically-isolated rural teaching and learning environment.

Because this is a multiple case study, I needed to complete the inductive analysis within each case as well as across all five cases. The analysis occurred with each separate case first. I then worked on developing patterns of commonalities and explanations across the cases. The challenge was to organize the raw information thoroughly within each case, and not to be overwhelmed by the multiple case study data (Merriam & Tisdell, 2016). The inductive analysis framework provided the scaffolding to successfully analyze individual cases as well as conduct a cross-case analysis for the multiple case study.

Limitations of the Research Design

Conducting a qualitative study has its limitations. Researchers must "engage their own intellectual capacities to make sense of qualitative data" (Hatch, 2002, p. 148). As the researcher, I needed to engage actively in the data collection process to make sense of the data collection. Like any researcher, I brought certain personal biases to the study. For instance, at the time of the study, I provided administrative support to the SRHS program of studies for the geographically-

isolated rural secondary school. This support resulted in a significant historical experiential background and ownership, which I did my best to account for during the data collection and data analysis processes. I needed to be careful not to impose and represent my vision for the program of studies into the data collection. My background knowledge of the program might have hindered me from probing deeply into participant responses, so I needed to be careful not to make assumptions about the participants' responses and corresponding meanings to their responses. Additionally, the familiarity I had with the SRHS program of studies could have led me to miss information because I expected certain responses based on what I know of the program of studies. Personal biases such as these can lead to incomplete and inaccurate data collection, which leads to a lack of rigor in the research study. Lack of rigor comes from the careless gathering of incomplete data and collection of evidence in an unduly biased fashion, which leads to false and inaccurate conclusions (Lin, 1999). In order to warrant rigor, I needed to approach this limitation with integrity in the data collection and data analysis process void of presuppositions, thus thwarting the criticism that qualitative studies are shallow or biased.

Often, the challenge of research is matching the methodology of choice to the research questions and purpose (Patton, 2002). This study's research questions and purpose were well suited to a case study methodology. However, this does not mean there were no limitations to the use of a case study. One of these limitations was that the management of extensive data can be challenging. I needed to complete a systemic process in order to go beyond the surface level of analysis (Merriam & Tisdell, 2016). The choice of a multiple case study expanded the representation of data beyond that of a single case study design. Making sure that there is a

complete representation of data collection and analyses through the multiple case study methodology is a prospective solution to the single case study approach.

This multiple case study also had several delimitations put on the study based on boundaries I established. The population of schools to sample was finite, as I predicted only a few educators qualified as participants from geographically-isolated, rural secondary schools. It is also important to note that there was only one teacher identified in each geographically-isolated rural secondary school, and these teachers did have course obligations beyond SRHS. By virtue of student enrollment in these geographically-isolated, rural secondary schools, course sections varied slightly from one to two and varied appreciably in student population size from three to 20. I also chose not to include interviews with other participants in the teaching and learning environment, leaving out students, community members, administrators, and parents. Finally, this study only has implications for SRHS teachers in geographically-isolated, rural secondary schools, although transference of some of the discussion may be possible. The boundaries of the research study were determined by these delimitations.

Validation

Qualitative researchers use several strategies to increase the validity of their research. This multiple case study is designed to examine similar cases individually in detail to better understand the whole (Stake, 2006). The value of using a multiple case study in this study was one of relevance; the study of the strategies used by multiple experienced SRHS educators was more likely to support the development of other diverse groups of educators. The more information gathered, the greater the tacit knowledge about how educators in geographically-isolated, rural secondary schools overcome a lack of social capital leading to students' success in

the SRHS program of studies. Increasing tacit knowledge and relevance for transference of identified strategies leads to the increased validity of the research study, allowing for transferability not only to the researcher but also to other educators (Stake, 2006; Yin, 2014). Accessing social capital within the context of the geographically-isolated, rural secondary schools' SRHS program of studies was a phenomenon that had not been studied, yet had the potential to offer transferability benefits to the SRHS professional learning community.

Credibility. Patton (2002) noted elements that need to be present for credibility to be recognized. The first is to use rigorous methods when conducting fieldwork (Patton, 2002). In this multiple case study, using the semistructured, interview, observation, and artifact/document protocols helped me establish credibility through continuity and commonality. Using these multiple methods also promoted the capturing of rich, descriptive texts and avoided inadvertent sidetracking and omission of valuable data (Patton, 2002). All three data collection means were needed to establish credibility.

The second element of credibility I used in this study is member checking. Member checking enables participants to review the data collected and to validate recordings, thus minimizing false interpretations (Patton, 2002). The researcher must heavily monitor, avoid and minimize false interpretations and must be prepared, present, open-minded, and unobtrusive, censoring their actions and words so that there is no undue influence on the participants (Patton, 2002). Member checking occurred after the notes from the semistructured interviews and observations were transcribed. The participants received these notes via secure email prior to the initiation of the coding process. Member checking helped me to ensure credibility by preventing false interpretations on my part.

Dependability. Dependability means making sure that the data collection is reliable. Merriam and Tisdell (2016) referred to dependability as methodological reliability. Methodological reliability is defined as providing consistent approaches to instrumentation in obtaining results (Merriam & Tisdell, 2016). Therefore, methodological reliability is heavily dependent upon the ethical integrity of the researcher. The assurance that the researcher practices methodological reliability stems from prolonged engagement, member checking, and triangulation of data, well-developed descriptions, and audit trails through journaling (Merriam & Tisdell, 2016). Triangulation allows the researcher to compare and contrast the data collected in the analysis process (Merriam & Tisdell, 2016). I began member checking and triangulation following the observation and at the culmination of the data transcription process and kept well-developed descriptions for each of the methods used (Merriam & Tisdell, 2016). Journaling allowed me to track these descriptions and include my analysis and interpretations as well as actions as a researcher. These records supported additional validity (Merriam & Tisdell, 2016). Consistent methods of operation with research integrity led to dependable data collection and results.

Expected Findings

I expected that the educators would share science inquiry and constructivist teaching and learning methodologies based on the SRHS program of studies intent and goals to overcome a lack of social capital present in their geographically-isolated rural community. I projected that these educators would have adapted their methods, resources, and tools to meet the needs of their students. I also anticipated engaging in conversations with participants regarding the reflective practice and subsequent modifications that had resulted. As expected, artifacts and documents

that indicated scaffolding for student success surfaced, and my observation of classroom interactions helped me further understand the teaching and learning evolution. Through the study, I expected to uncover how geographically-isolated SRHS rural secondary school educators used tools and resources, employed specific pedagogical teaching methodologies and strategies, and provided student alterations endeavoring to overcome a lack of community social capital to support their teaching and learning environment.

Ethical Issues

This multiple case study was designed to be an ethical study, with the intent to approach the research data collection process in a principled manner. I treated participants humanely, and participants had access to the data collected to verify as valid and reliable. I explored and accounted for potential ethical issues during the research process, noted conflicts of interest and eliminated related data if these conflicts had the potential to reduce the validity and reliability of the study. My position as researcher in the study was openly shared with the participants. Qualitative case studies require the researcher to work with participants on a one-to-one basis for a length of time; therefore, ethics, in this case, have to do primarily with the effect of the research on the participants (Aurini et al., 2016). I believe that my research was minimally invasive to the participants personally and professionally within their teaching and learning environments.

Conflict of interest assessment. As the researcher, I was personally invested in the success of the SRHS program of studies. At the time of the study, I had a professional association with the SRHS program of studies. I enjoyed a collaborative, collegial relationship

with the SRHS educator in the district and had no supervisory responsibilities over her. One of my sons had completed the SRHS 3-year program

Researcher's position. I served as the interviewer, observer, and artifact/document collector throughout the entire data collection process. I needed to remain cognizant of my enthusiasm for the SRHS program of studies and bracket my feelings and biases so as not to influence my participants' responses. It is impossible to divest our humanness as researchers; instead, we need to acknowledge our humanness and look to how we can reveal how these biases support the translation in our data analysis process (Stake, 2006). I followed this practice for addressing and adjusting for bias as I conducted my research.

Ethical issues in the study. Patton (2002) shared an ethics checklist for qualitative researchers to consider when interviewing and observing participants. The researcher should first explain the purpose of the study to the participants (Patton, 2002). I disclosed this purpose in the initial email contact and follow-up contacts before beginning the interview and observation(s) with each participant. Because one of the boundaries of the study was to have actively taught in the SRHS program for 3 years, there was not a need to explain the program comprehensively. I did not want to lead the participants by too much of an explanation. I did believe it was vital that the participants were aware that I intended only to study educators of geographically-isolated, rural secondary schools and this is why they were chosen as a participant. I informed participants that there is no immediate tangible benefit to them for participating. However, the study had the potential to lead to increased professional development benefits for their less experienced colleagues. Sharing the concerns and benefits of participating in the research study is a crucial step in transparency (Patton, 2002).

This study posed minimal risks to the participants and the participants' students. The two data collection means that posed the highest risk to participants and the participants' students are the interview and the observation. Inherently, the process of interviewing causes the participant to reflect and respond in a way that they may not have previously considered or acknowledged. Explaining this to the participant is critical; as a researcher, I needed to acknowledge even the most minimal risk. Observations may also influence the participants in unexpected ways. The presence of the researcher may cause the participant and their interactions with their students to change within the teaching and learning environment (Patton, 2002). Minimizing this effect by establishing a rapport with the participants was critical to conducting an ethical research study.

It is vital to secure informed consent that assures confidentiality after the disclosure process (see Appendix E). Informed consent protects the researcher and their research institution as well as reviews the purpose and risks associated with the study for the participant (Merriam & Tisdell, 2016). It promises reasonable confidentiality, and the process of data maintenance is outlined (Patton, 2002). In this research study, I used pseudonyms for the participants and eliminated any potentially identifying information. I acknowledge that it may not be possible to mask the participants entirely from others who have an intimate knowledge of the SRHS program of studies within their school environment. These individuals may be able to infer the participation of an educator they know. Because the interview questions did not address highly sensitive information, this concern is minimal. I was the only person with access to the participants' direct responses and the observations. I did not share portions of the artifacts and documents collected within the dissertation. However, I did refer to artifacts and documents in the results discussion. Finally, all of the data collected including the notes, interview

transcriptions, and any other identifying participant information were a locked file cabinet in my personal possession and I intend to shred the data three years from the publication of my dissertation.

Summary

This qualitative, exploratory multiple case study explored practices employed by geographically-isolated rural secondary school educators who teach the SRHS dually-enrolled program of studies. The purpose of this research study was to explore and characterize the best educational practices of geographically-isolated rural secondary school educators in their SRHS program of studies teaching and learning environment. This study was designed to help practitioners and researchers understand how geographically-isolated rural secondary school educators leverage their resources and acclimate the teaching and learning environment to overcome a deficiency of community social capital.

In this research study, I used three means to collect data during the data collection process. These means were interviews, observations, and artifact/document collection. The data analysis process began in conjunction with the data collection process. I analyzed the data using the inductive framework outlined by Hatch (2002). Inductive thinking supported my specific thinking about distinctive data points that began with the initial data collection process. This study had a minimal potential risk to the participants and negligible ethical concerns. As with all qualitative research, there was the possibility for researcher bias. It is essential to minimize this bias when collecting data from the participants and to provide transparency in the data analysis process. The information gathered in this research study may support the work of rural educators and provide professional development for inexperienced SRHS educators.

Chapter 4: Data Analysis and Results

Introduction to Data Analysis and Results

The purpose of this study was to explore the challenges geographically isolated rural SRHS teachers face due to a lack of naturally occurring communities of practice within their geographic location. The multiple qualitative case study was aimed at exploring how rural secondary school science teachers transcend rural community isolation by leading their students to establish communities of practice within a dually enrolled research science program of studies, with a focus on a lack of community social capital. Although the dually enrolled research science program of studies has core program requirements and curriculum guidelines, there is educational autonomy in its implementation at each site. Educational autonomy enables rural secondary school science teachers to differentiate their secondary schools' dually enrolled research science program of studies based on student interest, needs, and resources. Thus, creating a learning environment where social capital and human capital impact the development of communities of practice, an essential component of the scientific inquiry-based research process.

Chapter 4 builds upon the literature review and methodology of Chapter 2 and Chapter 3, respectively. Chapter 4 includes an introduction and a review of the focus of this study. The research sample is discussed and a synopsis of the initial findings is provided, followed by the presentation of data and the results as it relates to the main research question and the four subquestions. The data analysis application with respect to the multiple case study methodology is re-examined. Finally, a chapter summary is given.

A qualitative multiple case study design was used, allowing the researcher to explore the phenomenon within the context of the rural school research-science, a dually-enrolled teaching and learning environment (Baxter & Jack, 2008). I studied the teaching and learning environment as it functioned but did not seek to control the research environment within the context of the environment; no boundaries existed between the study and the environment (Baxter & Jack, 2008; Stake, 2006).

In addition to serving as primary researcher, I have a professional role with the SRHS program of studies. Therefore, I made an effort to establish independence from my professional role and drew boundaries between that work and the research that I conducted for this study. As the principal researcher, I explained the purpose, benefits, and risks of participation in the research study to each participant and assured that strict confidentiality of the data would be maintained throughout the study and upon completion of the study. Patton (2002) stipulated the researcher's ethical responsibility regarding confidentiality and the value of sharing with potential participants the measures the researcher is taking to safeguard confidentiality. The confidentiality practice was outlined in my protocols for the structured interview and was reiterated during my initial contacts, school visits, follow-up contacts, allowing participants to contribute to the study by sharing information freely.

The data collection process resulted in a database that exceeded over 125 typed pages of transcribed notes collected from structured interviews, semistructured interviews, and observations of educators in their distinctive SRHS teaching and learning classroom environment. The database also included notes of the analysis conducted using the pre-established protocol on all artifacts and documents collected from each participant. The analysis

process began with the first interview and continued simultaneously throughout the collection and transcription process to allow for triangulation of the data set (Merriam & Tisdell, 2016). I personally transcribed all interviews and observations to increase my familiarity with the data. To improve the inductive analysis process, I listened to and reread the data while I added to it. Repeated review of the data supported the purposefulness of the data collection and analysis process allowing me to focus on reoccurring patterns, phrases, and themes in the codification process (Aurini et al., 2016). Once the transcription process was completed, I reviewed the data sources from each case and identified the common phrases and themes within each of the cases. It was at this point in the process that I began looking for multiple domains that might be the most important for answering my research question (Hatch, 2002). I developed a coding system to track the domains and began highlighting evidence within each of the data sources that supported the domains. After coding, I looked across the data and discovered links in the data among the five cases. Crosslinking of domains allowed me to identify common themes through frequency and comparison coding (Aurini et al., 2016). It was through this process that I recognized and classified the themes as they related to my main research question and four subquestions. I outlined my process in Table 1.

