Beyond the City Lights: A Multiple-Case Study of Successful, Experienced Secondary Science Teachers in Rural Schools

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Beyond the City Lights: A Multiple-Case Study of Successful, Experienced Secondary Science Teachers in Rural Schools

by

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A DISSERTATION

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Beyond the City Lights: A Multiple-Case Study of Successful, Experienced Secondary Science Teachers in Rural Schools

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Recruitment and retention concerns for teachers, particularly in rural school districts and in science, fill the daily news and research literature. The shortage of STEM workers is also another concern as well. Then why do nationally recognized secondary science teachers remain in rural schools with lower salaries, increased responsibilities beyond teaching content, and multi-preparations, stay in those schools? How do they overcome challenges in their schools?

This multiple case study focuses on Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST) awardees who have taught secondary science in rural school districts 10 years or more. Eight rural PAEMST high school science teachers were identified in Nebraska and the six contiguous states; four consented to participate in this study. Interviews of these teachers and a colleague, principal, and or students were conducted to answer the research questions.

Using a lens of resiliency, similarities were identified that show how these teachers overcome adversity and thrived in their rural school and communities. Resilient themes that emerged from this study are adaptability, autonomy, collaborative, competency, connectedness, problem-solvers, and resourcefulness. Common themes of success for teaching in rural schools for the four teachers were autonomy and relationships. Common themes of challenges for teaching in rural schools were diversity,
funding, professional isolation, and teaching assignments. These characteristics and strategies may help schools with their recruitment and retention of teachers as well as teachers themselves benefiting from hearing other teachers’ stories of success and longevity.
I dedicate this not only to my parents, Jack H. DeVore and Ruth E. Caldwell DeVore, but to the hundreds of rural science teachers who not only persist, but thrive while providing their students with meaningful education and life-long learning skills.
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## Table of Contents

I. Introduction ................................................................................................................. 1
   Statement of the Problem ......................................................................................... 3
   Purpose of the Study ................................................................................................. 4
   Research Questions .................................................................................................. 4
      Central Questions .................................................................................................. 4
      Sub-Questions ....................................................................................................... 4
   Conceptual Framework ............................................................................................. 5
   Definition of Key Terms ............................................................................................ 6
   Delimitations and Limitations of the Study ............................................................. 8
   Significance of the Study ........................................................................................... 9
      Identify Characteristics of Successful Rural Teachers ......................................... 9
      Resilience and Persistence ..................................................................................... 10
      Improve Recruitment and Retention .................................................................... 10
      Identify Positive Teacher Attributes .................................................................. 11
      Implications for Future Research .......................................................................... 11
   Summary .................................................................................................................. 12

II. Literature Review .................................................................................................... 14
    Historical Perspective ............................................................................................... 14
    Ruralness .................................................................................................................... 16
    Rural Science Teachers ............................................................................................ 17
    Retention ................................................................................................................... 17
    Resilience .................................................................................................................. 19
    Attributes of Teaching in Rural Schools .................................................................. 24
    Rural Teacher Retention ........................................................................................... 25
       Retention ............................................................................................................... 25
       Migration ............................................................................................................... 27
       Professional Development ..................................................................................... 29
       Student Achievement ............................................................................................ 29
       Benefits and Challenges ....................................................................................... 30
       Summary ............................................................................................................... 30

III. Methodology .......................................................................................................... 33
    Research Questions ................................................................................................... 34
       Central Questions .................................................................................................. 34
       Sub-Questions ....................................................................................................... 34
    Rationale .................................................................................................................. 34
    Case Study ................................................................................................................. 35
    Role of Researcher ..................................................................................................... 35
    Data Collection Procedures ...................................................................................... 37
       Participants ............................................................................................................. 38
Data Sources and Collection Methods ......................................................... 39
  Interviews ................................................................................................. 39
  Behavior over time graphs ....................................................................... 40
  Observations and field notes ................................................................... 40
  Artifacts ...................................................................................................... 41
Data Analysis Procedures ........................................................................... 41
Triangulation of Data ................................................................................ 42
Methods for Verification .............................................................................. 43
  Member Checking ...................................................................................... 44
  Researcher Bias ......................................................................................... 45
  Triangulation of Data .............................................................................. 45
Limitations .................................................................................................... 46
Summary ........................................................................................................ 47
IV. Data Analysis and Findings ................................................................. 49
Restatement of Research Questions ......................................................... 50
Central-Questions ...................................................................................... 50
Sub-Questions ............................................................................................. 50
Data Collection ........................................................................................... 50
Data Analysis .............................................................................................. 52
Case Studies ................................................................................................ 56
  The Sara Wymore Case ............................................................................. 56
  Community and School ............................................................................ 56
  Teacher Background ................................................................................ 57
  Honors ........................................................................................................ 60
Behavior over Time Graph ......................................................................... 60
Benefits of Teaching in Rural School ......................................................... 62
  Autonomy .................................................................................................. 62
  Collaboration .............................................................................................. 62
Challenges of Teaching in Rural School .................................................... 65
  Geography .................................................................................................. 65
  Diversity ...................................................................................................... 65
  Funding ........................................................................................................ 66
Characteristics of Resilience ....................................................................... 66
  Autonomy .................................................................................................. 67
  Adaptability/Flexibility ............................................................................ 37
  Resourceful/Collaboration ...................................................................... 37
  Support Systems ....................................................................................... 68
Summary ........................................................................................................ 68
The Rachel Lake Case .................................................................................. 69
Community and School ............................................................................... 69
List of Tables

Factors that promote resilience ........................................................................................................... 21
Benefits and challenges teaching science in rural schools ................................................................. 31
Community and school demographics of participants ........................................................................ 53
Education and career background of participants .............................................................................. 54
Awards and recognition of participants ............................................................................................. 55
Emergent resilient themes of teaching in rural schools ....................................................................... 111
Emergent benefits themes of teaching in rural schools ..................................................................... 115
Emergent challenges themes of teaching in rural schools ................................................................. 117
List of Figures

Sara Wymore’s Behavior over Time Graph ...............................................................61
Rachel Lake’s Behavior over Time Graph ...............................................................74
Josephine Christof’s Behavior over Time Graph ...................................................88
Brad Kent’s Behavior over Time Graph ...............................................................104
CHAPTER I

Introduction

Reading the news headlines, one develops the feeling that there is an increasing shortage of teachers across the United States of America (USA). For example, Clark County Schools (Las Vegas, Nevada) needed almost 1,000 teachers as they began the 2015-2016 school year and the state of California was short 21,500 teachers (Partelow, 2015). While this is a concern for all school districts, imagine how this teacher shortage affects the nation’s rural school districts which make-up about one-half of all school systems in the USA.