Table 1

Analytical Strategies Within and Across the Five Cases

Comparison	Data Source	Purpose	Strategy	Domains and Themes Common Across Cases
Individual Cases	Structured interviews Semistructured interviews Observations Artifact and document reviews	Identify the common language and phrases across multiple data sources within each case	Transcription of the notes Close reading and re-reading of interview transcripts, observation notes, and documents to identify common language, phrases, and themes	Teacher willingness and dedication to research science and education Fostering student supported inquiry Exhibiting high levels of teacher efficacy Teacher demonstration of growth mindset Organization and management of the teaching-learning environment
Across Individual Cases	Five sets of common phrases, coded domains, and themes across multiple data sources gathered from individual cases	Identify reoccurring coded domains and themes across the individual cases	Close reading of the domains and themes across the multiple data sources and cases	Building mentor capacity and relationships Belief and understanding of the constructivist pedagogy Intune to the social and emotional well-being of students Recognized the need for networking and has the skills to strategically network
Across Individual Cases	Reoccurring themes across individual cases	Refine themes and codes to answered RQ and subquestions		Understands the need to develop resource capacity

One central research question and four subquestions were used to guide the qualitative multiple case study. The central research question that provided the focus for this study was, "How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?"

The four subquestions that guided my analysis were:

- How do the human actions of the educators compensate for a lack of social capital caused by geographic isolation?
- What are the human actions that allow the educators to enhance students' involvement and participation in the community of practice?
- What are the factors that allow a community of practice to harness limited social networks and resources to establish legitimization for the student member?
- How does social constructivist learning through communities of practice support the evolution of the student knowledge-acquisition process?

The research questions will provide readers with a guide for this multiple case study and a better understanding of the SRHS dually enrolled research science program of studies.

The semistructured interview questions were written to guide the interview process and provided a reference for the interview and the participants. The intent of these questions was to guide the discussion towards answering the research questions while providing latitude for the researcher to probe and explore the topic more deeply (see Appendix C). Table 2 shows the mapping of the semistructured interview questions with the secondary research questions.

Table 2

Mapping of Semistructured Interview Questions

Subquestions	Semistructured interview questions
How do the human actions of the educators compensate for a lack of social capital caused by geographic isolation?	IQ2, IQ3, IQ4
What are the human actions that allow the educators to enhance students' involvement and participation in the community of practice?	IQ1, IQ4, IQ10
What are the factors that allow a community of practice to harness limited social networks and resources to establish legitimization for the student member?	IQ3, IQ6, IQ8, IQ9
How does social constructivist learning through communities of practice support the evolution of the student knowledge-acquisition process?	IQ5, IQ7, IQ9, IQ11

Description of the Sample

Participants were chosen based on the purposeful, convenience sampling. Nine SRHS secondary schools were originally identified as having potential participants through the process of cross-referencing the New York State Center for Rural Schools' identification of rural and the list of approved programs/educators on the SUNY UHS website. Only schools identified as rural fringe, rural distant, and rural remote by the New York State Center for Rural Schools were included in the initial sample. As part of the SUNY criteria, educators had to be from an approved SUNY SRHS secondary school program and have received approval through SUNY to teach the SRHS program of studies. Additionally, these educators must have taught a minimum of three consecutive years as a SRHS teacher.

From the original SRHS educators identified, recruitment emails were sent to all nine potential participants. I received five interested responses and one response declining

participation. Three recruitment email contacts were followed up upon and remained unresponsive. From the potential nine participants, three females and two males, a total of five participants agreed to participate in the study. Therefore, this qualitative multiple case study used data from five different SRHS educators teaching at five different secondary schools. Five cases to study is a reasonable number to provide rich data sets in which to identify themes and conduct a cross-case analysis of the data in a multiple case study (Creswell, 2014). All five participants participated in a one to one structured phone interview, completed a semistructured interview on site, allowed their teaching and learning environment to be observed, and provided the opportunity to gather relevant artifacts and documents. The respective semistructured interviews, observations, and artifact and document collection were conducted on-site during one school day for each participant. All site visits occurred during the first two weeks of June 2019. The two-week data collection period allowed me to capture data within the same relative cycle of the SRHS program of studies; the students were wrapping up their studies and preparing for their summer work, and all of the secondary schools had recently held their annual symposium. The tight time frame ensured consistency of the educators' frame of reference. Likewise, member checking of the notes collections also occurred within a consistent time frame, during the fall of 2019. To protect the identities of the participants and schools, the participants were assigned letter codes (A-E). Participants and corresponding schools were referred to using these letter codes and are identified by these letters in the results and analysis section. The letter coding was used to maintain confidentiality. To protect schools from being identified through their locale types, no distinction was made in the collection, results, and analysis processes between the locale types of rural fringe, rural distant, and rural remote.

Research Methodology and Data Analysis

Qualitative multiple case study. Qualitative research allows for an inquiry-based, exploratory study of a phenomenon, and a multiple case study approach supports the exploration within the context of several teaching and learning environments (Baxter & Jack, 2008; Stake, 2006). I used the multiple case study approach to conduct a detailed study of a SUNY dually enrolled SRHS program of studies within a rural secondary school context. My goal was to study the behaviors and strategies used by rural SRHS secondary school educators to build communities of practice in their teaching and learning environments and provide evidence of how they utilized and developed social and human capital within their professional practice.

In this study, I examined professional practices through the participants' accounts of activities involving inquiry-based scientific learning and constructivist teaching methodology within each participants' teaching and learning environment. Additionally, I examined these instructional frameworks within the context of supporting the use of interpersonal skills to access and grow social and human capital, which is valuable to the successful acquisition of skills needed for postsecondary employment and studies.

Data collection and analysis. I used multiple data collection techniques to explore the actions of the educators and their use of instructional tools and resources to foster communities of practice. I collected the data using structured interviews, semistructured interviews, observations, and artifact and document gathering. The data I collected was coded with the intent of identifying common themes among the five cases, which are discussed in this chapter. The structured interview allowed me to determine the eligibility of each participant and their willingness to discuss their teaching and learning environment. Through each semistructured

interview, I was able to identify details about the teaching and learning environment of the educators and their constructivist pedagogical approach to scientific inquiry through their dually enrolled research science program of studies. I recorded teacher actions in their teaching and learning environment throughout the observation process. The artifact and document collection allowed me to gather supportive data that furthered the theme development begun during the semistructured interviews and observations.

The first data collection technique was the structured interview. The structured interview required me to ask predetermined established questions (see Appendix B). I conducted each structured interview via a telephone conversation. During the conversation, I explained the purpose of the study and verified the potential participant's eligibility in accordance with the previously identified criteria. All five potential participant respondents met the criteria of actively teaching in their secondary school's dually enrolled research science program of studies for a period of three or more years. Additionally, they indicated that they had completed a Master of Science degree in either Education or Science, completed the SRHS week-long training, filed an approved curriculum with SUNY, and received an endorsement from the University as an adjunct professor. They also agreed that their secondary schools were accurately identified as rural. All five potential participants were ready to host me on their campuses for an in-person semistructured interview and observation and were willing for me to collect applicable artifacts. These potential participants indicated they would be willing to review my transcribed notes following the semistructured interview and observation as well as answer any follow-up questions as needed. Upon completion of the five structured interviews, I decided to conduct site visits with all five participants for inclusion in my database.

The second data collection technique used was semistructured interviews, which I conducted on-site with each respective participant. I used a semistructured interview protocol to collect data from each respective participant for my data collection process (see Appendix C). To begin the semistructured interview, I introduced myself, explained my role as the principal researcher, and shared the purpose of the study with the participant. I also explained the requirement of recording our conversation, reviewed confidentiality protection measures, and secured signed consent to continue with the data collection process. Each interview lasted approximately 40 minutes (see Appendix C). I followed up by asking participants additional clarifying questions as well as probing questions when responses required further explanation for me to consider them for the dataset.

I conducted classroom observations of approximately 40 minutes per class to further the data collection in this study. Observation information was recorded using the observer protocol (see Appendix D), observations were also recorded and later transcribed. The observations centered primarily on the teachers' actions and behaviors. Although I observed exchanges between the teachers and students, I only recorded the teachers' words. A total of six classroom observations were completed as part of this study, as one of the participants had two class sections in their research-science program. I took detailed notes throughout the observations using the designed protocol; these notes included identifiable behaviors. I also recorded each classroom observation; recordings were transcribed and added to the dataset. In each of the cases, member checking occurred as an essential strategy to ensure the validity of the data collection process (Merriam & Tisdell, 2016).

The fourth data collection technique used in this study was the collection of artifacts and documents. The collection of artifacts and documents supported and added to the semistructured interview and observation dataset. The artifacts and documents I collected included milestone timelines, rubrics, exemplars, organizational tools, and student work. Notes were recorded from the review using the artifact and document review form (see Appendix E). The process of mining data from artifacts and documents allowed me to more deeply explore the contextual elements of the research-science teaching and learning environment. I reviewed the notes to identify additional data, which supported the common themes identified through the semistructured and observation datasets.

Multiple data sources. In this multiple case study, I used three different data sources, recorded interviews, recorded observations with field notes, and artifact and document review notes. The data collected from these three data sources was triangulated to corroborate and validate meaning. The collection of data through multiple methods allows the researcher to identify converging lines of inquiry; this method of data collection is known as methodological triangulation (Yin, 2014). Using multiple instrumentation increases methodological rigor, producing a more complete, inclusive and richer representation of the data (Patton, 2002). I was able to use multiple data sources to learn more about the educators' thoughts, behaviors, and pedagogical practices within their teaching and learning research-science classrooms through the interview processes. The observations supported a more in-depth study of the environmental context of the classroom. The interview accounts were compared with the actions observed within the classroom environment. The analysis of artifacts and documents furthered the dataset

with additional evidence. Through the triangulation of the datasets, I was able to verify consistencies and clarify the data analysis.

Data analysis. I analyzed the data using the inductive framework outlined by Hatch (2002). The data analysis process occurred from the beginning of the collection process with the initial coding of the individual interviews, observations, and artifacts/documents collected from each case. I used an open-minded approach to analyze the data in multiple ways, beginning with each case and proceeding through each of the cases. An open-minded approach to the data analysis process minimizes researcher bias (Patton, 2002). As I analyzed each case, commonalities came to the forefront and ideas developed. The data collection process and analysis were conducted simultaneously, and I adjusted and re-aligned to deepen the evidence gathering process as I proceeded through the data collection process. This interactive approach is a common practice when conducting qualitative research (Merriam & Tisdell, 2016).

I then compared these ideas as I collected additional data and identified patterns among the cases using the inductive framework. All of the transcribed datasets were reread multiple times and analyzed within each case and across all five cases. Codes and domains emerged through this process of reading repeatedly and assessing for saliency. As I continued through the coding process, my coding became more focused and thematic, allowing me to recognize semantic relationships and distinguish themes that provided discussion material for addressing my research question and subquestions. The coding became more replicable and thematic as I proceeded through the process (Aurini et al., 2016).

The following steps were used to triangulate the data collected in this research study.

1. Data were collected from the structured interviews, semistructured interviews, observations, and artifacts and documents of five cases. I kept field notes. Each case was read and reread starting with the initial collection date. I also recorded in my research journal my initial reflections.
2. The semistructured interviews and observations were audio-recorded on two different devices to ensure accuracy and back-up data protection. Pictures were taken of the artifacts and documents collected.
3. The interviews and observations were personally transcribed using Word. The artifact and document protocol was completed on each data sample collected. During this process I looked for sematic relationships within the data.
4. During and immediately following the transcription process data were coded using a multi-colored high-lighting system for domains within each case.
5. Triangulation occurred as data were coded and re-coded and organized into frames and domains.
6. The cases were compared among each other to search for commonalities and domains were examined for saliency and solidified with supporting evidence.
7. I next mapped out the identified domains and studied the linking relationships I was able to recognize as themes to create new meaning.
8. Mapping of the domains and links led to my development of a master outline to discuss my results.

9. I completed the analysis process by citing the evidence that supported the elements demonstrated in my master outline (Hatch, 2002).

Summary of Findings

The study was guided by one central research question, which focused on geographically-isolated rural secondary school SRHS educators. Four subquestions centered my questioning so that I could better understand how the participants utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for the purpose of student knowledge acquisition.

The four qualitative data collection methods used were structured interviews, semistructured interviews, observations, and document and artifact review. The structured interview was a phone interview and lasted approximately 5–10 minutes. The semistructured interviews and observations occurred within the classroom environment. Classroom observations occurred during full class periods of approximately 40 minutes in length. Artifacts and documents were collected from the classroom environment, and the webpages of the participants. Including artifacts and documents in the data collection method allowed me to collect data within the participants' natural teaching and learning environment. Research conducted within the natural environment supports the researcher in developing contextual, specific knowledge leading to stronger researcher understandings (Stake, 2006).

All five participants were eager to discuss their SRHS program of studies with me, and their passion for the program was evident in their willingness to participate and requests to see my final publication upon completion. Participant A shared about his own professional growth as a SRHS educator, "I think for me it has been one of the most challenging, and one of the most

interesting, and one of the most exciting journeys that I could have taken as an educator." Additionally, Participant C emphasized eagerness to see the results of the study, stating, "I am excited to hear about what you learn." All participants willingly shared information through all of the data collection methods.

All of the five participants taught in rural secondary schools using the designation status determined by New York State Center for Rural Schools. Three of the participants were female, and two of the participants were male. Of the five participants, one taught at a school which fits the criteria to be a remote rural school, two taught at schools that fit the criteria for distant rural schools, and two taught at schools that fit the criteria for fringe rural schools. All five participants had been teaching SRHS program of studies for at least four years. Four of the five participants taught one section of SRHS, and had four other teaching assignments throughout the day. One of the participants taught two sections of SRHS and had three other teaching assignments. Class section loads ranged in size from three students to 20 students. All five secondary schools used the traditional nine-period schedule with scheduled periods ranging from 40–45 minutes in length. There was a high level of consistency among the administrative components of all five classroom learning environments such as classroom physical, space, and scheduling, except for the significant variation in class section load size.