Rural school systems lack the glamour and glitter of those in large, urban areas and draw from a much smaller pool of potential teachers. Rural school systems are often located in isolated communities defined by a smaller population of qualified teachers. Additionally, these rural systems often provide limited community resources and suffer high-need designations in terms of fiscal resources and classroom equipment. Finally, rural school teachers likely face social and professional isolation where they assume multiple-class preparation duties, responsibility to teach outside of their disciplinary areas, and limited opportunity to access the membership benefits of professional associations or attend professional development sessions in their content area. (Monk, 2007; Thomas & DeVore-Wedding, 2016).

The current focus on science, technology, engineering, and mathematics (STEM) and the education for STEM employment also highlights teacher shortages in STEM content areas. In pK-12 public schools, STEM is often taught by science and mathematics teachers; if there is a need for more STEM employees, these teachers can be lured away from teaching to earn higher, industry salaries (Goodpaster, Adedokun, & Weaver, 2012).
STEM careers require STEM-educated personnel. Secondary science teachers with a content degree (and pedagogical knowledge as well), provide an excellent employee pool—particularly when one compares the differences between salaries in STEM industry and STEM education (Atkinson, Hugo, Lundgren, Shapiro, & Thomas, 2007; Carlsen & Monk, 1992; Monk, 2007, Oliver, 2007). Rural teachers are particularly susceptible since they often receive lower salaries than teachers in urban regions and larger school districts (Goodpaster, Adedokun, & Weaver, 2012).

Particularly in the case of science teachers, if the working conditions in rural schools are less than ideal, then why do teachers stay? How do rural science teachers manage the isolation and shortage of resources? It seems science teachers who choose to stay in rural schools can find opportunity to thrive. In fact, some rural science teachers have received distinctive science teaching awards at the national level, such as the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST) recipients. How do these teachers not only persist but gain recognition as award winning teachers?

The bulk of the research literature on teacher shortages focuses on teacher recruitment and retention practices within the first five years of a teacher’s employment in terms of both quality and effectiveness of instruction as well as fiscal repercussions (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2008; Falk, 2012; Gray & Taie, 2015; Phillips, 2015). Narrowing the focus to rural teacher recruitment and retention, there is a shortage of recent literature, particularly regarding secondary science teachers (Collins, 1999; Arnold, Gaddy, & Dean, 2006; Monk, 2007).
Induction and mentoring programs for novice teachers (rural and non-rural schools) frames another concern in the literature (Henry, Bastian, & Fortner, 2011; Luft, Firestone, Wong, Ortega, Adams, & Bang, 2011) though there remains little research on those teachers who do stay, especially those who teach in rural school systems. Coladarci’s (2007) insistence on the need for more rural science education research has gone unheeded. It seems, rather, researchers have chronicled the successes of rural teachers over the last century and, due to concerns related to the teacher shortage, the research thrust has shifted from veteran teachers’ retention to novice teachers’ retention (Carlsen & Monk, 1992; Stern, 1994; Yarrow, Ballantyne, Hansford, Herschell, & Millwater, 1999; Luft et al., 2011; Wong & Luft, 2015). This research trend defines the gap in the recent literature reporting on the status of rural science education in the USA and 20% of the current pK-12 students in the United States who depend on rural school systems (National Center for Education Statistics, (NCES), 2013; U. S. Census, 2015).

Rural school systems have been criticized for their (a) high-need, in terms of fiscal and physical resources (Goodpaster et al., 2012), (b) isolation from amenities (such as universities and industries) (Hadfield, 1992), and (c) less experienced, less-knowledgeable teachers (Carlsen & Monk, 1992; Monk, 2007; Oliver, 2007). How do teachers, particularly science teachers, both continue and succeed in rural school environments? This was the intent and focus of this dissertation study.

Statement of the Problem

The problem addressed in this study was two-fold: Why do nationally recognized secondary science teachers remain in rural school systems and how do they manage the limitations of their unique working environment? This study sought to understand what
it was about a purposefully selected group of secondary science teachers that enabled them to remain and thrive in rural school systems.

**Purpose of the Study**

The purpose of this study was to understand the career histories of successful, veteran science teachers in rural schools using a multiple case design resulting in a multiple case study. For purposes of this research, *successful teachers* were defined as nationally recognized, *veteran teachers* were those with ten or more years’ experience, and *rural schools* were defined as schools with a population of 1,000 or fewer students.

**Research Questions**

This multiple case study was guided by two central questions and three associated sub-questions (Creswell, 2014).

**Central Questions**

Why do nationally recognized secondary science teachers stay in a rural school environment?

How do nationally recognized secondary science teachers, who have taught in a rural setting for at least 10 years, describe their own success and longevity?

**Sub-questions**

1. How do these teachers describe any challenges to their success and longevity?
2. What are the common, emergent themes related to success and longevity of the participants?
3. What unique, traits defined the success and longevity of each participant?
Conceptual Framework

A pragmatic perspective provided the foundation of this research plan--where my quantitative, positivist training connected with my constructivist teaching background and blended into my working research philosophy. This paradigm did not commit to any one philosophy, giving me the freedom of choice to do what “works” (Creswell, 2013, p. 28).

In this dissertation research, I engaged the lens of resiliency to help me understand the success of veteran science teachers in rural schools. Looking at teachers who persist encompasses more than just “sticking it out” but incorporates qualities of resiliency: “enabling teachers to respond positively to challenging circumstances which they may meet over the course of a career” (Gu & Day, 2007, p. 1302). Since the current research literature focuses on novice teacher retention, shifting the view to veterans and longevity, moved my literature review beyond persistence to also consider teachers’ ability to adapt to challenging circumstances as in resiliency (Le Cornu, 2009).

According to Bobeck (2002), resiliency of teachers--the ability to adapt to varied situations--increased their competency to overcome adverse conditions vital to a teacher’s success, persistence, and retention.

Science teachers, particularly, those in rural schools with multiple daily preparations, need more than persistence to succeed over many years. As Gibbs and Miller (2014) explained, resiliency explains this phenomenon: resiliency depends on the resources available to teachers that enable them to overcome negative circumstances. Resources that resilient teachers draw upon include support from colleagues and administration, from friends and family, and from the non-teaching community (Bobek,
2002). Teachers with personal traits of altruism and strong self-efficacy also display strong resiliency or the ability to increase their resiliency over time (Malloy & Allen, 2007; Beltman, Mansfield, & Price, 2011). Given this perspective, multiple researchers determined resilient teachers are happier and more effective as teachers (Gu & Day, 2007; Beltman et al., 2011; Pretsch, Flunger, & Schmitt, 2012).

Some researchers have studied the effects of teaching resilient skills to pre-service teachers and early-career teachers to increase their success and retention (Huisman, Singer, & Catapano, 2010; Beltman et al., 2011; Doney, 2013). Though, rural science teachers have not been the specific focus of such research, Malloy and Allen (2007) reported on a rural school that adopted a resiliency culture that resulted in improved teacher retention. These teachers expressed their satisfaction in the teaching assignments, felt their voices were not only heard but encouraged to speak out, and wanted to continue their employment in this district (Malloy & Allen, 2007).

**Definition of Key Terms**

Defining a school or school district as rural was not easily done given the wide variety of definitions found in the literature (Coladarci, 2007; Oliver, 2007; Goodpaster et al., 2012; Avery, 2013). According to the National Center for Education Statistics (NCES) rural schools include those schools with less than 1000 students which are (a) located 25 miles or farther from an urban center (another conundrum of classifications) or, (b) situated in a school district designated as rural by the state department of education and or, (c) in a town classified as rural by the town’s state (U. S. Census, 2015). The U. S. Bureau of the Census (2015) defined urbanized areas as regions with 50,000 or more people and urban clusters as regions with 2,500 or more people. Conveniently then, rural
would be anything not classified as urban or urban cluster (U. S. Census, 2015). Rural schools then would be schools that are in classified rural areas (The Rural School and Community Trust, 2013). The Small, Rural School Achiement program (SRSA) uses the following criteria to identify rural school districts:

- Total average daily attendance is less than 600 students;
- District is in a county with a population density under 10 people per square miles; and
- Every school in the district is in a community defined as rural by the Census Bureau (The Rural School and Community Trust, 2013).

For the purposes of this study, a rural school was defined as a school with less than 1000 students, in a town identified as rural or remote by residents and/or governmental agencies, and is at least 25 miles from an urban center.

Longevity was defined as ten or more years of employment in a rural school district. Teachers are often labeled as novice the first five years of their teaching tenure (Wong & Luft, 2015) and up to 50% of teachers leave the profession within the first 5 years of employment (Ingersoll & May, 2012), but teachers who stay ten years or more have made a commitment to schools and teaching.

Success was defined as recognition outside of the local school and community, such as state teacher or leadership awards, national awards such as PAEMST or national organizations’ awards. National board certification, active participation in state, regional, or national education policies and leadership will also be considered.
Delimitations and Limitations of the Study

In this dissertation study, I chose a multiple case study method to look for common themes across participants with a common background, despite their own unique circumstances and environment. Emergent, common themes from this study could assist rural school districts not just recruit teachers, but retain science teachers that demonstrate similar characteristics and perspectives on teaching science in a rural school system. Rural school districts could provide professional development and training based on these common themes as well for all teaching staff.

The PAESMT served the common national recognition award for success. The PAEMST website provided a list of teachers who have won the award since 1983. In this dissertation research, I limited the study area to the state of Nebraska and its six contiguous states: Colorado, Iowa, Kansas, Missouri, South Dakota, and Wyoming (National Science Foundation (NSF), 2016). The PAEMST website provides the awardees names and school district where the awardee is currently employed (NSF, 2016). After identifying these states’ secondary science PAEMST awardees, I visited each school’s website to determine if that school district fit the definition of rural.

The scope of this study was limited to four individual teachers to allow me to review teachers’ perspectives on their own longevity and success in a rural school system, observe the teachers in their classroom, and interview their supervisors and colleagues. This approach made my study practicable within the time and fiscal constraints.
Significance of the Study

Recent research on teachers focuses on novice teachers and seldom highlights science teachers specifically, but usually focuses on teachers in general (Monk, 2007; Henry et al., 2011; Luft et al., 2011; Falk, 2012; Ingersoll & May, 2012). This study will begin to fill the gap in the literature about science teachers and education in rural school systems. Previously, several researchers called for more research, but the call has gone unheeded (Arnold, Gaddy, & Dean, 2005; Coladarci, 2007; Monk 2007; Goodpaster et al., 2012; Ingersoll & May, 2012; Wong & Luft, 2015). This multiple case study will (a) add to the literature on the characteristics of successful rural science teachers and the functions of resilience and (b) illuminate the positive aspects of rural school districts and their teachers.

Identify Characteristics of Successful Rural Teachers

Identification of the characteristics of veteran, successful science teachers in a rural setting will define and describe the behaviors of teachers who have not only stayed but thrived in the rural environment. This illumination can help to improve the means of teacher recruitment and retention, better align teacher professional development opportunities, and further organize professional support for rural science teachers. Suggestions and ideas from rural science teachers regarding their own teaching experiences might also assist in the definition of school districts policies for induction, mentoring, and retention of teachers (Collins, 1999; Harmon, 2001; Monk, 2007; Goodpaster et al., 2012; Wong & Luft, 2015).
Resilience and Persistence

Recognition of how persistence of these rural veteran science teachers seems to be linked to their resiliency, development of resilient skills may add to induction and mentoring programs and to the literature on teacher resiliency (highlighting proven techniques of nationally recognized teachers) (Beltman et al., 2011; Gu & Day, 2007; Pretsch, et al., 2012; Gibbs & Miller, 2014).

Mentor and induction programs are currently provided for novice teachers (in their first 3-5 years in schools). Given that the expertise of veteran teachers is a common component of induction programs, rural schools may lack a veteran science teacher to fill this role. Identification of the characteristics of successful veteran teachers can help rural schools support their novice science teachers learn alternate ways of science teaching. For example, identification of a cadre of successful veteran science teachers in rural areas could help with virtual mentoring, which would be possible and even more probable in our digital age.

Improve Recruitment and Retention

Information about successful veteran rural science teachers may help to form policy changes and enhance the preparation of master teachers by the contribution of what makes a successful science teacher in rural settings. Collins (1999) recommends that candidates for rural teaching placements should have personal characteristics, educational experiences and rural background experiences that predisposes them to live in rural areas. In Australia, recruiting and retaining teachers in their rural schools is an ongoing issue, suggesting preservice teachers’ attitudes need to be changed about rural teaching (Hudson & Hudson, 2008). Seventeen preservice teachers were accepted for a
program that provided a five-day introduction to rural living in Australia; participants interacted with the community, spent time in the schools, learning activities, and some teaching (Hudson & Hudson, 2008). The data collected from these participants included narrative which participants wrote in anticipation of their involvement with this project followed by a reflection questionnaire afterwards (Hudson & Hudson, 2008). A survey identifying traits that are complementary to rural teaching could assist rural school districts attract and retain teachers as well as screen pre-service teachers with a propensity for rural teaching would be extremely useful. Findings from this study could guide the development of such a survey.

**Identify Positive Teacher Attributes**

Last, but certainly not least, this study helped to illuminate the positive aspects of teaching, specifically in a rural setting, and of science teachers. These noted aspects can help rural school districts promote their positive attributes for all of their teachers, but especially their science and STEM teachers.

**Implications for Future Research**

Hudson and Hudson (2008) suggested student teaching in a rural environment would help novice teachers to see how they function in a rural environment. Incorporation of a resiliency training program with in the student teaching experience might be another avenue for retaining teachers in rural schools. Such a program might help teachers who struggle with the isolation or small community to develop resilient traits that would increase their likeliness to stay.

A self-awareness survey, based on the common and unique themes for successful science teachers in rural schools, might help those contemplating employment in rural
schools and help to guide a teacher’s success in the rural school environment (Carlsen & Monk, 1992; D’Amico & Nelson, 2000; Hudson & Hudson, 2008). Following through with such an instrument, administered to a larger population of rural, secondary science teachers would provide data on teacher success beyond the limitations of this multiple case study. Additionally, these data could add to the limited research literature addressing rural science educators. This will be considered as a post-doctorate research project.