All five participants were observed and demonstrated competency in their teaching preparation as science research educators. During the structured interview collection phase, I successfully verified that all of the participants had completed at least one master's degree, had completed the 40-hour SRHS required professional development, and were approved adjunct professors for the UHS SRHS Program of Studies. The semistructured interviews provided data

to support educator competency and self-efficacy. All five participants expressed confidence in their teaching preparation and skill set to teach the SRHS program of studies.

The central research question for this study was, “How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?” Throughout the data collection process it was clear that the participants did utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environments to support the knowledge acquisition process for their students. Participant C summed it up well, noting, “In some ways having fewer resources, [requires] having [the students] take on more of the role of the scientist and own it, and then they become part of the community in a more authentic way.”

The central research question was supported by four subquestions, from which themes emerged. The subquestions were used to formulate the questions I asked in my semistructured interview and supported my evidence gathering process. The subquestions bracketed my quest for clarity in answering my central research question. The analysis of data began by examining each of the four subquestions in isolation. Through the examination process, themes became apparent with associated subthemes (see Figure 1). These themes did cross the subquestions, as the subquestions were purposefully designed to support the semistructured interview data mining process to answer the central research question, as demonstrated in Figure 1. Additionally, there was a level of subjectivity and individual variation among participants in their response to the semistructured interview questions due to their interpretation of the interview questions. The semistructured interview questions were designed to elicit data in a holistic, inclusive sense,

explaining the repetition purposefully designed within the protocol. Therefore, the presentation of the themes is not specific to the subquestions and are presented in a holistic, inclusive manner to understand the web of connections as demonstrated in Figure 1.

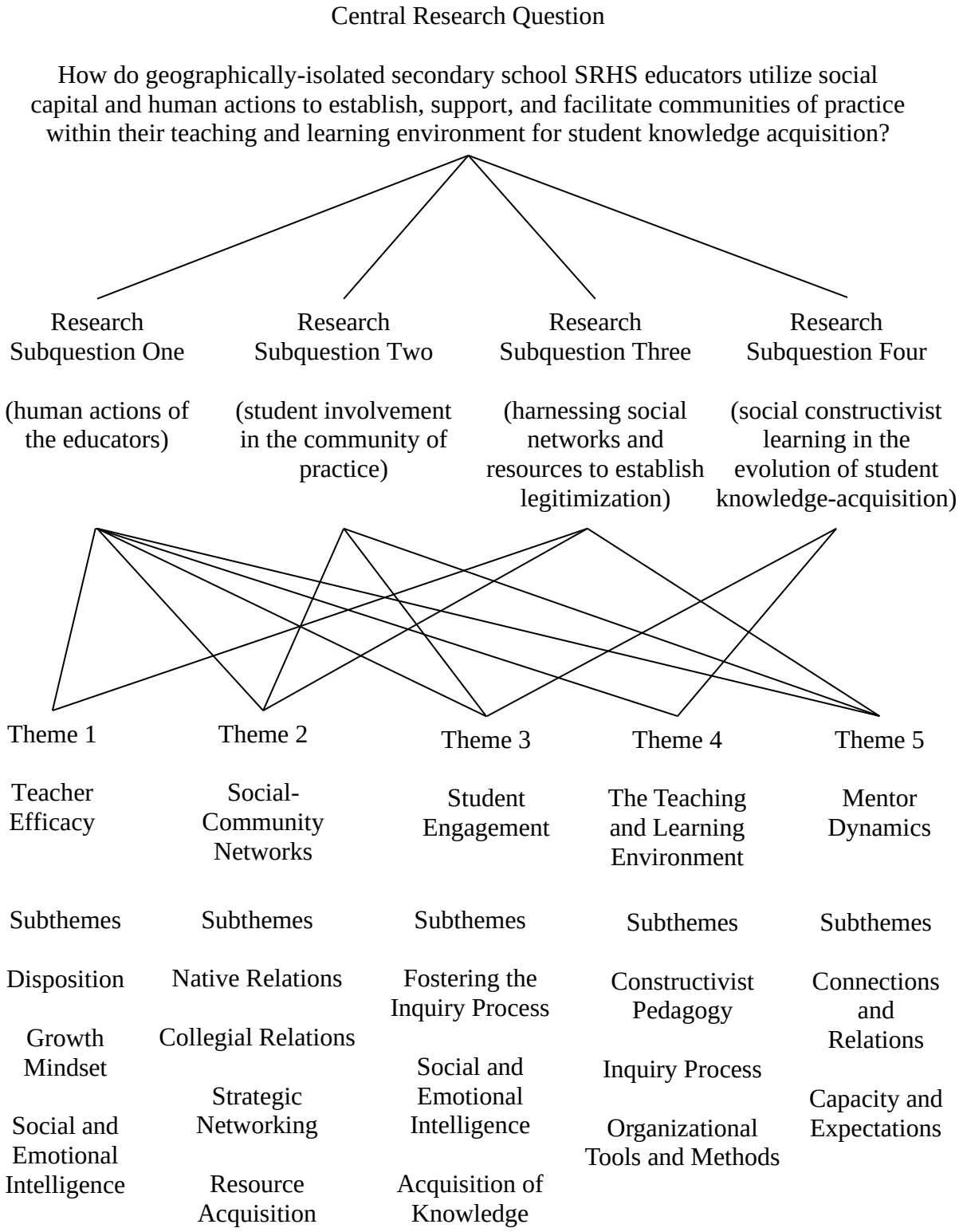

Figure 1. Research questions and themes.

Presentation of the Data and Results

The data from the semistructured interviews, structured interviews, classroom observations, and artifact/document collection were analyzed in relation to one main research question and four subquestions. The following five themes emerged: teacher efficacy, school-community networks, student engagement, the teaching and learning environment, and mentor dynamics. Each of these themes contained additional subthemes. These subthemes supported my analysis and strengthened my deeper exposition of the attributes associated with human and social capital, the resources that support human and social capital acquisition, and the pedagogical philosophies related to inquiry and constructivist instructional methodologies.

Central research question. The central research question for this study was, "How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?" As the participants shared insights into their roles as SRHS educators in geographically-isolated rural secondary schools, it was clear that they understood their roles and resources to be different from those of SRHS educators located in more urban and suburban areas. All of the participants were excited to participate in the study and to share their experiences as SRHS educators in rural secondary schools. Participant E shared, "I am [my students] biggest cheerleader . . . it is hard not to be when we have such a successful program and the kids are really doing pretty amazing things at pretty amazing places!"

Several participants were eager to have me share my final results with them, expressing that they hoped they would learn from the results of this study and the responses of their

colleagues who also participated in the study. The participants are educators and scientists. Therefore, I believe they are familiar with the data collection and research process, making them informed and valuable participants for my study. All five participants were able to share specific student successes with me, establishing credibility for their specific SRHS research science dually-enrolled program of studies. All five participants demonstrated evidence of strong teacher efficacy and possessed a growth mindset. Based on the observation notes, all five participants would likely be classified as highly effective in their practice by New York State's Department of Education's definition of professional practice.

Theme 1: Demonstrated teacher efficacy. The theme of teacher efficacy became apparent early in the research process. All five participants expressed the belief that they have the ability to affect their students positively and that their students will be successful. Within this theme, disposition, growth mindset, and social and emotional intelligence surfaced as subthemes. Each of these subthemes indicated a high level of teacher efficacy, a necessary condition in order for the participant to respond rationally and provide valuable data in response to the research question, "How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?"

Subtheme 1: Disposition to teaching and research science education. Within the data sources, I was able to identify that all five participants were SRHS teachers by choice. Four of the five teachers entered the district through recruitment processes where they understood that the district was looking for their level of instructional and scientific expertise and the growth mindset to teach the SRHS program of studies from day one of their employment. The

manuscript notes in two instances revealed that the participants had served as SRHS educators in at least one other district and were recruited by their current districts. Additionally, notes from the other participants revealed curriculum vitaes that included significant research experience and professional development capacity within the areas of scientific processes and inquiry, and constructivist pedagogy.

Through the semistructured interview process, several of the educators provided specific information about scientific research they are currently working on. I learned that three of the five teachers are actively conducting scientific research, Participant E shared,

> I did shark research in the Bahamas this past year, so it was nice, I got to reconnect. I also did microbiology research with P53 that is a pathway which is involved with potentially cancer and a bunch of other things in my graduate school, so I am definitely living inquiry-based science and leading by example.

Others shared information regarding scientific activities and professional organizations with which they are currently engaged. Participant D indicated he had established a large network within the scientific research community, having taught in four other districts prior to his current district. He noted, "I still communicate with those four other districts with things about science research; we try to visit other schools' symposiums." Additionally, these statements made by the educators indicating a scientific research educator disposition are consistent with the data recorded through the classroom observations and the artifact and document collection process.

Subtheme 2: Exhibiting a growth mindset. The educators' level of expertise was supported by a love of learning specific to science. All five participants shared examples of having a growth mindset. Growth mindset is a belief system where people believe through hard

work and dedication their knowledge and abilities can be developed extended and grown; an individual's inherent abilities and talent are just the beginning; individuals with this viewpoint are often referred to as life-long learners, resilient, and of a growth mindset (Dweck, 2015). The growth mindset is essential for inquiry and learning. An example of a growth mindset was apparent in this statement made by Participant B about how she models openness to learning new knowledge through questioning,

> I will put them on the spot where they have to ask questions, so they don't feel uncomfortable asking those questions when they come to them on their own. I will model that to them. I don't know everything about salmon. I don't know everything about dehydration, but I will happily learn alongside you or look up what you need me to know. That is one of the best parts of this is that I learn so much from them, I do.

Participant A noted that a challenging part of being a SRHS teacher is that students read a ton of common articles. Participant A explained,

> I read them too, so as soon as I find a student who is interested in something, I read like crazy and build. I build a broad base of knowledge and this way I can have conversations and verify their understanding of certain concepts.

The quotes from these participants demonstrated a work ethic characterized by a growth mindset. Additionally, all five participants appeared to have an attitude of doing whatever it takes for success. For instance, Participant A stated, "My job is to make sure the program is surviving, make sure that the students have all of the resources that they need and that no external forces get in the way of them pursuing science." There was a consciousness of ownership and obligation for student success among the participants.

Subtheme 3: Presenting social and emotional intelligence. Social and emotional intelligence is commonly defined as an awareness of the feelings of others and your own and using that information to lead others. My research revealed significant evidence that all of the participants cared deeply for their students and were in tune to their students' feelings as well as their own. While all of the participants exhibited a strong propensity for understanding the feelings of their students and their own, one example of leadership in this area surfaced as especially significant. Most observations began in a manner of a teacher to student check-in exercise. Participant B on the day I was observing took this check-in even further. She shared with the class that the previous night she had come across a poem entitled *Fire* by Judy Sorum Brown (2000) found in Appendix G. Participant B then led her class in a discussion about how it feels when too much is piled on for too long. She used examples from her personal life and openly shared that she sometimes felt overwhelmed with "stuff." The class discussed the need to reflect, and to "provide space in life," which is accomplished "by not piling on so many logs," noted Participant B. Following the observation, Participant B shared, "I think really the basis of our class is built on respect for each other and freedom to say whatever they want . . . they come in like another extension of their house . . . so they are not afraid to ask a question." Participant E revealed that she has an event planning committee. They do one class event per quarter, allowing students to bond together as a group and just get out of the school environment and relax. "It gives the kids a sense of like she gets it, she understands," noted Participant E. Participant D used part of his lesson time to allow the students to plan their end of the year celebration which included the teacher's well-known cheesecake. Many of the participants remarked that they become a family within the classroom environment.

Theme 2: Establishment and maintenance of school-community networks. Although all five participants agreed in the structured interview stage that their secondary school was correctly identified as rural, once on-site, I found considerable variation in the geographic isolation of each of these rural secondary schools. Three of the secondary school educators were able to identify significant sources of social capital within their immediate community, including library access, university presence, and connections with large metropolitan areas; additionally, two of these districts identified social capital resources directly connected with scientific research. One of the schools was located in a small town where the main source of income for the inhabitants was secondary homeowners and vacationers. In this same town, a well-respected private university had an active research facility stationed in the locale. In another case, the headquarters of a major scientific research supply company was located within the district's boundaries. This secondary school also had significant metropolitan influence and financial support due to this scientific research company. The third secondary school was a 90-minute drive from a major metropolitan city, and many of the students' relatives worked in this city. Participants B, D, and E, who were from less isolated districts, were able to identify the social capital that provided direct resources to their SRHS program of studies. The final two secondary schools appeared to be truly isolated from metropolitan/suburban influence, and Participants A and C did not identify any higher education institutions or industries that were scientifically orientated within close proximity to their school district. In contrast to Participants B, D, and E, Participants A and C were not able to identify relevant social capital resources within their immediate community.

Subtheme 1: Development and continuance of native relations. When asked to describe the involvement of their school district's local community, all five participants described feeling positive about the support of and involvement with the SRHS program of studies from their community. However, they were quick to add that developing the relationships that are necessary to get community buy-in and support took time and effort on their part as the educator. I have labeled these relationships as native relations. Participant B noted, "We're in our ninth year, and so it is really just getting the recognition that it deserves. It is as you know a very academically challenging course, and people just haven't really been recognizing it as such." Participant C similarly noted, "We are building a larger community from those small groups that are actively interested." Participant C is in her fourth year of teaching in the SRHS program of studies.

Participant A discussed the varying attitudes toward higher education often present in rural communities, whose residents may be weighing anti-intellectual sentiments against wanting to support their children. Ultimately, the communities support the students. Participant A noted, "I think one of the great things about this community is that they do kind of rally around the students." Participant C supported her statement with her own observations, noting,

> Another part is [community members] see the value to the students individually, but they see the value to the district as a whole. When you have a school that has students learning at a higher-level, it rather brings up scientific awareness, the scientific culture in the school. I think that they're probably hoping that's what will happen, and this school community could use a raising of culture for intellectual pursuits, in the sense of we can do big things, and we can accomplish hard things.

A desire to bring up scientific awareness also emerged in the artifact collection process, where both Participant A and Participant C had previous students' posters on display in the hallway in the format similar to how universities display research work of their professors and students. This action purposefully sends the message to students and the school's community that as an institution, the school values research as an academic endeavor.

Subtheme 2: Development and continuance of collegial relationships. All five participants acknowledged the importance of their colleagues to the success of their students in the SRHS program of studies. Examples of this support were abundant in both the observation and semistructured data sources. During the observations, three of the five classrooms had another teacher stop in to check-in on the students and their progress. In two of the classrooms students were writing thank you notes to teachers who had supported them with the symposium. Participant B's family and consumer science (FACS) teacher had worked with her FACS students to make and serve the refreshments for the annual symposium which was clearly an event supported by the entire school. Participant C had bought a special "Dr. Seuss" card to thank the technology integration specialist for the work he had done with the students in preparation for the symposium.