**Summary**

Recent news reports on the shortage of teachers points out that the greatest shortages are in mathematics, science, and special education. Additionally, current research focuses on recruiting and retaining novice teachers, but little focuses on those teachers who choose to stay, or persist as teachers; even less research focuses on rural teachers or rural science teachers.

Rural school systems have often been painted as fiscally poor, lacking equipment and resources, and providing little support for their science teachers. Then why do some rural science teachers not only persist but thrive in their unique working environment?

The purpose of this study was to identify the positive attributes successful teachers demonstrate in their career experiences as rural secondary science teachers. These science teachers who persisted in rural teaching environments provided perspectives on their success and longevity that could assist school districts to recruit and retain teachers, particularly those in the science and STEM fields, as well as help schools provide long-term support through their policies and programs.

A comparison of the career experiences of rural science teachers enabled this multiple case study to provide insight into the ways resilient traits undergirded these
teachers’ success and adds to the limited research on rural and science teachers. Learning how these teachers have developed and implemented resiliency may help to improve rural schools’ ability to recruit and retain teachers, particularly science teachers.
CHAPTER II

Literature Review

Historical Perspective

Over the last one hundred years, there has been an ebb and flow in the United States’ interest of science education, research in science education, and the supply of scientists in the workforce (Shamos, 1995). During and after World War II, science knowledge grew rapidly, requiring more scientists, and therefore, an increase in emphasis on science education. Ten years later, Sputnik concerns (and a race to beat the Russians into space) focused science again. Interest in science education decreased after the Chernobyl and Three Mile Island accidents and in the pace program, especially after landing on the moon, by the 1980s (Shamos, 1995; Feyerabend, 2011), a crisis in science education was being met by the American Association for the Advancement of Science’s (AAAS) Project 2061 (1989). In response to students’ performance on international tests such as National Assessment of Educational Progress (NAEP) and Trends in International Mathematics and Science Study (TIMSS), the National Research Council (NRC) (authored the National Science Education Standards (1996). With concerns over the emphasis on reading and mathematics through the first decade of the 21st Century, as well as the reauthorization of the Elementary and Secondary Education Act in 2001 as the No Child Left Behind (NCLB) act (H.R. 1, 2001), science education was brought to the forefront again with the publication of A Framework for K-12 Science Education Practice, Crosscutting Concepts, and Core Ideas (NRC, 2012) and the Next Generation of Science Standards (NGSS) (NRC, 2013). Science education returns to the spotlight with the reauthorization of the Elementary and Secondary Education Act (S. 117, 2015), titled Every Student Succeeds Act (ESSA). ESSA not only includes emphasis on science
along with reading and mathematics, but calls for a corps of master STEM teachers as well.

The bulk of rural science education literature, however, referenced a paucity of research on rural science teachers, specifically, as well as rural schools’ science programs in general (Stern, 1994; Harmon, 2001; Arnold, Newman, Gaddy, & Dean, 2005; Oliver, 2007; Goodpaster, Adedokum, & Weaver, 2012). Even less literature referred to the STEM teachers and programs in rural schools, let alone a corps of master STEM teachers (Harmon, Henderson, & Royster, 2003; Ingersoll & Perda, 2010; Wang, H.-H., Moore, T. J., Roehrig, G. H., & Park, M. S., 2011; Goodpaster et al., 2012).

Oliver (2007) provided an historical background in the interest in researching rural schools, and rural science educators specifically. Prior to World War II, the interest and the means to conduct research in rural schools were not evidenced in education research literature. He expected that the ruralness of the schools, their distance from universities and cities, prevented researchers from being involved with or even aware of their existence. Oliver (2007) mentioned the Curtis Digests (1926/1971a, 1931/1971b, 1939/1971c), which were a series of digests examining research in science education, included very little rural science education research. Several factors identified for this lack of research on rural science education include research designs not being sufficiently rigorous for publication and, even more onerous, was the difficulty of defining rural.

Suggestions for improving both the quantity and quality of rural education research, in general and rural science education specifically, include incorporating more qualitative approaches to quantitative research approaches which require samples sizes greater than what is available in rural settings (Coladarci, 2007). More specifically,
quantitative data analyses provide only a descriptive boundary for the research, but qualitative data can tell a deeper, richer story and may fill in the gaps between the quantitative data.

The following sections review the literature contributing to this study of secondary science teachers’ persistence and success in rural school settings. These sections include a basis for my own delimitation of rural school systems; a global perspective on USA rural science teachers and a glimpse into the last century’s view of rural science teachers as well as review retention in terms of rural science teachers. Finally, a review of the positive attributes and limitations of teaching in rural schools completes the background for this study.

**Ruralness**

One of the problems with rural education research is the variety of interpretations of what defines rural schools. Some researchers identify rural schools as those that are geographically as close as ten miles to an urban region to rural schools that bus in urban students to increase diversity and consolidate resources in their rural school (Shroyer & Enochs, 1987; Harmon, 2001; Oliver, 2007; Biddle & Azano, 2016). There is no consistency in the definitions of what a rural school is, although most of the papers published in the past 10 years often use US Census Bureau data, National Center for Education Statistics (NCES), and individual state’s classifications to define their definition of rural (Barley & Beesley, 2007; Howley, Wood, & Hough, 2011). The National Center for Education Statistics (2011) codes rural locations into three categories: rural, fringe (less than or equal to 5 miles from an urbanized area); rural, distant (more than 5 miles and less than or equal to 25 miles from an urbanized area); and
rural, remote (more than 25 miles from an urbanized area). NCES identified over half of United States of America’s schools rural (2013). To make things even more complicated, states have their own classification for rural, suburban, and urban schools based on geographic location and student numbers, which makes classifying rural education research even more complicated (Howley, et al., 2011; Biddle & Azano, 2016).

**Rural Science Teachers**

Considerable recent research focused on rural education in general, however, the lack of recent rural science education research required that this researcher review literature from the last century. Carlsen and Monk (1992) studied rural and non-rural secondary science teachers looking for differences. In this, they analyzed quantitative data from the 1988 Longitudinal Study of American Youth (LSAY), looking for and identifying consistent differences between the rural and non-rural science teachers. They reported that rural science teachers recounted fewer science courses, content and methods than their non-rural colleagues. Rural science teachers were less likely to have degrees beyond their bachelor’s and that degree was more often an education degree. Rural science teachers also had less experience teaching in their school districts and often taught more than science-only courses. Overall, their research pointed to a workforce of less experienced, poorly prepared, teachers of science in rural schools. Unfortunately, that negative image was consistent throughout the literature (Sterns, 1994; Barrow & Burchett, 2000; Harmon, 2001; Harmon et al., 2003; Barley & Beesley, 2007).

**Retention**

The National Center for Education Statistics (NCES) estimated that teacher turnover is 9% annually, which presents more of a challenge to rural schools (2009).
Rural schools (especially with less than 100 students,) have a difficult time recruiting and retaining teachers and often have teachers with three or less years of teaching experience, with smaller schools having even a harder time recruiting and retaining science teachers (Monk, 2007; Goodpaster et al., 2011). A large percentage of rural teachers have few professional and community connections, especially the novice teachers, and 4-6 preparations daily (Harmon, 2001; Harmon, Gordanier, Henry, & George, 2007). Researchers argued this concern for teacher recruiting and retention affects the quality of instruction and student achievement (Bybee, McCrae, & Laurie, 2009) as teachers do not have time to develop community relationships while establishing new curricula and or programs (Harmon, Gordanier, Henry, & George, 2007; Goodpaster et al., 2012). These schools also serve students from low-income families, have fewer fiscal resources, lack equipment, and community resources (Atkinson, Hugo, Lundgren, Schapiro, & Thomas, 2007; U.S. Census Bureau, Visited July 9, 2015).

Recruitment and retention of science teachers has received nominal research attention in the face of concerns for recruiting and retaining all teachers in rural areas. Hodges, Oliver, and Tippins (2013), however, focused research exclusively on retention of science teachers in the rural schools of the Deep South. They found autonomous teachers remained linger in a school district. They also determined a positive correlation between autonomous teachers’ longevity and their students’ performance on tests, (standardized and classroom assessments). Teachers who were not part of the decision-making team (from policies and procedures in the district/building to their curricula, lessons, and activities) were “deprofessionalized” and lost their enthusiasm and commitment to the district.
Resilience

Teachers encounter many situations that create stress or conflicts with their daily instruction and resulting effectiveness (Bobek, 2002). Teachers in rural schools can add to these situations—potential lack of fiscal and physical resources and geographical and professional isolation—and the stress may increase so significantly that they leave either rural schools or teaching altogether (Boyd et al. 2008; Gary & Taie, 2015; Partlow, 2015; Biddle & Azano, 2016).

Resiliency skills have been studied in schools where teacher retention is high, as well as with novice teachers to increase their likelihood of staying where they are first hired or even teaching altogether (Bobek, 2002; Gu & Day, 2007; Beltman et al., 2011; Pretsch et al., 2012; Gibbs & Miller, 2014).

Resiliency is the ability to overcome obstacles, to respond positively to challenges, and to increase one’s competence in the face of these challenges (Bobek, 2002; Gu & Day, 2007). Individuals may display resilient tendencies or skills, but resiliency is not inherent and can be learned (Gu & Day, 2007; Doney, 2013). Resilience varies as well among individuals and can both grow or decline over time (Henderson & Milstein, 2003). Both intrinsic and extrinsic factors that affect one’s resiliency (Table 2.1) are summarized from Henderson and Milstein (2003).

Individuals who demonstrate several or more of these resilient skills or have resilient tendencies (Henderson & Milstein, 2003);

Bobek (2002) proposed that resiliency is essential for teacher success and retention. However, she discovered that the understanding of resilience development in adults, especially teachers, was insufficient and required further study. Interviewing
young adults and their former teachers, Bobek (2002) found that (1) many of the factors identified by Henderson and Milstein (Table 2.1) (2003) were essential to development of resilience and (2) supportive relationships were particularly important for novice teachers to develop resiliency. Bobek (2003) concluded that resilience may increase teacher effectiveness, increase job satisfactions, and help teachers adapt to changes that occur in their schools and education, itself.

Henderson and Milstein (2003) categorized six protective factors that align with resiliency:

1. purpose and expectations (PE),
2. nurture and support (NS),
3. positive connections (PC),
4. meaningful participation (MP),
5. life guiding skills (LGS),
6. clear and consistent boundaries (CCB).
Table 2.1. Intrinsic and extrinsic factors that facilitate resiliency in individuals modified from Henderson & Milstein’s Table 1.1 (2003, p. 9).

<table>
<thead>
<tr>
<th>Factors that Promote Resiliency</th>
<th>Intrinsic</th>
<th>Extrinsic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altruistic</td>
<td></td>
<td>Appreciates uniqueness of individuals</td>
</tr>
<tr>
<td>Autonomous</td>
<td></td>
<td>Encourages goal setting and mastery</td>
</tr>
<tr>
<td>Collaborates</td>
<td></td>
<td>Encourages prosocial development</td>
</tr>
<tr>
<td>Competence and Confidence</td>
<td></td>
<td>Encourages supportive relationships</td>
</tr>
<tr>
<td>Connections (develops relationships)</td>
<td></td>
<td>Express high, realistic expectations</td>
</tr>
<tr>
<td>Problem-solver</td>
<td></td>
<td>Promotes collaboration</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td></td>
<td>Provides leadership</td>
</tr>
<tr>
<td>Sense of humor</td>
<td></td>
<td>Sets clear boundaries</td>
</tr>
<tr>
<td>Volunteers</td>
<td></td>
<td>Values learning</td>
</tr>
</tbody>
</table>

Henderson and Milstein (2003) developed a 36-item survey with responses on a 7-point Likert scale called the Assessing School Resiliency Building, that screened for resiliency tendencies. This survey has been used with teachers, preservice, novice, and experienced. This survey, modifications of it, or alternative surveys have been used to measure teachers’ resiliency in urban, rural, and specific high needs areas such as special education (Howard & Johnson, 2004; Malloy & Allen, 2007; Cornu, 2008; Muller, Gorrow, & Fiala, 2011; Mansfield, C.F., Beltman et al., 2012). More of the literature reported qualitative methods such as a case study with interviews, often semi-structured, to identify resilience tendencies (strongly altruistic and self-efficacy) (Malloy & Allen, 2007) to capture a picture of the development of resiliency skills in individuals (Howard & Johnson, 2004; Qu & Day, 2007; Malloy & Allen, 2007; Castro, Kelly, & Shih, 2010; Doney, 2013). Malloy and Allen (2007) are listed in both categories as they followed a mixed methods design and used a survey, interviews, and other archival data.

Teacher shortages and retention are two areas of concern in resiliency research of teachers. Cornu (2008) reported that approximately one-third of novice educators in the western world leave teaching in the first five years. Teacher content, that is what
discipline the teachers taught was not a factor but instead the years of teaching experience. The literature identified what resilience skills, if any, these preservice and novice teachers employed when confronted with challenges (Howard & Johnson, 2004; Cornu, 2008; Castro, et al., 2010; Muller, Gorrow, & Fiala, 2011; Doney, 2013). Retention is even more a concern in rural schools and fortunately resiliency literature does include rural school teachers, although again the focus is on novice teachers (Malloy & Allen, 2007; Hudson & Hudson, 2008; Castro et al., 2010; Sullivan & Johnson, 2012).