Academic collegial support was also evident. Participant B shared that a recently retired science teacher was working with a student and his passion for the topic Dark Sky. Participant B noted, "so reaching out to people, understanding that people don't have to have a degree or designation behind their name to be an expert in something or to have something to show with you about that topic." Participant D was able to site several instances where colleagues had supported his students directly with their research, including the other science teachers, the

school psychologist, and the spouse of a colleague who was a university librarian. Participant D observed,

> We have an extremely strong science department in a small school. . . . They meet with any student that is in their fields, and they have also connected them with other people that they know to facilitate their experiment or act as a mentor.

It was apparent that these educators were able to support their students in areas where they did not have the academic expertise by drawing upon their collegial relationships.

Subtheme 3: Strategic local networking. All of the participants were able to identify ways in which they personally worked on developing the relationships that would lay the foundation for community support. These actions included activities such as taking field trips into the community to see science-related activities, developing budget line requests specifically for the SRHS program of studies, putting donation jugs out into the community with students faces and research titles on the jugs, letter-writing campaigns, grant writing, living in the community, owning a business in the community, coaching and/or advising other school activities, working with Cooperative Extension, and involving their local Chamber of Commerce. Two participants cited their role as publicity manager for the program. Participant E noted, "I email local newspapers to get our information out on what the students are really doing, and how they are competing." Participant D explained a similar activity, stating, "We have a [district] person that represents us for the newspaper articles and such for promotional reasons. They promote anything that we do; if we go on a field trip they put it in the newsletter, we compete somewhere they put it in the newsletter." Participant E also noted she created "swag," or gifts printed with the science research name.

Several examples arose of how the educators and students were using resources that would be available in any rural community. For example, one student was currently doing research in nutrient education, working with the local community church down the hill from the school. Another student conducted research on how different scents could influence customer spending at a local restaurant. Participant B described these collaborative relationships, noting, "They're not necessarily researchers but people in the community who have things that we can use or facilities that we can use for their studies or they just have specific expertise in an area." Two poster examples at Participant C's school showed how students had teamed up with a local dairy farmer and used his facility to conduct research and also relied on his expertise in breeding and raising cattle, while three others at that same school demonstrated partnerships with local environmental agencies.

Subtheme 4: Community-based acquisition of resources. Resource acquisition emerged as a subject all five participants had carefully thought about and developed through the years within their school and community networks. Participant D recognized a significant advantage for his program as he had secured yearly corporate sponsorship of $1,000 to buy specialized equipment and supplies for his students to use as they conducted their research as well as travel and other student expenses. Participants A and E noted that they specifically asked their school board to include a sizeable sum of money as an line item in their school budget yearly. These funds were used to cover student travel, research supplies, symposium costs, printing, and other related expenses. Participant A noted that these are "the types of things a good class needs to have." Several participants noted that the head of the Chamber of Commerce was typically invited to the schools' symposiums.

Participant C discussed an endowment fund initiative. A small dedicated committee of community members had recognized the need for specialized support that may not be appropriate to fund through the school tax base. Therefore, they were working together to raise enough funds to provide an endowment which would allow students to access approximately $1,000 per year through a grant writing process. Participant C also pointed out that there was a sustainability factor in this effort. Once the funds were raised, students would have access to the funds for years to come, providing protection for the program from budget swings and administrative changes.

Participant A shared that administrative changes were a concern for his program's longevity. Unfortunately, as is common in geographically isolated schools, he described having experienced significant administrative changes. There had been 11 different administrators in decision making roles over the previous five years. Participant A observed, "One of the most frustrating parts of being a science research teacher is trying to explain to every new administrator what the program is and what we do and why it is important." He found some administrators supportive of it and others not. At one point he had parents involved in a letter writing campaign to save the program during these administrative changes.

Participant C supported the need to have administrative support for the acquisition of resources, stating, "My principal, my assistant superintendent, and my superintendent are all incredibly supportive and advocates for the program." She also noted that the energy from administration is key, that the "catchiness" of the enthusiasm for the program helped community members understand how good it is for kids.

Participant E was equally complimentary of her resource acquisition network of community members, parents, board members, and administrators, noting, “They support everything that we go to, not only financially but in terms of advertising and stuff like that.” Participant E also highlighted significant parent support, which was not as apparent in the data sources of the other cases. An example of parent support included food for the class when they were working late at night on projects. Participants described how parents offered to drive kids to competitions if they had conflicts. Participant E noted, “They come to every single event, I do pizza socials because we really are family, we do potlucks throughout the year, like during stressful times, after midterms and all of the parents come to that.” When I probed deeper on this parent involvement resource, Participant E acknowledged that she felt parent involvement across her district was high relative to other school districts’ levels of parent engagement as a resource.

Theme 3: Cultivating student engagement. Student engagement refers to the sustained interest of the individual student in order to succeed. It became evident that there were numerous human actions SRHS educators purposefully take to capture student interests in the scientific process begin long before the students officially enroll in their first year of the course as a sophomore. Several of the teachers mentioned the junior high-level science fair as an avenue to recruit students who have the mindset of inquiry, and others suggested that often the students who participate in the SRHS are the “movers and shakers” of the school. All of the educators agreed that students who enter the program needed to be process and inquiry orientated and not driven by GPA. Participant B noted the difference between the student who wants to take the class to get college credits, but doesn’t really love science versus the student who sees science in everything and understands science is a “process, not a content.” Participant A shared,

> I ask them to think about that; I ask them to share about that. . . . I think the hardest hurdle I have is that they are not used to not looking for the right answer but looking for several answers. There is a great deal of conversation in the school about what scientific research is and how science research works, so the students who walk through the door are generally students who are interested in developing their own idea of inquiry so that is kind of the first thing we do, is that they are a self-selected group.

Process mindset appeared to drive the recruitment actions of educators. One of the SUNY requirements of enrolling in the course is to have students begin their journey of inquiry the summer prior to enrollment in the class. This requirement is fairly open-ended and opens the door for a student's own personal inquiry journey.

Subtheme 1: Fostering the inquiry process. The SRHS program of studies is an elective sequence of three classes in which students enroll over three years, with the option of completing two summer units of independent study. Participant A identified this as the first way of fostering the inquiry process, stating,

> There is a great deal of conversation in the school about what science research is and how science research works, so the students who walk through the door are generally students who are interested in developing their own idea of inquiry in the first place so that is kind of the first thing we do, is that they are a self-selection group.

Self-selection process leading to inquiry propensity was validated by the other participants. Many of the participants required students to attend conferences, presentations, and the symposium prior to enrollment, so that there were no surprises about the nature and caliber of the work expected. All of the participants shared that they strongly encouraged students to develop

their own lines of inquiry; to find that thing they are passionate about. Participant A stated, "I think really it is about . . . looking for something that makes them a little crazy, looking for something that they can't let go of." Participant B shared the importance of providing them the space and time to do that inquiry, as well as building on their interests. She described how she tried to develop the scientific attitudes by showing them science is "a process not a content."

The summer project was seen as beginning of this process. "Nobody is sitting over their shoulder telling then what is okay and what is not okay, so that is opening the door for their own personal inquiry," said Participant C. Several participants discussed how this part of the process can be disarming to the students at first. Participant C continued,

> I find the thing that surprises my new students the most is when I say back to them, "What do you think?" I think that is the hardest hurdle I have, is that they are not used to not looking for the right answer but more looking for several answers. . . . They are so used to there being a right and wrong answer.

Participant A supported, stating, "A lot of times their answers are different and not wrong, so different and not wrong is something we strive for."

Additionally, Participants B and E made a point of mentioning that they fostered inquiry by devaluing the conceptual value of GPA and college credits over the learning process. Participant C verified, noting, "One of the biggest struggles I have is how uncomfortable, particularly the upper-level kids are, the kids that have been taking all of the high honors classes. They are really uncomfortable being novices and so they shy away." These participants mentioned an emphasis on scientific attitudes as a mechanism to utilize to help students grow in this area. The participants often identified the following as scientific attitudes: curiosity, open-

mindedness, honesty, reflectiveness, perseverance, collaboration, skepticism (questioning), and ethics. Several of these teachers had posters of the scientific attitudes displayed in their classrooms.

Subtheme 2: Attending to student social and emotional intelligence. Students who demonstrate scientific attitudes are likely to have a high degree of social and emotional intelligence (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2019). All of the participants noted a typical social and emotional intelligence evolution within their students as they proceeded through the SRHS program of studies. However, they also noted that students, as individuals, entered the program with different experiences, strengths, ability levels, and areas for growth.

The ability to communicate through conversation was noted by the educators as a major area in which most of their students needed support. The participants noted that this seemed to be especially hard for students who were used to communicating through social media and cell phones, rather than face to face or talking on the phone. “It takes a little while for them to warm up but they come back so excited once they actually do meet with a person and find out that it is actually a good experience,” noted Participant D. Participant B also observed that as students broke that barrier they became much more willing and able to speak with people and share their research with others, noting,

> Sometimes they feel like adding another person to their circle is just difficult for them, they have all the people they need in their life. . . . Some are apprehensive about reaching out and putting themselves out there into a community that they don’t necessarily thing they belong in, they might feel like if they’re not a science person and so new to this, they

> don't have anything to offer to a discussion, but they really do in fact that they are new to it and just learning about it, so they don't have prior knowledge preconceptions, misconceptions. They might be seeing new research that someone who began their research 10 years ago hasn't looked at yet.

Several educators shared that once the students began to make these communication steps, they began to understand what networking is and the value of networking.

One strategy used by Participant E is what she termed as "elevator speeches." I was able to observe these 2-minute speeches. The students were expected to give a synopsis of their research with no access to any supporting materials, while role playing getting on and off an elevator. The object was to be able to engage and impress the other person on the elevator, specifically noting the uniqueness and value of their research work. The expectation was that students would be able to discuss their research succinctly and intelligently no matter their stage in the research process. "The elevator strategy supports students in their communication skills and networking abilities" Participant E.

Growth in the students' collaboration skills was also verified by all of the participants. The nature of multiple grades in each class section provided the natural environment alongside of the scientific attitudes to promote collaboration. Participant B described how she made sure all her students are put into vulnerable situations early on, noting, "We share what a senior has done as a sophomore . . . , so that they can see that even though a senior is really, really good at everything they're showing right now, they weren't always that good." Sharing vulnerability provides the opportunity to discuss and showcase the growth of students in all areas— their thought processes, notebook and journal reflections.

Participant E noted that students had a lot more onus and responsibility as they moved through the program of studies. Participant E explained how younger students depended upon seniors for advice, stating, "I'm teaching them, but then I want them to teach each other and use their resources, they are going to trouble shoot themselves, and trouble shoot together. . . . I really want them to manage and use their resources."

Other participants discussed how collaboration tended to happen organically. Teachers were busy during their class, trying to reach all of their students. Often, other students may have questions they cannot get answered straightaway. Therefore, some students take the initiative to ask somebody else. The participants noted that they used this as an opportunity to reinforce the collaborations and might say to their students, "Why don't you ask for advice or their thoughts on this?" Participants noted that as teachers modeled collaborative behaviors, students started to do it more naturally. Also common among the cases was a recognition that as students became seniors, their focus turned more outward than inward and they began to look for more opportunities to help their peers.

Subtheme 3: Acquisition of student knowledge. Common among the participants was the knowledge that students became more confident in their own knowledge building abilities as they move through the SRHS program of studies. They were also aware that students were able to take in what their peers and others were saying and doing and in turn process and reflect on the information to extend their learning. Participant C explained that her students' relationships with her as a teacher also changed through the knowledge acquisition process, stating,

> [They] treat me not a just the person who is like the gatekeeper of knowledge, but the person to go to, to help them navigate how they are going to seek the knowledge out. . . .

> They are more able to access the information and use it with more confidence and sophistication.

Additionally, Participant B noted that students who had gone through the SRHS program of studies were much more skeptical of everything they read, stating, “They like to know both sides of it, they don’t want to just know their side of it.” Participants also noted how students who had gone through the program were much more capable of defending their ideas and wanted to own their thoughts. Participants emphasized that their students had the opportunity to acquire skill sets and knowledge in many ways that wasn’t possible in other classes. They learned how to read a scientific journal, communicate with strangers, network, find additional information and opposing viewpoints, write a journal entry, conduct statistical analysis, write a research paper, and collaborate.

Participant A summarized the knowledge acquisition process this way,

> I make mistakes and I learn from those mistakes. The students see that process. They see me struggling with an issue or they see me struggling with a process and they realize that science is messy, that learning is messy, and that figuring it out is messy and that is really okay. So I think that from my perspective making sure students know that knowledge acquisition is a filthy job, it is really dirty, it is messy and the soon that people get to that point where they are willing to get their hands dirty and make mistakes . . . the better off they’ll be.

Participant A was expressing how SRHS teachers know their students were engaged in life-long learning processes.

Theme 4: Creating an effective teaching and learning environment. Every educator has the responsibility of establishing a classroom environment which optimizes the best learning environment for their students, an expectation of SUNY. All SRHS educators are bound by certain requirements to obtain approval as a voluntary adjunct faculty member for the SRHS dually-enrolled program of studies. These requirements include a submission of the educator's syllabi, scope and sequence, and grading policy for the course sequence. Additionally, all approved SRHS teachers must complete a one-week training as well as conduct and present their own research as part of their training. SUNY provides SRHS teachers with supportive materials including general forms, bibliographical forms, and checkpoint forms. Approved SRHS teachers are subject to audit which may include visits to their classroom and their school's annual symposium. SRHS program visits typically include a summary rubric evaluation. All five participants where consciously aware of the SUNY requirements and expectations and the data collection process supported the educators' adherence to these expectations.

Subtheme 1: Fulfilling the constructivist pedagogy. The SUNY SRHS dually-enrolled program of studies is built upon the constructivist pedagogy. The expectation is that the class and symposium are student led. Therefore, while evaluating data from the semistructured interviews and observations, I looked for evidence of student directed activities which aligned with constructivist pedagogy. Participant A described such activities, stating,

> I have a small goal and a large goal, so the small goal—I view it as the small goal—is for students to approach the class with seriousness and integrity and with academic rigor and progress through the steps of science research and do a good project. That is my small

goal. That is the day to day goal. My big goal is to really instill this idea of curiosity and empowerment in students.

Participant A explained that I would be able to see his philosophy emerge during the classroom observation portion of the visit. He asked me to look for evidence of him letting his students struggle, of him rarely providing an answer to their questions, and of his encouragement of the students to work together to find the answers to their questions. I was able to record these purposeful teacher behaviors during the observation.

Participant D shared his strategy for creating a team by having his students become part of the evaluation processes through written journal reflections and peer evaluations using rubrics. All of the other participants used some form of peer evaluation also, although these were not as formula and rubric driven. Participant E had students evaluate "elevator speeches" during her observations through a simple t-chart graphic organizer of strengths and areas for improvement.

Safety, freedom to be creative and explore, learning from mistakes, and trust appeared as key elements important to supporting a constructivist learning environment. For instance, Participant C noted, "I treat [my students] as people first and my students second. They are thinking of who they are as a researcher, so when it comes to doing actual research they own it and they actually understand it."

Several of the participants expressed their consternation about the competition their students faced when competing against other SUNY SRHS students. They indicated that often their students are more authentically involved than their competitors and own their research in a true constructivist sense. Noting that schools with heavy scientific community resources often have students jumping into research projects authored by others, Participant B stated,

> We never do that, here we start with an idea, we develop the idea, we develop the knowledge of the idea, and we develop the hypothesis, develop an experimental plan, andthen bring in our mentors to help us. We don't just jump into a lab, scribble a few lines on a paper, and do some data collection about our research.

Several participants noted the challenge of seeing a contestant ranked highly, who has clearly not come up with the hypothesis, written the paper, or completed the statistical analysis. They cited the inability of these students to answer the questions about their project in a manner that demonstrated they knew and did the work, critiquing that these students fall back on what someone else did in their responses. Participant B noted,

> It is interesting to me to see that in some ways having fewer resources is having them . . . take on more the role of the scientists and own it and then they become part of the community [of practice] in a more authentic way.

While the participants acknowledged this frustration, they also recognized that their students were probably further ahead and had a stronger understanding of the scientific inquiry process even without the community resources found in more suburban and urban environments.

Subtheme 2: Fostering the inquiry process. All of the participants shared several examples of how they promote and support the inquiry processes with their students. In addition to the initial assignment of reading common articles in the summer prior to starting the course sequence to discover an area of interest and develop questions, participants described how this process continued and articles became more sophisticated. Students eventually reach the level of reading peer reviewed, scientific journal articles. Participant E noted, "Often times [the summer projects] just eliminate things that they are not interested in." Typically, the educators then had

the students move on to ask expert questions through emailing with some of the writers of research articles that most closely aligned to their questions.

The participants also shared that they provided many opportunities for students to present formally and informally about their work, allowing teachers to give constructive criticism and note strengths and weaknesses. The older students guiding the younger students was a key component of the presentation process. “Older kids are like, oh my gosh, I had the same thing happen to me, just push through it,” said Participant E.

Statistical analysis is another skill set supported through the inquiry process. Participant D described how his students conduct an experimental analysis which requires them to identify poor sampling and skewed data, during which he sought transference for experimental design. Participant C had “data shares,” where students shared the data of an article they were currently reading. The students shared the data and their questions about it; then the class discussed the data. “I try to build opportunities for them to [ask deeper questions and discuss these questions] beyond just the very quiet intense working,” noted Participant E.

Several of the participants identified the Scientific Review Committee (SRC) and/or Institutional Review Board (IRB) requirement as a key component of the inquiry process. The nature of this process required students to anticipate questions members of these committees may have regarding their experimental design. The requirement necessitates students explore arguments and discussion points that they might not otherwise consider. The process of defending their thoughts allowed students to fully consider the inquiry processes.

Subtheme 3: Utilization of organizational tools and management strategies. The artifacts and documents used and collected during the data collection process indicated that SRHS

participants were using the resources provided on the SUNY website, as well as revamping these resources to use in a manner that fit their teaching style. Many of the participants used rubrics as their main grading and feedback documentation method.

Each of the participants had some manner of organizing the students' materials and supplies using laboratory drawers, cupboards, and wall pockets within the classroom space. Students appeared to manage these materials and supplies on their own and successfully self-regulated their work space. Routines and expectations were well established and supported by wall charts in many of the classrooms. One of the participants remarked that if she is out, students self-manage and support themselves with no need of intervention from the substitute teacher. I had the sense, while watching the flow of the classroom, that a substitute's intervention could be a distraction.

During three of the classroom observations, I witnessed students developing a timeline for themselves. One situation was a verbal discussion with the support of the SRHS teacher, the other was a written, graphic version of their summer research timeline, and the last was a large wall chart created collaboratively between seniors and juniors with the intention of laying out the senior year for the juniors.

***Theme 5: Developing communities of practice with mentors*.** SUNY requires students to be matched with a mentor who is an expert in the field of their research. Participants noted that the process could be especially challenging for geographically-isolated rural school educators who do not have active scientific research facilities within their immediate geographic region. "That is one of the biggest problems that we have is finding mentors because there are not scientists locally," Participant B.

Subtheme 1: Connecting and establishing relationships. A successful strategy used by several of the participants was to have students develop a strong enough knowledge base to formulate thoughtful questions. They then began having their students reach out to these experts and start a conversation by asking the questions. Participant B noted, "[Students] are conscientious about how they are going to come across . . . so I feel like that is a really important step right from the beginning." Participant E observed that she has her students do a lot of methodology development and develop a rough design prior to her students asking an expert to be their mentor. Similarly, Participant D emphasized that he does not allow his students to even look for a mentor until they have solidified a hypothesis or several hypotheses.

Subtheme 2: Building capacity and revealing expectations. There seemed to be a wide variation even within each SRHS participants' classrooms of mentor capacity and expectations, with several participants acknowledging mentor acquisition as an area of growth for their program. Several participants felt that program longevity and reputations were critical to successful acquisitions of mentors. Many of the teachers were sure to share that they take measures to make sure mentors know their expectations, are frequently communicated with, and are adequately thanked. "If they have a good relationship with that mentor they will usually come back say we would love to work with one of your kids again," Participant D.

Not all mentor-student relationships develop into a community of practice. Participant C explained, "We've had some mentors [who are] practically nonexistent and then we've had mentors that talk to their students every two weeks throughout the entire program." When I probed deeper into why this might be the case, Participant C thought there could be several reasons, including the personal schedule of the individual, the fit from the beginning, shifts in the

student's experiment that might not align with the mentor's research, and comfort with qualitative or quantitative research. "I am learning to notice the signs that people give," Participant C explained.

When discussing the problems that can arise in the community of practice relationships Participant C explained that the way the timeline for the program is structured, the students are required secure a mentor near the end of their sophomore year or as a last effort at the very beginning of their junior year and the focus of the experiment can kind of shift over that time. A change in focus on the part of a student can cause the mentor and student relationship to wane as the research interest of both parties evolves in two different directions. Attending to the right fit is a challenge for the students, teachers, and mentors. Mentors will often refer students to other experts when there is not alignment of the expert's research and the student's capacity and interest, although this is not always the case. The SRHS educator must be able to monitor and assess mentor-student relationship and help the student exit gracefully when there is not a good match. "It's one of the areas that I'm working on improving," Participant C. Participant C indicated that this skill set requires a certain savviness and experience level that the SRHS develops with time and experience. All five participants noted the problem of finding engaged mentors with the capacity to effectively support the high school student through the scientific process was a significant challenge.

Chapter 4 Summary

Through my study, I aimed to identify how rural secondary school science teachers transcend rural community isolation by leading their students to establish communities of practice within a dually-enrolled research science program of studies, with a focus on the lack of

community social capital. Using a qualitative, descriptive multiple case study design, I secured data from interviews, observations, and artifact and document collection. The use of multiple data sources allowed for a deeper analysis of each of the five SRHS programs. I analyzed five cases; each case was analyzed individually and I coded the data from each case. Following the individual case analysis, I conducted a cross analysis. I used a thematic analysis to identify the themes that answered the main research question, "How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?" Four subquestions also guided my analysis.

Through the coding process, five themes and 15 subthemes emerged. The themes and subthemes are shown in Figure 1 and are described in detail in this chapter. The themes identified through the coding process were: teacher efficacy, school-community networks, student engagement, the teaching and learning environment, and mentor dynamics. Each of the themes contained two to four subthemes, which supported the context of the theme. Two of the themes, Student Engagement and Teaching and Learning Environment present guidelines for educators developing high quality instruction in rural schools, and specifically observance of phenomena based scientific research instruction. The themes, School-Community Networks and Mentor Dynamics, address implications of developing social and human capital resources within the school community network. Theme one, Teacher Efficacy, provides valuable insight to rural school leadership when initiating and sustaining a dually enrolled, program of studies, specifically within the research context.

This study confirmed that SRHS educators in rural secondary schools do utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition. The results of this study contribute to the limited body of research on teaching and learning best practices within rural schools and rural school dual enrollment programs. Additionally, this study has the potential to provide insights to educators as they ponder best practices within the teaching and learning environment, the shift in science instruction to become more phenomena-based, and the most effective ways to prepare their students for a global STEM career market. In Chapter 5, I will further establish the findings and describe connections across the data.

Chapter 5: Discussion and Conclusion

Introduction to Discussion and Conclusion

I presented the findings of the data collected in this multiple case study in Chapter 4. In Chapter 5, I will construct connections between the findings and what it means to the community of practice of geographically isolated rural secondary school educators teaching in the SRHS program of studies. The conceptual framework for this research study was the acquisition of knowledge through communities of practice and the reciprocal relationships communities of practice have with social capital and human capital. In this chapter, I will begin with a summary of the results. I will then present my interpretation of the results as it relates to the published literature, connecting how my findings support current literature and how practitioners might use these findings to influence their teaching and learning environments. Next, I will share my thoughts about the implications for practice, policy, and theory through an examination of my findings in relation to research science education, dual-enrollment partnerships, and general education policy and theory. I will also discuss the limitations of the research design and my recommendations for further study. Finally, I will conclude with a summary of the research study by revisiting the research questions, reviewing the critical points of the study, and providing concluding thoughts.

Summary of the Results

The critical, central research question for this study was, “How do geographically-isolated rural secondary school SRHS educators utilize social capital and human action to establish, support, and facilitate communities of practice within their teaching and learning environment for student knowledge acquisition?”

There were also four secondary research subquestions:

- How do the human actions of the educators compensate for a lack of social capital caused by geographic isolation?
- What are the human actions that allow the educators to enhance students' involvement and participation in the community of practice?
- What are the factors that allow a community of practice to harness limited social networks and resources to establish legitimization for the student member?
- How does social constructivist learning through communities of practice support the evolution of the student knowledge-acquisition process?

This study is significant because it adds to the current body of research on both the value of and implementation challenges of dually-enrolled programs of study, particularly for rural school communities of educators and students in the research science field. According to The Education Trust (2019), high school students who participated in Dual Enrollment had higher on-time and eventual college completion rates than high school students who did not participate in Dual Enrollment. Data from this study indicated low income students in smaller, rural New York high schools were more likely to complete college than low-income students from nonrural New York schools when they participated in dual-enrollment programs (The Education Trust, 2019). High school educators throughout the United States, including in New York State, have recognized the importance of preparing students for college. These educators are looking to adopt best practices to promote college-readiness and provide students with the skills (human capital) and resources (social capital) to persist through college. Studying the interactions of this SRHS dual-enrollment program of studies provided valuable data on how the interaction

between social capital and human action within SRHS communities of practice can lead to an increase of knowledge and a net increase of social capital (Fullan, 2014; Manuti et al., 2017; Pyrko et al., 2017).

In this chapter, I will discuss the findings from data sets collected through five different cases in the context of the overall research question and secondary research questions. The data sets included content gathered using interviews, observations, and artifact and document reviews. After an in-depth study of the five cases independently, I conducted a cross-case analysis. Five themes emerged: demonstrated teacher efficacy, establishment and maintenance of school-community networks, cultivating student engagement, creating an effective teaching and learning environment, and developing communities of practice with mentors. Each of the themes contained two to four subthemes which supported the context of the theme.

Discussion of the Results

In this section, I will discuss the qualitative results and my interpretation of the data gathered to answer the critical, central research question and research subquestions that framed this multiple case study. I analyzed data from five different geographically isolated, rural schools in New York State. After examining each case separately, I conducted a cross-case analysis to determine commonalities and differences. Although each case had a unique teaching-learning environment, common themes across all five cases surfaced. In this section, I will discuss the themes that emerged across the five cases within the context of the research questions.

Human actions of the educators. To determine the human actions rural school educators took to compensate for the lack of naturally occurring social capital caused by the geographic isolation of their high schools, I began by examining the requirements instituted by

the UHS faculty. These requirements ensure that all SRHS students are supported by qualified and prepared research science teachers. These requirements established a baseline of actions for the educators participating in the study. In addition to the baseline human actions mandated to meet these requirements, I found additional human activities through the data collection process, which supported the development of the identified themes and subthemes. The themes and associated subthemes that arose through the examination of the educators' actions are shown in Table 3.

Table 3

Human Actions of the Educators: Linked Themes and Subthemes

Themes	Subthemes
Demonstrated teacher efficacy	Disposition to teaching and research science education
	Exhibiting a growth mindset
	Presenting social and emotional intelligence
Establishment and maintenance of school-community networks	Development and continuance of native relations
	Development and continuance of collegial relationships
	Strategic local networking
	Community-based acquisition of resources
Cultivating student engagement	Fostering the inquiry process
Creating an effective teaching and learning environment	Fulfilling the constructivist pedagogy
	Fostering the inquiry process
	Utilization of organizational tools and management strategies
Developing communities of practice with mentors	Connecting and establishing relationships

The data sets allowed me to document many of the human actions of the educators. However, the data sets were limited to one semistructured interview, one observation, and the reviews of the artifacts and documents collected during the site visit and through web page searches. A more robust data collection methodology that spanned a more extended period would have allowed me to capture more human actions.

In my initial research that I conducted to prepare for the methodology development, I learned about criteria set forth by the University that all SRHS teachers must meet to secure approval as volunteer adjunct professors. These criteria were as follows:

- Hold a master's degree.
- Complete the one-week professional development course provided through the University.
- Stay up to date on program changes.
- Take part in a support group of teachers in the program

The manuscript notes from each of the cases indicated each of the participants had completed the first two criteria and were actively engaged in the second two criteria. According to Sánchez-Cardona et al. (2012), collaborating and establishing networks among fellow practitioners leads to learning and innovation within the work environment, helps the organization adapt to changes and environmental pressures, and allows the organization to remain competitive within the rapidly changing "knowledge era" (p. 1821). Several of the participants noted the value of their fellow SRHS collegial and school collegial relationships and shared personal stories of how they had connected with colleagues and supported each other. All of the participants shared the need to stay current and demonstrated a thirst for learning within the context of education as well as

the scientific discipline, citing professional relationships through communities of practice as an avenue for professional learning.