Mentor and induction programs have been implemented to increase retention of novice teachers (Luft, Firestone, Wong, Ortega, Adams, & Bang, 2011; Wong & Luft, 2015). While most of the literature mentioned previously examined preservice and novice teachers’ resiliency tendencies, a few have included mid-career and experienced teachers as well (Qu & Day, 2007; Muller et al., 2011).

Drawing on the literature, schools have implemented a culture of resilience, providing resiliency training with their teachers which have increased teacher retention (Harvey, 2007; Malloy & Allen, 2007; Meiklejohn, Phillips, Freedman, Griffin, Biegel, Roach, . . .Saltzman, 2012).

Again, a gap exists in the literature regarding resiliency and rural science teachers. Although, all teachers and schools may benefit from a culture of resiliency, the added challenges of teaching science with limited resources and multiple courses requiring equipment set up adds another dimension to the literature on resiliency, success and longevity of rural science teachers.
Attributes for Teaching in Rural Schools

Data from the US. Department of Education National Center for Education Statistics (NCES) 1987-88 Schools and Staffing Survey identified characteristics of rural teachers that formed the basis for several studies (Carlsen & Monk, 1992; Stern, 1994; Collins, 1999; Harmon, 2001; Barley & Beesley, 2007). These data simply compared rural and non-rural teachers, so no identifying characteristics of rural science teachers were reported. The general characteristics of rural teachers included: younger, less experienced; no education beyond a Bachelor’s degree in education; and salaried at a lower level than their non-rural counterparts. Additionally, concerns included working conditions such as older facilities (in need of repair), lack of equipment and resources and greater workload (though class sizes were smaller than in urban schools, secondary teachers taught a wider diversity of courses, with multiple preparations). As well as having to alternate course offerings (to provide adequate course offerings to their students) and having higher control of what they do in their classrooms, rural teachers reported less control overall regarding school policies and procedures (Stern, 1994, Collins, 1999). While Shroyer and Enochs (1987, p. 39) identified strategies for rural science teachers to assess their “unique strengths and needs,” no strengths or needs were reported in their study.

Common themes that emerged from a study of high performing, high needs rural schools in Colorado, Wyoming, and Missouri, were that each school had a “close and mutually supportive relationship with the community” (Barley & Beesley, 2007, p. 9). The shared perspective was that the school the community wherein the school, a source of community pride, became a social events center, used by school and non-school
groups for their meetings and activities. High teacher retention and high expectations, for all students to perform to their best ability through hard work, were also common. This sense of community and positive relationships is reported throughout the literature from Hadfield’s developing successful relationships with community organizations and businesses (1992) to Goodpaster et al.’s (2012) positive community relationships (Herzog & Pittman, 1995; D’Amico & Nelson, 2000; Avery, 2013).

The benefits, identified by previous researchers of teaching in a rural school for science teachers, provide insight into teachers’ longevity in rural school settings (Stern, 1994; Herzog, Ronan, & Pittman, 1995; Goodpaster et al., 2012; Avery, 2013). A summary from these studies includes the following positive aspects of teaching in a rural school:

1. Teachers’ autonomy within their own classrooms,
2. Teachers’ opportunity to develop and implement their own curricula,
3. Teachers’ opportunity for close relationships with their colleagues, administrators, students, and community, and
4. Teachers’ opportunity to work in picturesque location in rural, country settings.

Researchers found, however, the consequence of teaching science in a rural science school includes the following (Hadfield, 1992; Barrow & Burchett, 2000; Harmon, 2001; Goodpaster et al., 2012; Avery, 2013):

1. Personal and professional isolation,
2. Lack of fiscal and physical resources such as insufficient equipment (safety and other), lack of current textbooks,
3. Demands on time with teaching multiple science and other classes daily,
4. Lack of relationships with colleagues, administrators, students, and community, and

5. Isolated geographical location (far from the amenities of urban regions).

**Rural Teacher Retention**

**Retention.** There was little research that focused on why teachers stay or persist (Wong & Luft, 2015), but more research on why teachers leave (Arnold et al., 2005; Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J., 2008, Goodpaster, et al., 2012). Current educational research in this vein focused on the supply of high quality science teachers (Ingersoll & Perda, 2010), retention of science teachers (Ingersoll & May, 2012; Goodpaster, et al., 2012; Wong & Luft, 2015), and improvement of the quality of instruction (Howley & Howley, 2005; Wang, H.-H., Moore, T. J., Roehrig, G. H., & Park, M. S., 2011).

Perceived benefits and challenges of rural teaching in terms of retention included these factors: preparation time for rural teachers, relationship with colleagues and administration, relationships with the community, and the lifestyle of the rural communities (Murphy & Angelski, 1997; Goodpaster et al. 2012; Wong & Luft, 2015). Isolation (personal and professional) was another factor to consider when teaching and researching rural schools and their teachers (Harmon, 2001; Harmon et al., 2007; Avery, 2013). In addition, rural science teachers, while isolated and often lacking fiscal and equipment resources, had more freedom to develop, implement, and adjust their curriculum readily to meet their students’ needs (Monk, 2007, Avery, 2013).

The turnover rate for rural educators has been estimated as high as or higher than 50%, using data from NCES (Monk, 2007; Falk, 2012). This leads one to question why
some teachers, particularly rural science teachers, decide to stay. Monk (2007) actually found that rural schools included fewer inexperienced teachers than had been previously reported (Carlsen & Monk, 1992) but small schools, rural or not, had a higher number of inexperienced teachers.

Implementation of induction programs for first-year and new teachers to a district seemed to slow the departure rate—not only from a school district, but from the teaching profession itself (Luft, Firestone, Wong, Ortega, Adams, & Bang, 2011; Wong & Luft, 2015). These implementation programs provided mentoring and other support activities in the first 2-3 years of a teacher’s assignment in their buildings or districts. Other than continuing professional development, researchers found no mentoring or programs like the induction programs for veteran teachers.

**Migration.** Rural teachers’ compensation is often lower than their non-rural colleagues as rural areas are place-bound and often defined by a low economic base. This not only affects teacher salaries, but also the school’s fiscal status and the availability of funds to purchase needed equipment and teaching resources.

Researchers have found that the combination of smaller numbers of students, lower salaries and fiscal resources, and teachers with bachelor’s degrees (often in general education rather than a specific content area), affects the science discipline even more in terms of breadth of teacher knowledge and thus course offerings and or quality of instruction (Carlsen & Monk, 1992; Gardiner, 2008; Goodpaster et al., 2012). Rural science teachers have multiple daily preparations, sometimes teaching singleton classes, and in fact may be the only science teacher in the building or the district (Barrow & Burchett, 2000; Harmon, 2001; Goodpaster et al., 2012). While they may be satisfied
with their work environment, teachers’ workload may be a factor in leaving their rural school setting (Monk, 2007). However, Monk (2007) cautioned that blanket statements and solutions will not correct these issues as every school and school district has its own unique concerns and community climate (Herzog, & Pittman, 1995; Yarrow, Ballantyne, Hansford, Herschell, & Millwater, 1999; Goodpaster et al., 2012).