This enthusiasm for establishing collegial relationships is an indicator of the high teacher self-efficacy displayed by all the participants. Each participant discussed their learning within the context of being an SRHS educator. They openly shared that they continuously make adjustments within their teaching and learning environments based on their students' needs and the evolution of our society. They acknowledged the need to adapt to and to continuously build social networks. They frequently cited technology as a tool to procure resources and support the building of social networks. These teachers referred back to scientific research that they had conducted or supported and networks that they had established in the past, as well as citing current research and networks. Participants consistently acknowledged that a portion of their role as the SRHS teacher in their rural high school was dedicated to harnessing social capital and resources. The participants generally felt that this role was more significant for them as geographically isolated rural school educators than it was for their counterparts teaching in nonrural high schools. However, the educators made it clear that it was the students who were establishing the primary relationships with experts in the field and the teachers functioned in a supportive role, which included resource acquisition, developing connections, and organizational support.

The primary responsibility of the SRHS teachers is to guide their students through an authentic scientific research study individualized to the students' interests. Ultimately, the students will have a full, comprehensive understanding of the scientific research process. Therefore, I examined the human actions of the participants through this lens. As the participants

discussed their SRHS program, they shared intentional actions they took to ensure the successful completion of the scientific research process for their students, including supporting them in conducting research studies and sharing their findings through papers, posters, and oral presentations. Based on the manuscript notes, each participant was a successful SRHS educator and has had students complete their program with a full, comprehensive understanding of the scientific research process.

The manuscript notes indicated several actions that the SRHS educators took to support their students in executive functioning through the use of organizational methods and tools, while still staying true to social constructivism principles. These actions centered on maintenance of the required University documentation, including journals and lab notebooks. Additionally, all of the participants put a heavy emphasis on timelines. The program of studies is cyclical, and expected outcomes vary by the year that the student is in the course sequence. Therefore, providing students with a framework, exemplars, and rubrics helped the students successfully meet each year's unique set of requirements. Also, all of the educators regularly involved their students in some form of peer- and self-evaluation. The educators discussed frequent leveraging of student knowledge as a part of the teaching and learning environment. The leveraging of student knowledge led to the establishment of a community of practice within the classroom, which became apparent through the manuscript notes. Therefore, not only do geographically-isolated, rural SRHS programs leverage communities of practice within the scientific community to support student knowledge acquisition, they leverage communities of practice within their teaching and learning environment to support student knowledge acquisition.

Student involvement in the community of practice. Participants discussed students' involvement in a community of practice from two different frames of reference. These frames were as follows:

- The community of practice within the scientific community of experts.
- The community of practice within the teaching and learning classroom environment.

Table 4 shows identified themes and subthemes associated with the students' involvement in the community.

Table 4

Student Involvement in the Community of Practice: Linked Themes and Subthemes

Themes	Subthemes
Establishment and maintenance of school-community networks	Strategic local networking
	Community-based acquisition of resources
Cultivating student engagement	Fostering the inquiry process
	Attending to student social and emotional intelligence
	Acquisition of student knowledge
Developing communities of practice with mentors	Connecting and establishing relationships
	Building capacity and expectations

Scientific community of experts. All of the SRHS educators reported engaging their students in the inquiry process during the summer before starting the course officially. Students were required to read 10 *common* articles on a topic of interest. Participants reported these topics tended to be broad, and that teachers would work with their students during their sophomore year to narrow their topic into several questions that were then researched through peer-reviewed

scientific journal articles. I found that the SRHS educators used several strategies for supporting the students in developing their scientific communities of practice. Students were required to keep notes and journal entries of *wonderings* as they delved into each research article. The authors of the journal articles were noted. Participants reported that contacts to experts began during the fall of the students' first year. The initial contacts started with email outreach. These contacts were typically supported by an introduction made by the SRHS educator with the goal of legitimizing the students' inquiry. Participants noted that a typical e-mail would cite the author's work read by the student, explain the student's interest in the content, and include several follow-up questions. The purpose of these emails was to begin to build connections and relationships. Participants noted that often one expert would refer the student to another expert based on the student's questions. The student's community of practice would then develop as the student extended their outreach to experts and after a series of exchanges occurred. While most SRHS educators did not report becoming involved in the discussions, they did say that they monitored the communications. At some point, each teacher and student would determine that a relationship had developed between the student and expert to a level where the student could comfortably ask an expert to serve as their mentor/advisor for the student's research. The manuscript notes indicated this approach was typical to establishing scientific communities of practice for the students. These communities of practice were often facilitated through technology with an occasional site visit(s), dependent upon the student's resources. However, on occasion, the educators noted their students were able to establish a community of practice within a researcher's laboratory. A laboratory experience seemed to occur more often in the fringe districts compared to the remote districts.

The SRHS educators openly conceded that the depth and consequence of the students' community of practices varied, and was often dependent on the students' skill sets and expectations for the community of practice. They did not feel distance was a hindrance, although acknowledged it could be an advantage. The strength of the relationship that the student was able to build was reported as a major factor in obtaining the resources and support needed. The educators identified two important student involvement factors, which influenced the success of the students' involvement in the scientific communities of practice. These student involvement factors were (a) clarity of expectations and (b) the soft skill sets connected to skillful networking. Educators shared that building mentor relationships required students to demonstrate a growth mindset in their outreach while remaining clear about their research ideas and expectations. Students who could clearly identify their thoughts and expectations while still maintaining an openness to suggestions from their mentors were more likely to build a higher functioning community. This likelihood indicated students with developed social-emotional skill sets might be more fully able to utilize the scientific community of practice framework.

Teaching and learning classroom environment. The second community of practice framework was the community of practice that forms within the classroom. The interviews showed that the SRHS educators placed a high level of importance on establishing a classroom community of practice. Although the teachers worked hard at establishing a positive classroom community, they also shared that the community of practice within their teaching and learning environment happened more organically because of the students' actions and their responses to the classroom environment than through teacher intervention. Students were encouraged to form communities of practice because students in the program needed individualized support yet there

was only one teacher to provide that support. To meet this need, participants described how students in years one through three were stratified, which, along with the cyclical nature of the program of studies, created a support group of less experienced and more experienced students. Participants described how, when the educator provided a safe teaching and learning environment, the students began to share concerns, successes, questions, and advice. They also described how students' personal experiences were often relatable to each other as the students tended to experience similar circumstances. In collaborative communities, students feel connected to each other and are more likely to be committed to the learning and knowledge acquisition of each other (Darling-Hammond et al., 2019). Helping students to create connections leads to a higher level of collaboration and social-emotional intelligence within the classroom teaching and learning environment.

Harnessing social networks and resources. Research subquestion three focused on the factors that allowed a community of practice to harness limited social networks and resources to establish legitimization for the student members. The themes and subthemes associated with harnessing social networks and resources are cataloged in Table 5.

Table 5

Harnessing Social Networks and Resources: Linked Themes and Subthemes

Themes	Subthemes
Demonstrated teacher efficacy	Disposition to teaching and research science education
	Exhibiting a growth mindset
	Presenting social and emotional intelligence
Establishment and maintenance of school-community networks	Development and continuance of native relations
	Development and continuance of collegial relationships
	Strategic local networking
	Community-based acquisition of resources
Developing communities of practice with mentors	Connecting and establishing relationships
	Building capacity and revealing expectations

A strong sense of teacher efficacy was present in each of the individual cases. The SRHS educators who participated in this study were experienced, competent, and devoted practitioners. Although I did not specifically observe or interface with the students during the data collection processes, there were significant pieces of evidence gathered to indicate that all of the teachers were passionate about their students' work and the research science program. All five participants appeared to be highly effective educators with a disposition for research and student knowledge acquisition, a growth mindset, and healthy social and emotional intelligence. It is my opinion that, to be successful as an SRHS educator, one must possess these characteristics of

high teacher self-efficacy. A high level of teacher self-efficacy is what supports the educator in harnessing social networks and resources. Wu, Wang, Liu, Hu, and Hwang (2012) established that social self-efficacy has a positive influence on social trust and supports the acquisition of social capital.

The manuscript notes revealed that the rural SRHS educators continuously worked at building relationships by networking within their immediate school community and beyond their school community to harness social capital and acquire resources. These relationships were classified as either colloquial or collegial. The colloquial relationships typically centered within the rural community and often existed between the SRHS educator and parents, students, and interested community members who wanted to support students. These relationships tend to be long-term in nature, and in the case of students, may become more collegial as the student furthers their studies. The collegial relationships spanned both the immediate rural community and beyond the rural community. Included in these relationships were fellow educators within the school, fellow SRHS educators, librarians, Cooperative Extension agents, governmental agents, industry leaders, university leaders, the Scientific Review Committee and Institutional Review Board members, research experts, and mentors. These relationships tended to be more fluid as they were more directly connected to the social capital and resources needed by individual students. The colloquial relationships often tended to be nurtured in a manner to support the programmatic needs. In contrast, the collegial relationships were often established to meet specific student needs. However, this was not always the case, and I found that the purposes of the relationship spanned programmatic and student social capital and resource acquisition needs.

The relationships that the rural high school SRHS educators established within their rural communities were likely beneficial not only to their students but to their rural communities' viability. Many of the SRHS educators shared student research studies that were focused on a direct community need. When this happened, students had the opportunity to engage in meaningful learning experiences that served the community while meeting their learning needs and interests. Collaborative community-based learning allowed the community to build additional social capital and strengthened the connections students had with their rural community. Researchers have found community-based learning experiences promote a more profoundly engaging and relevant learning experience for students (Daniel, Quartz, & Oakes, 2019).

SRHS educators supported students in acquiring their mentors/advisors. The role of the teachers was to facilitate contacts and maintain protocols. When asked what makes a successful mentor-mentee collaboration, the educators shared that, in addition to the students' efforts to establish the relationship, there should be a reciprocal effort on the part of the mentor to establish a collaborative relationship. There was acknowledgment among the SRHS educators that this does not always happen. The educators offered several possible reasons why. These reasons included a lack of time, a shift in the focus of the student's research away from the mentor's area of expertise, communication failures, a lack of comfort on the mentors' part, which might include a lack of expertise in qualitative, quantitative, or mixed-methods research. Although several of the teachers appeared uncomfortable providing specific reasons, these explanations were offered. Several of the teachers stated that this could be the stumbling block or trickiest obstacle to maneuver around in a student's work. All of the participants indicated some struggle

with this relationship networking requirement, and many felt that their nonrural counterparts had more opportunities to engage with potential mentors. The participants also acknowledged that the colloquial and collegial relationships take time to develop, and as they acquired more time teaching SRHS within their rural community, it became easy to build upon pre-established relationships to harness social capital and resources.

Social constructivist learning in the evolution of student knowledge acquisition. The results of this study showed that teachers who embrace the social constructivism pedagogy provided self-directed learning opportunities for students, taking into consideration the students' prior experience and knowledge with the goal of the students acquiring additional knowledge. Table 6 shows the themes and subthemes associated with research subquestion four.

Table 6

Social Constructivism in the Evolution of Student Knowledge Acquisition: Linked Themes and Subthemes

Themes	Subthemes
Cultivating student engagement	Fostering the inquiry process
	Attending to student social and emotional intelligence
	Acquisition of student knowledge
Creating an effective teaching and learning environment	Fulfilling the constructivist pedagogy
	Fostering the inquiry process
	Utilization of organizational tools and management strategies

The rural school SRHS educators shared many commonalities in their approach to teaching the research-science dually-enrolled program of studies. These commonalities focused on the constructivism pedagogy and the inquiry process, as well as the establishment of a supportive and safe learning environment. A review of the participants' interview responses and observational notes revealed the following best practices exhibited by the SRHS practitioners:

- Student-centered instruction
- Attention to the processes of learning (learning to learn)
- Connection to students' current knowledge and experiences
- Trust and connectedness between the teacher and students and among the students
- Establishment of the classroom as a safe place
- Establishment of the classroom as a learning community

- Promotion of the growth mindset
- Development of social-emotional and self-regulation skills
- Integration of social-emotional and academic skills
- Extension of knowledge acquisition through scaffolded and expanded learning opportunities

A teacher who aligns with constructivism pedagogy values the students' prior knowledge and provides learning experiences that support further knowledge acquisition through authentic experiences that tend to be highly individualized to the interests of the students. Participants were able to share specific instructional strategies they use to support the inquiry process, foster motivation, and promote self-directed learning. SRHS educators described employing several methods to relay the curriculum specific to the scientific inquiry process, including literature reviews, model class research studies, data shares, group sharing, public speaking, journal reflections, and conversations with experts. These scaffolded learning methods helped the educators to conduct ongoing formative assessments so that students were supported in furthering their conceptual understandings while considering their prior knowledge and experiences. The inquiry methodology allowed the SRHS teachers to challenge their students with relevant and engaging knowledge acquisition opportunities while avoiding saturation of the students' frustration threshold.

The observation notes confirmed healthy, safe personal relationships among the educators and students, and the students themselves. The observation evidence demonstrated that the SRHS educators provided environmental conditions that fostered strong relationships among the students within the classroom community. Additionally, evidence gathered through the

observational notes and the interview manuscript referenced several physical tools and organizational resources used to support students' self-regulated learning behaviors and emotional well-being. Students need a sense of physical safety for learning to occur (Darling-Hammond et al., 2019). The organization tools and materials included lab notebooks, journals, laptops, Google Classroom, timetables, rubrics, and graphic organizers. Within each classroom, students seemed to *own* a physical space such as a cupboard, a section of the classroom, or a wall pocket. The individual spaces were a place where their instructional materials were kept safe when the students were not in the classroom. These organizational tools and materials supported the students' self-regulation of their learning behaviors.

Discussion of the Results in Relation to the Literature

As a curriculum director for a geographically-isolated, rural school district that services a student population with high socio-economic needs, I continuously look for ways to leverage social and human capital to create resources for students. I have watched teachers struggle to raise the bar and provide students with authentic life experiences so that they are prepared to progress into and complete the next step of their life and career preparation. I often wonder how students will fare as they enter this next phase of their life where they must compete in a global world and an increasingly technology dependent economy.

Constructivist pedagogy: Implications for deeper learning. Educators are continuously looking to meet the challenge of attending to the relational and academic needs of their students through the promotion of holistic, healthy social-emotional wellness, while at the same time providing life-long learning experiences. Educators use social and human capital environmental resources to provide for the developmental needs of their students. The

constructivist pedagogical framework clearly asserts that a student's development and learning are influenced by the relationships they experience, how they interact within their environment, and the experiential learning opportunities they have (Daniel et al., 2019). These relationships, experiences, and learning opportunities are heavily dependent on the individual educator and the capital resources the educator is able to access and employ throughout their teaching and learning environment.

In Chapter 2, I discussed Piaget's and Vygotsky's learning theories, which concluded that children's engagement in their social learning environment is essential for learning to occur. Vygotsky went on to draw the connection between social experiences and mental processes, clarifying that social participation is more than external stimulation for thinking; it is part of a child's thought processes (Daniel et al., 2019). These early learning theorists provided background research to support educators with alternatives to traditional behaviorist approaches that have failed to meet all of the needs of learners and all learners' needs (Oakes, Lipton, Anderson, & Stillman, 2018).

Recent advances in learning theory have underlined the necessity of a holistic, integrated, and dynamic approach to the knowledge acquisition process rather than behavioral methodology. Advocates of a holistic approach to learning encourage practitioners to educate the whole child in an integrated manner, addressing their developmental needs in all domains—academic, cognitive, ethical, physical, psychological, and social-emotional (Darling-Hammond et al., 2019). Providing students the opportunity to learn in a well-scaffolded, constructivist learning environment can help them to develop their metacognitive learning skills. A major social constructivism methodological approach that promotes social-emotional well-being and

metacognitive growth is inquiry teaching; inquiry offers collaboration, cultural sustainment, and contextualization (Daniel et al., 2019; Darling-Hammond et al., 2019; Jones, 2012). Through the inquiry teaching and learning process, together, students navigate complex learning tasks by questioning, explaining, constructing new meaning, assessing, reflecting, and developing further questions, subsequently evolving all students' knowledge acquisition processes.

Communities of practice in the classroom. Communities of practice regularly form within the inquiry-based teaching and learning environment when students share a concern or an enthusiasm for what they do or study; this affinity brings them together as a group (Wenger et al., 2002a). It is the role of the teacher to establish their teaching-learning environment in a manner that fosters the inquiry process and nurtures the development of a community of practice among their students. This creation of a community of practice promotes the active engagement of learners in the knowledge acquisition process rather than passive learners.

Jones (2012) identified three essential components an educator must facilitate to establish and develop a safe and productive community of practice within a classroom: (a) inclusiveness, (b) participation, and (c) shared cognition. Everyone is included in all activities which take place within the teaching and learning environment. Every student participates; however, the level of participation will vary as well as the mode of involvement. These levels and methods depend on the personal comfort level and the unique knowledge and experience a student offers to a particular inquiry task (Jones, 2012). Shared cognition is the synergy that takes place as the members of the community of practice question, synthesize, discuss, assess, reflect, create new meaning, and continue the process of building knowledge.

The role of the teacher is to facilitate the creation of a community of practice within their teaching and learning environment. This responsibility requires the teacher to not only attend to students' instructional needs but also their social and emotional needs. The teacher must be the leader and develop trust, making sure the classroom is an intellectually safe community environment. According to Jones, "teachers in a constructivist classroom act as a guide in discovering areas where the student lacks understanding or is simply mistaken and in need of assistance from the teacher" (p. 64).

Deepening learning through school-community connections. Community schools have the opportunity to address the opportunity gaps found in underserved student populations, including rural student populations. Recent research has demonstrated that small community schools offer the ability to create structures that ensure access to equitable learning opportunities, which are similar to larger, well-financed schools (Daniel et al., 2019; Darling-Hammond et al., 2019; Lester, 2020). Harnessing the human and social capital available within the community allows practitioners to create connections within the community, which support the holistic development of their students

The community school approach requires educators to perform non-traditional roles and partnerships but also offers a potentially more fulfilling and sustainable professional career. Maier, Daniel, Oakes, and Lam (2017) identified four key features that characterize the structure of successful community schools; these features are integrated student supports, expanded and enriched learning time and opportunities, family and community engagement, and collaborative leadership and practice. Supporting teachers with the time and resources needed to become part of the collaborative community so they can effectively work with community partners is key to

effectively integrating student supports in a manner that attends to the developmental needs of the whole child (Lester, 2020). Looking at learning through the interests of the community by expanding the classroom beyond four walls and the six-hour day will lead to the enlargement of learning opportunities and learning time (Lester, 2020). Teachers must be willing and supported by the district administration to connect in new ways with non-typical partners, including family members who have historically disengaged (Daniel et al., 2019). The support and engagement of all stakeholders within the community school system are required for a community school to achieve the conditions that truly engage students within a more in-depth and holistic learning community (Daniel et al., 2019). Schools can use community connections to their advantage by developing the social and human relationships within their community in a manner that engages students' authentic background knowledge and interests to expand learning in a developmental, integrated, and holistic context.

Rural student success through dual-enrollment/concurrent programs. All students benefit from dual enrollment programs that allow high school students to enroll in college courses and earn credits that can transfer to their postsecondary academic pathway. Historically, research has shown that this opportunity has not been evenly distributed. Often dual enrollment opportunities have favored high-achieving learners and often serve middle- or higher-income students and first-generation college students (Chatlani, 2018; The Education Trust, 2019). However, research supports the social responsibility and value of offering dual enrollment opportunities to middle-achieving learners and low-income students. The Education Trust (2019) stated, "participation in high-quality dual enrollment correlates with higher rates of high school graduation, college attendance, and persistence to a certificate or degree or transfer" (p. 2).

Providing rural school students the opportunity to access dual enrollment programming is crucial as it helps to support the growth of human and social capital for individuals and our society. For a society to develop, education of the society's youth resulting in the formation of human capital must play a dominant role in the society; this is how socio-economic progress is made (Webb, Kuntuova, & Karabayeva, 2018).

Rural schools are faced with distinct challenges in providing dual-enrollment coursework to their students. These challenges are often related to geographic isolation by which many of the schools are constrained. Zinth (2014) identified challenges schools face in providing high-quality dual enrollment programming due to geographic isolation, the ability to hire qualified instructors, low enrollment to program costs ratios, and access to the latest technical equipment and community college. Rural schools and state education systems are exploring strategies that provide solutions to overcoming these challenges. These strategies include offering financial support for teachers to complete additional master's credits, qualifying them to become an instructor for a dually-enrolled course (Zinth, 2014). Another common strategy employed by high schools is offering 101 level courses that are universal to a greater percentage of the cohort as well as a college course that follows a program of study sequence such as a foreign language (Cassidy, Keating, & Young, 2010). More rural schools are also exploring alternative delivery methods, such as online and blended learning opportunities. However, issues associated with these modes of delivery are acknowledged. These models offer less structure, limit personal interaction between the students and teacher, have access issues due to scheduling difficulties and broadband availability, do not replicate the traditional college campus experience, and there is minimal supporting research available demonstrating linkage to higher completion rates

(Zinth, 2014). Continued exploration of effective implementation strategies for dual-enrollment programs, which should result in an increase in the participation of their student population and can potentially address the disparity of affording rural students equal access to postsecondary completion.

Limitations

This study did have some limitations, which were mainly those associated with any multiple case study where it is impossible to make generalizations due to the small sample size. The purpose of the study was specifically to understand how rural secondary science teachers overcome community isolation within a research-science, dually-enrolled program of studies. A purposeful sample of five geographically isolated, rural, secondary school educators was used for this study. Due to this specific, small sample size, I had to protect the confidentiality of the participants by guarding against the disclosure of identifiable information while sharing the results and discussing the results. Purposeful sampling also limited the study in terms of my ability to generalize the findings to nonrural schools implementing research-science, dually-enrolled programs of studies.

This research study also focused on SRHS educators that met a standard level of experience and training. It did not include less experienced teachers who may have revealed obstacles that were not revealed by experienced teachers. I also believe that the participants were extremely proud of their programs and therefore were less robust when discussing challenges they faced as compared to successes. Additionally, this study did not include student, family, and mentor participation. The data collection included conjectures made by the educator participants but did not include direct thoughts from the students, families, and mentors involved in the

program. Student voice is an important factor in any school improvement initiative and key to the inquiry process.

The data collection took place over a two-week time period in early June 2019. The SRHS program of studies is cyclical in design. Therefore, a longitudinal study that included classroom observations and follow-up interviews throughout the full academic year would provide a more robust data set that reflects the cyclical nature of the program of studies. A longitudinal study would allow the researcher to validate the participants' responses and expand on their original thoughts. The interview portion of the study allowed for approximately forty minutes. Extending the time allotted for each interview would have allowed for more follow-up questions and might have encouraged the participant to be more expansive in their responses. Also, the time constraints I had as a researcher and transcriber extended the transcription process into a longer period than initially anticipated. This constraint meant that I was collecting data before transcribing the previously collected data and continued the transcription process for several months after the initial collection. The lag could have created researcher bias as the data collection process proceeded.

Finally, as an administrator who initially established the research science program of studies in my rural high school and the parent of two children who have completed the program of studies, I needed to guard against presuppositions and biases. I tried not to disclose to the participants my thoughts on the educational best practices to avoid bias to best represent participants' authentic thinking and experiences within the research-science program of studies.

Implications of the Results for Practice, Policy, and Theory

The findings of this study have implications for practitioners and educational leaders in secondary schools, school districts, and postsecondary institutions. This study also provided insight into the mutually beneficial relationship between communities and schools as they develop shared social and human capital through communities of practice. With dedication and purposeful planning, community members, practitioners, and leaders can successfully work to address student equity issues faced by rural school communities. Researchers and politicians can provide tangible support to rural community members and practitioners to assist in this equalization process.

Implications for practice. The foremost implication for practice is a set of identified best practices rural school educators of research science dually-enrolled program of studies can use to maximize their human and social capital resources to establish and refine communities of practice within their teaching and learning environments. This information is essential given the importance of preparing geographically isolated rural school students to effectively take their place next to nonrural peers in the scientific research community at the university level. The best practices identified by rural secondary-school SRHS educators may provide a resource for other rural research science educators as they develop strategies to implement in their classrooms.

The second implication for practice centers on school, district, and university leadership. Understanding the challenges and opportunities SRHS educators face is helpful for leadership as they support programming and student participation. Leaders have the opportunity to strengthen the use of community resources and provide educators with the scaffolding needed to access these resources successfully. The SRHS teaching and learning classroom is grounded in current

teaching and learning theory. Leadership can help practitioners make the connections between theory and practice with a firm understanding of how this translation happens effectively, thus extending the learning beyond the traditional classroom. Daniel et al. (2019) noted that relationships are key to learning and development, and they involve many people and contexts that extend far beyond the classrooms.

Implications for policy. Often, practitioners see little connection of policy to practice as the policy is often seen as an obstacle blocking good teaching and learning practices based on teaching and learning theory. The findings of this study and similar studies can be used to inform policies that promote the wellbeing of the whole child and address the multiple developmental domains identified by Darling-Hammond et al. (2019)—academic, cognitive, ethical, physical, psychological, and social-emotional. This study revealed practitioners that address these multiple domains through an integrated and dynamic approach.

The New York State Department of Education has developed a new set of science learning standards in response to this holistic need, called NYS P-12 Science Learning Standards (NYS P-12 SLS). The purpose of the standards revision process is to prepare an ever-increasingly diverse population of students to be scientifically literate in a knowledge-based, technologically advancing economy (NYSED, 2016). NYSED (2016) stated that "the real innovation in the New York State P-12 Science Learning Standards is the requirement that students are required to operate at the intersection of practice, content, and connection" (p. 7). The NYS P-12 SLS offer significant opportunities to build 21st learning skills through multiple learning domains within an inquiry-based classroom experience. However, key to education

policy implementation process of any kind is a coherent, multi-dimensional, targeted approach to outreach and adoption.

To ensure successful outreach and adoption of the NYS P-12 SLS, policymakers must use a framework that provides smart policy design; inclusive stakeholder engagement; a recognition of the existing policy environment including educational governance, institutional settings, and external context; and a sound strategy to reach the educators within every New York State school (Viennet & Pont, 2017). I believe that by studying exemplary research science teaching and learning environments such as the SRHS classrooms in this study, policymakers can work with stakeholders to develop a plan for effective and inclusive implementation of the NYS P-12 SLS.

Implications for theory. Constructivist learning theory served as the foundation for this research study. Constructivist learning environments inspire student engagement and provide structures that allow students to learn science (Hsu & Espinoza, 2017). Characteristics of a constructivist learning environment include a learning environment that is- inclusive and participatory, where learners are actively engaged in interactive activities, activities are of high interest to the students, the teacher performs in the role of a facilitator of the learning processes, and students are encouraged to own their learning. The participants in this study shared many examples of how their teaching and learning environments epitomize these characteristics.

The participants also shared examples of how they utilize human and social capital in the development of the community of practices. Additionally, the participants were able to identify the reciprocal relationships between communities of practice, human action, and social capital. The conceptual framework cited for this study is the acquisition of knowledge through

communities of practice, and the reciprocal relationships communities of practice have with social capital and human capital. The findings in this study provide evidence of and align with the reciprocal relationships identified between human actions, social capital, and communities of practice to acquire knowledge.

The findings also suggest the value of research as it relates to modern-day learning theory in conjunction with human capital and social capital resources. Research on modern learning theory has identified the need to educate children in a holistic, integrated manner addressing their developmental needs in all domains—academic, cognitive, ethical, physical, psychological, and social-emotional. The findings from this study allow researchers and theorists to identify students' developmental needs in an integrated context. The information gathered in this qualitative multiple case study reinforces the need for connecting modern-day learning theory to practical classroom application for knowledge-acquisition for all students, but particularly geographically-isolated, secondary school, research science students.

Recommendations for Further Research

Researchers have identified disparities between students in rural school settings and their nonrural peers. Along with these disparities, there is a general lack of research available that is specific to rural school practitioners, communities, and leaders. Rural schools and communities have not benefited from solid, methodological research connected theoretically to the needs of its members (Schafft, 2016). This deficit is in part because each rural environment has its own unique context, referred to as a *sense of place* (Bauch, 2001; Biddle & Azano, 2016; Eppley, 2015; Greenough & Nelson, 2015; Misra et al., 2013). This multiple case study allowed me to

gather evidence within the sense of place for each secondary school, while at the same time identifying findings across cases.