Overwhelmingly, the research literature about why teachers leave, focused on novice teachers (1-5 years’ experience), and little research focused on the why teachers stay, in either rural and non-rural settings. There was even less research that focused on science teachers in rural settings. However, there are a few studies looking at mathematics and science teacher retention or turnover. Of these vacancies, the highest, 56%, was in science. During that same time, the most challenging teaching positions to fill were mathematics followed by science, special education, and foreign language. More interestingly, these researchers found that the perceived shortage of teachers (specifically in science and mathematics) depended upon the location of the schools (with rural schools having a more difficult time filling their science and mathematics openings).

Following-up on this data, Ingersoll and May (2012) noted that migration, attrition, and total turnover increased for both science and math teachers over a 15-year period, 1988-89 to 2004-2005. Those teachers who moved to a different school, often, left their school districts for another district, frequently in another state, with the highest percentage of teachers moving were in the science and mathematics disciplines. Those who left the classroom entirely went to other jobs in education (but not K-12 teaching) or retired, with science teachers having the highest attrition from the classroom rate, 39% compared to mathematics 30% and non-math/science, 29% (Ingersoll & May, 2012). The
implication was that rural schools felt a greater impact from the migration and attrition of
the mathematics and science teachers.

While there seems to be a higher turnover of science and mathematics teachers, Herzog and Pittman (1995) suggested that the strengths of rural communities and their schools were more positive than negative, with first-year college students responding favorably about their education and life in the rural communities where they grew up and were educated. In fact, they favored the rural lifestyle that almost half—43% pre-service teachers-planned to return to their home with 85% of those planning to work in an education career.

**Professional development.** Professional development is another aspect of rural science teaching that can be both a plus and a minus (Goodpaster et al., 2012). Rural school districts often provide a “one-size fits all” professional development for their teachers that does not meet the needs of science teachers. Some rural teachers of science have a bachelor’s degree in science education and need more content knowledge in earth, life, and physical sciences for their teaching assignments (Barrow & Burchett, 2000; Howley & Howley, 2005; Thomas & DeVore-Wedding). As researchers have explained, finding that needed professional development is one limitation, attending it is another issue entirely. Distant and virtual professional development may be readily available but, for science teachers, hands-on, experiential training is preferred (Sadler, Burgin, McKinney, & Ponjuan, 2010l Avery, 2013).

**Student achievement.** One last area to mention is the balance of student achievement and novice teachers. While there is a fiscal cost in recruiting teachers, especially in high turnover schools and disciplines, there is also a cost to the students’
learning and performance (Henry, Bastian, & Fortner, 2011). Students’ achievement gains were greater with second-year teachers than first year teachers and smaller gains from third-year teachers over second year teachers, with student gains flattening after the third year of teaching (Henry, Bastian, & Fortner, 2011).

The categories, subcategories, and the benefits and challenges of teaching science in rural settings, are summarized in Table 1 (Goodpaster et al., 2012). Several of the categories have not been discussed as there is limited literature addressing them.

**Benefits and Challenges.** Resistance to change is a common human trait and there was ample research literature about this, just not about science teaching specifically. Shroyer and Enochs (1987) assessed the strengths and needs of rural science teachers to encourage them to develop their own vision, goals, and objectives for their personal professional growth and instruction. Howley and Howley (2005) proposed three principles to define more effective PD for rural teachers: learning must be situated, requires open and sustained dialog among members of the PD and organization, and depends upon the ability of teachers to reflect on data about performances. More research is necessary to see if successful veteran science teachers look for opportunities to “change” their teaching strategies, curricula, activities, and even their classroom environment to enhance student learning as well as their own.

Hadfield (1992) briefly discussed the lack of access to university resources and proposed making community connections with organizations and business to provide more learning opportunities for one’s students and oneself. As Hadfield (1992) pointed out, such partnerships also increased the possibility of sharing equipment that a teacher or school district might not be able to purchase.
Table 2.2 Benefits and challenges teaching science in rural areas (Modified from Goodpaster et al., 2012).

<table>
<thead>
<tr>
<th>Categories</th>
<th>Positive aspects</th>
<th>Negative aspects</th>
</tr>
</thead>
</table>
| Strong interpersonal relationships & community ties | Teacher-parent connections & mutual trust  
Sense of reward | Developing connections as an “outsider”  
Maintaining boundaries  
Challenging public relations |
| **School factors**                  | Contact between teachers & administrators  
Personal interactions with students  
Safe school environment | Resistance to change  
Rural student performance  
Problems with administrators  
Salaries & benefits |
| **Professional factors**            | Intellectual stimulation  
Connecting science and rural life  
Opportunities for PD  
Satisfaction & job security | Insufficient mentoring  
Preparing for multiple classes  
Lack of access to university resources |

**Summary**

The literature regarding rural education in general continually stated that rural educators have less depth in content courses, primarily teach with a bachelor’s degree in education, are less experienced, and their rural schools are often fiscally poorer than urban schools (Carlsen & Monk, 1992; Herzog & Pittman, 1995; Monk, 2007; Goodpaster, Adedokun, & Weaver, 2012). However, Monk (2007) found that less-experienced teachers were not an exclusive rural-school phenomenon, but rather a small school phenomenon, regardless of whether the small school was urban or rural.
There is a paucity of research in the literature regarding rural science educators (Harmon et al., 2003; Coladarci, 2007). Current educational research focuses on the supply of high quality science teachers (Ingersoll & Perda, 2010), retention of science teachers (Ingersoll & May, 2012; Goodpaster, et al., 2012; Wong & Luft, 2015), and improving the quality of instruction (Howley & Howley, 2005; Wang, H.-H., Moore, T. J., Roehrig, G. H., & Park, M. S., 2011). There is little research that focuses on why teachers stay or persist (Wong & Luft, 2015), but more on why teachers leave (Arnold, M. L., Gaddy, B. B., & Dean, C. B., 2005; Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J., 2008; Goodpaster, et al., 2012). To date, the focus of research literature regarding rural educators involved the retention of early career teachers and has not focused specifically on rural science teachers (Herzog & Pittman, 1995; Monk, 2007; Henry, Bastian, & Fortner, 2011).
CHAPTER III

Methodology

This study followed a qualitative research design, incorporating multiple case studies, bounded by the factors of nationally awarded secondary science teachers in the West Central United States who had taught ten or more years in a rural location. Qualitative research situates the researcher in a natural setting, interacting, but not influencing, the participants of the study (Creswell, 2013). Qualitative research covered an array of interpretative techniques which allowed me to describe, decode, translate or otherwise explain the meaning of naturally occurring phenomenon in the natural world (Merriam & Tisdell, 2015). A multiple-case design, also called a multiple case study, provided the opportunity to collect more than single-case data and allowed for richer interpretation of multiple participants’ stories. As Yin (2014) explained, these data are considered more compelling, and thereby, produce a more robust study.