My first recommendation is to expand the study to include all of the stakeholder groups from each secondary school. I would recommend gathering evidence directly from students about how they view their learning experiences within the SRHS classroom. Community members are also an essential part of developing and providing the human and social capital resources utilized by educators. Understanding the perspective of community members would further add to these findings. Leadership at the administrative and board of education levels would also likely have added insights to offer specifically regarding student knowledge acquisition. Finally, looking at the mentors' involvement in the dually-enrolled program of studies and hearing their thoughts on how to improve the practices of both the teacher and student may provide valuable insight into improving the future functioning of students' scientific communities of practice.

My second recommendation is to study the impact of the program on students through a longitudinal study. My study did not include the student perspective, and, to date, no study has been conducted that proves that this specific dually-enrolled program of study translates to students' completion of 4-year degrees or entrance into STEM majors and career pathways. The findings from this additional study could provide valuable support for the University as well as secondary schools and rural secondary schools exploring program implementation or looking to sustain programs within a fiscally volatile climate.

Finally, I feel that there is more to learn from the rural school educators about the mentor/mentee relationship. This was an area of my data set that I found lacking and I did not

probe deeply enough so I could gather more information from the participants. The participants generally expressed feelings of discomfort when reflecting on their perceived success in this area. My third recommendation is a follow-up study, focusing on the mentor theme. After another interview, I might be successful in probing deeper into this theme. I believe gathering more data on this theme is related to establishing trust and a rapport between the researcher and participant, as participants specifically stated this as a concern.

Conclusion

The results of this research study helped me identify best educational practices of SRHS educators for establishing communities of practice within geographically-isolated rural secondary schools. This study is valuable because geographically-isolated, rural secondary SRHS teachers must overcome challenges due to social capital deficits, which are not experienced by their nonrural colleagues. The results showed that rural SRHS educators employ many best educational practices that grow the reciprocal relationship between human action, social capital, and communities of practice. The conceptual framework which guided this study was the use of this reciprocal relationship for the advancement of the community and educational achievement.

The findings of this study added to the current body of research on research science dually-enrolled programs of study, especially to the dearth of research specific to rural secondary school students. The identified need to prepare students for a more global, technological, and knowledge-driven society makes this study valuable and timely. The literature review revealed that college preparation, specifically in STEM-related fields, remains a significant issue for rural

schools. The findings of this research support educators as they address this significant issue and affirm best practices linked to modern teaching and learning theory.

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Appendix A: Recruitment Email Protocol

Dear Science Research in the High School Educator,

I am currently conducting research as part of my doctoral studies in education. I hope to better understand the teaching and learning environment of the SRHS classroom. As an educator in a geographically-isolated rural secondary school, you are in the position to offer me valuable first-hand information from your own perspective. This study is multiple case study that is not evaluative of you as an educator or the SRHS program of study. Your responses to the questions will be kept confidential. Each potential participant will be assigned a number code to help ensure that personal identifiers are not revealed during the analysis and write up of findings. There is no compensation for participating in this study. However, your potential participation might be a valuable addition to my research and the findings could lead to stronger professional development opportunities for colleagues. If you are willing to participate, please complete and facilitate the completion of the attached participant and institution informed consent forms. Also, please suggest a day and time that I may contact you to conduct a phone conversation, structured interview, and further explain your role in this research study and better determine a fit for your anticipated participation. If you have any questions please do not hesitate to ask.

Sincerely,

Sandra J. Gardner

Doctoral Candidate

Concordia University–Portland

Appendix B: SRHS Research Study Structured Recruitment Interview Protocol

As you know from my email contact, I am working on my dissertation and studying the SRHS teaching and learning environment. This interview is structured, with the intent of providing clarity to you as the potential participant and greater specificity on the aim of the study. I will also offer definitions of for clarity. As I noted in my initial contact with you, I am asking you to participate in my study based on your tenure as an adjunct instructor of the SRHS dually-enrolled, program of study. This study is multiple case study that is not evaluative of you as an educator or the SRHS dually-enrolled, program of study. Dually-enrolled refers to the concurrent enrollment of a high school student that affords both high school and university credit hours. A program of study refers to a sequence of courses completed over time. In the case of SRHS this is three-year long classes worth four credits each and two summer classes worth two credits each. Are you comfortable answering a few questions for me? Assuming yes, I would move through the structured question protocol.

1. Do you feel you meet the participant criteria of a SRHS educator with three years of experience teaching in the program of studies, have completed a Master of Science degree in Education or Science, have completed the SRHS week-long training, and have an approved curriculum on file with the University, and have received endorsement from the University as an adjunct instructor?
2. Do you agree that your high school is identified correctly as rural by the New York State Rural Schools Association?
3. In addition to this initial interview, I may need to conduct one on-site, day-long, spring-term visitation, which will include a 40-minute, semistructured interview, an

observation of your SRHS classroom(s) while students are present, and artifact/document collection. Will you be willing to host me for the day?

4. Upon completion of the visitation day, I will compile my notes and ask you to check my data collected for accuracy and completion. Are you willing to review these materials?
5. The study is a multiple case study. There will be several schools that I will include in the study. As the collection and analysis process progresses, I may need to contact you by phone for follow-up questions and clarifications. Would you be willing to speak with me about the study following the initial data collection process?
6. It is my intent to wrap –up the data collection and analysis process by June, 2019. Does this timeframe work for you?
7. Thank you for your willingness to participate, may we arrange a date for my visitation now?

Appendix C: Semistructured Interview Protocol

INSTRUCTIONS

As you know from our previous contacts, I am working on my dissertation and studying the SRHS teaching and learning environment. This interview is semistructured. I will begin with several pre-determined questions and will follow-up and probe by asking additional questions, which will help me to understand your teaching and learning environment more deeply. This study is multiple case study that is not evaluative of you as an educator or the SRHS program of study. There are no right or wrong, or desirable or undesirable answers. I would like you to feel comfortable with saying what you really think and how you really feel.

RECORDING INSTRUCTIONS

I will be recording our conversation; this is a requirement of the data collection process. The purpose of this is so that I can get all the details but at the same time be able to carry on an attentive conversation with you. I assure you that all your comments will remain confidential. I will be compiling a report, which will contain all participants' comments without any reference to individuals and/or schools. Pseudonyms will be used for all names to avoid identification of individuals and/or schools.

CONSENT FORM INSTRUCTIONS

Before we get started, please take a few minutes to read and sign this consent form. The interview and recording will begin when the consent form is signed.

INTERVIEW QUESTIONS

Date:

Time:

Location:

Interviewer:

Interviewee:

Interview Questions	Interviewee Responses	Researcher Thoughts
1. Teaching and learning environments have both direct and indirect influences on student learning, including the students' spirit of inquiry and science research attitudes and skills. How do you foster student inquiry and scientific attitudes and skills? 2. How would you describe the school district's local community involvement in the SRHS program-of-studies? 3. What are the social networks you and your students use in the SRHS program-of-studies? 4. How do your students begin the knowledge building process with		

content experts? 5. Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. Describe how a community of practice develops for a typical student as they progress through the SRHS program-of-studies. 6. What actions do you take as the teacher in the facilitation of a community of practice for a student? 7. What actions does the student take in the formation of a community of practice? In the sustainment? In the closure? 8. How do students' backgrounds influence their engagement in a community of practice? 9. What is your impression of students' feelings about communities of practice? 10. How do you help establish trust and respect within the community of practice for each student? 11. How does the process of knowledge acquisition change as they become a		

member of a community of practice?		

CLOSURE

Thank you very much allowing me to spend the day with you. Your time is very much appreciated and your contributions have been very helpful. The purpose of this interview and observation is to better understand the SRHS teaching and learning environment. We are interested in your opinions and the social constructivist methodology and scientific inquiry methods you embrace in your teaching-learning environment. In no way is this interview and observation designed to individually evaluate a person's abilities and will not provide an evaluation of you and your teaching and learning environment. The results of this research will provide useful information to other SRHS educators, in helping them to structure their SRHS program of studies for student success. You will be kept confidential during all phases of this study including any experimental writings, published or not. Procedures for maintaining confidentiality include redacting of any identifying information and using pseudonyms for names.

Appendix D: Observer Protocol

Date:

Time:

Location:

Observer:

Participant:

Elements	Questions	Data Collected	Reflective Notes
The Physical Setting	What is the physical classroom set-up?		
	How is the space designed to impact human behavior?		
	What tools, resources, and technologies are in the physical space?		
The Participants	Who is in the space? What are their roles?		
	How do these people organize themselves?		

	How do these people interact and communicate with each other, including frequency and patterns?		
	How do these people use the tools, resources, and technologies?		
Activities and Interactions	What is going on?		
	How do people interact with the activity and one another? What are the connections?		
	What evidence of norms or rules structuring the activities and people are there?		

Conversations	What is the content of the conversations?		
	Who speaks to whom? Who listens to whom?		
	What nonverbal communications occur?		
Subtle Factors	What informal/unplanned activities occur?		
	Are there symbolic and connotative communications?		
My Behavior	What is my role?		
	What are my thoughts about what is occurring?		

(Merriam & Tisdell, 2016)

Appendix E: Artifact and Document Protocol

Date:
Location Origination:
Artifact/Document ID Number:
Artifact/Document Name:

Photo of Artifact or PDF of Artifact

1. Where did the document/artifact originate from?
2. How, why, and who was the document/artifact produced?
3. What is the author trying to accomplish through the document/artifact?
4. Does the document/artifact address its purpose?
5. How does the document/artifact link to the interview?
6. How does the document/artifact link to the observation?
7. Is there institutional text in the document that needs deconstructing or demystifying?
8. Did the author of the document/artifact have a bias that can be determined?

(Merriam & Tisdell, 2016; Miller as cited in Patton, 2002)

Appendix F: Informed Participant Consent Form

Concordia University–Portland Institutional Review Board
Approved: February 22, 2019; will Expire: February 22, 2020

Research Study Title:	A Multiple Case Study Exploring Communities of Practice Led by Rural Secondary School Science Teachers to Overcome Community Isolation in a Research-Science, Dually-Enrolled, Program-of-Studies
Principal Investigator:	Sandra Gardner
Research Institution:	Concordia University–Portland
Faculty Advisor:	Chad Becker

PURPOSE OF STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

The purpose of this study is to explore the social constructivist methodology and scientific inquiry methods used by Science Research educators within their teaching and learning environment.

STUDY PROCEDURES

The participant will complete a structured interview of about 10 minutes, a semistructured interview of about 40 minutes, a classroom observation, provide supporting artifacts and documents, and participate in a facilitated member checking session by reviewing the researcher's notes. Photographs will be taken of artifacts and documents.

RISKS

There are no risks to participating in this study other than providing your information. However, we will protect your information. I will record interviews. The recording will be transcribed by me, the principal investigator, and the recording will be deleted when the transcription is completed. Any data you provide will be coded so people who are not the investigator cannot link your information to you. Any name or identifying information you give will be kept securely via electronic encryption on my password protected computer locked inside the cabinet in my office. The recording will be deleted as soon as possible; all other study documents will kept secure for 3 years and then be destroyed.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may identify social constructivist methodology and scientific inquiry methods that can be shared with less experienced colleagues.

CONFIDENTIALITY
For this research study, your comments will not be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following:
• Assigning code names for participants that will be used on all research notes and documents
• Keeping notes, interview transcriptions, and any other identifying participant information in a locked file cabinet in the personal possession of the researcher.

This information will not be distributed to any other agency and will be kept private and confidential. Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents. The only exception to this is if you tell us abuse or neglect that makes us seriously concerned for your immediate health and safety.

CONTACT INFORMATION
You will receive a copy of this consent form. If you have questions you can talk to or write the principal investigator, Sandra Gardner at email [redacted]. If you want to talk with a participant advocate other than the investigator, you can write or call the director of our institutional review board, Dr. OraLee Branch (email obranch@cu-portland.edu or call 503-493-6390).

VOLUNTARY PARTICIPATION
Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

_____		_____
Participant Name	Date	
_____		_____
Participant Signature	Date	
_____		_____
Investigator Name	Date	
_____		_____
Investigator Signature	Date	

Investigator: Sandra Gardner; email: [redacted]
c/o: Professor Dr. Chad Becker;
Concordia University–Portland
2811 NE Holman Street
Portland, Oregon 97221

Appendix G: Fire

What makes a fire burn

is space between the logs,

a breathing space.

Too much of a good thing,

too many logs

packed in too tight

can douse the flames

almost as surely

as a pail of water would.

So building fires

requires attention

to the spaces in between,

as much as to the wood.

When we are able to build

open spaces

in the same way

we have learned

to pile on the logs,

then we can come to see how

it is fuel, and absence of the fuel

together, that make fire possible

We only need to lay a log

lightly from time to time.

A fire

grows

simply because the space is there,

with openings

in which the flame

that knows just how it wants to burn

can find its way.

Appendix H: Statement of Original Work

The Concordia University Doctorate of Education Program is a collaborative community of scholar-practitioners, who seek to transform society by pursuing ethically-informed, rigorously-researched, inquiry-based projects that benefit professional, institutional, and local educational contexts. Each member of the community affirms throughout their program of study, adherence to the principles and standards outlined in the Concordia University Academic Integrity Policy. This policy states the following:

Statement of academic integrity.

As a member of the Concordia University community, I will neither engage in fraudulent or unauthorized behaviors in the presentation and completion of my work, nor will I provide unauthorized assistance to others.

Explanations:

What does "fraudulent" mean?

"Fraudulent" work is any material submitted for evaluation that is falsely or improperly presented as one's own. This includes, but is not limited to texts, graphics and other multi-media files appropriated from any source, including another individual, that are intentionally presented as all or part of a candidate's final work without full and complete documentation.

What is "unauthorized" assistance?

"Unauthorized assistance" refers to any support candidates solicit in the completion of their work, that has not been either explicitly specified as appropriate by the instructor, or any assistance that is understood in the class context as inappropriate. This can include, but is not limited to:

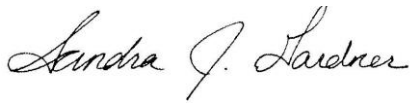
- Use of unauthorized notes or another's work during an online test
- Use of unauthorized notes or personal assistance in an online exam setting
- Inappropriate collaboration in preparation and/or completion of a project
- Unauthorized solicitation of professional resources for the completion of the work

Statement of Original Work (continued)

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University–Portland Academic Integrity Policy during the development and writing of this dissertation.

2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly references and all permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association.*



Digital Signature

Sandra J. Gardner

Name (Typed)

March 23, 2020

Date