Qualitative research is an inductive process. Thus, qualitative researchers gather a variety of data to understand phenomena from the perspectives of the participants. This research study, focused on participant interviews as the primary data set and a variety of secondary data pieces. The semi-structured interviews concentrated on identifying the purposefully selected participants’ beliefs and perspectives on their success and longevity in a rural school system. Secondary data included classroom observations, field notes, behavior over time graphs (BOTGs), artifacts (i.e. classroom photos, lessons plans, school newspapers), interviews with colleagues and supervisors, and basic demographic data (i.e. teachers’ educational background, teaching situations, and other related information the participants choose to share). Interviews were audio-recorded,
transcribed, coded, and analyzed for themes, across the participants and within the individual participants’ story. Data sets and analysis procedures are more fully described in the sections to follow.

**Research Questions**

Research for this multiple case study was guided by two central question and three sub-questions (Creswell, 2014). These questions included the following:

**Central Questions**

Why do nationally recognized secondary science teachers stay in a rural school environment?

How do nationally recognized secondary science teachers, who have taught in a rural setting for at least 10 years, describe their own success and longevity?

**Sub-Questions**

1. How do nationally recognized rural science teachers describe any challenges to their success and longevity?

2. What are the common, emergent themes related to success and longevity of nationally recognized rural science teachers?

3. What are the unique, individual themes related to the success and longevity of each of the nationally recognized rural science teachers?

**Rationale**

These central questions and sub-questions focused on the phenomenon of successful, veteran secondary science teachers in rural districts. Qualitative research processes provided the opportunity for the participants to voice their own career experiences, that is, their successes and challenges from their own perspectives. Their
voices provided a richer description of the meaning of their career narratives than a survey or my own voice as the researcher might supply (Creswell, 2013; Merriam & Tisdell, 2015). The inductive processes of qualitative research allowed the researcher to review the participants’ own stories and make connections, compare similarities and differences between the participants, and identify common themes (Merriam, 1988; Creswell, 1994).

**Case Study**

A qualitative case study research approach includes a phenomenon within a real-life, setting. A case study is a bounded system that can be delimited within a specific context. A case-study approach provides a detailed, in-depth (rich and thick) collection of multiple sources of data. A system of multiple case studies, moreover, includes different locations, participants, or time-frame, which enhances the robustness of the study (Yin, 2014).

This case study fits within a replicative design of a multiple case study (Yin, 2014) as participants were bounded by setting (rural school systems); by time (as all participants had 10 or more years of experience teaching in rural schools); by context (all participants were secondary science teachers). Following a replicative design, the same interviewing process and data analysis process was followed with each participant. A variety of sources provided data for each participant case, (e.g., interviews, behavior over time graphs (BOTG), observations, field notes). The unit of analysis was the individual teacher in each case, a national recognized secondary science teacher in a rural school.
Role of the Researcher

In qualitative research, the researcher interprets the data and thus introduces the potential of bias, value-making, and judgement by the researcher (Marshall & Rossman, 2011; Creswell, 2014. The researcher should explicitly state their possible bias, values, and judgements. Transparency on the part of the researcher contributes to the validity of the research, data collection, analysis, and interpretation (Creswell, 2014; Merriam & Tisdell, 2015).

As the researcher, I was aware of the unique aspects of teaching science in a rural school system, having experienced 26 of 30 years in a P-12 rural school district with approximately 540 students, approximately 180 students in grades 9-12. My teaching assignment in this school district usually consisted of four-to-six different course preparations. In addition to teaching, I also served as a class sponsor, following a class through their four years in high school, which involved overseeing fundraising for homecoming activities, junior year prom, and senior graduation their last year. I also served on district and building content committees in health, mathematics and science, the district content standards committee, and curriculum alignment committees. For 18 years, I was also the head boys’ and girls’ track and cross-country coach. These commitments and responsibilities were not beyond the usual assignment of other district teachers (except for my commitment to standards and curriculum development committees).

Two of those 30 years were spent teaching at an American Indian community college (also in a rural setting). Certainly, my rich and satisfying teaching experiences in a rural setting compelled me to tell the stories of these successful veteran science teachers.
in rural settings. However, from my own experience and conversations with other teachers (rural and non-rural), I began this research expecting that, while we might have shared certain similarities, we each faced unique circumstances in our own work environment.

I am not a PAEMST award-winning teacher, but I have been an active leader in professional organizations, such as American Association for the Advancement of Science (AAAS), American Chemical Society (ACS), Colorado Association of Science Teachers (CAST), Colorado Science Educators Network (CSEN), National Association of Science teachers (NSTA), and National Science Educator Leadership Association (NSELA). I understand the efforts required to stay active in these organizations, to attend their workshops and conferences, and to serve on their committees and boards. However, I endeavored to remove my own bias when collecting data, so that each participant’s story and perspective could be the focus of the data analysis. After data analysis of the participants’ data, during the interpretation and reporting phase, my own experiences did become part of the study and helped me to better communicate these teachers’ stories. Again, maintaining transparency throughout the study, from data collection to interpretation and reporting was vital to the measure of authenticity in this study.

**Data Collection Procedures**

Semi-structured interviews with purposively selected rural science teachers were the primary source of data. Secondary data sources included behavior over time graphs, observations, and field notes of the participants in their classrooms and school setting, basic demographics, interviews with participants’ supervisors or colleagues, and artifacts such as newspaper articles, participants’ C.V.s, lesson plans, and curricula.
Participants

Four teachers were selected from a pool of eight teachers based on three initial criteria:

1. Secondary science teachers;
2. Ten years or more teaching experience in a rural school system; and
3. Nationally recognized as a PAEMST awardee.

The PAEMST was established by Congress in 1983, and authorizes the President of the United States to bestow up to 108 awards each year (National Science Foundation (NSF), 2016). Teachers of mathematics and science at both the elementary and secondary level are encouraged to apply from the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, the Department of Defense Education Activity schools, or the U.S. territories as a group (American Samoa, Guam, Commonwealth of the Northern Mariana Islands, and the U.S. Virgin Islands) (NSF, 2016). Up to 2002, both elementary and secondary levels were awarded annually, then starting in 2003 odd years are for secondary teachers, and even years for elementary teachers (NSF, 2016). All applicants must meet the same requirements, although each state has their own selection method, involving a committee or state education department official (NSF, 2016).

The PAEMST website provides a searchable database by state and by grade level of past awardees. I screened the database for rural awardees in Nebraska and the six contiguous states: Colorado, Wyoming, South Dakota, Iowa, Missouri, and Kansas for a sampling of western mid-west and western rural teachers. Eight potential participants
were identified from the PAEMST website. I then accessed potential participants’ school websites to determine if they were still employed at that school and gathered school and community descriptors (i.e., student population of the high school, and the designation of both their school and community as rural).

**Data Sources and Collection Methods**

**Interviews.** Interviews are an essential feature of case study research design. Interviews with the participants provided the lived career histories, perspectives, and nuances of each of the participants. Semi-structured interviews provided the researcher with a standard protocol but allowed for each participant’s interview to be unique and authentic to that individual’s own unique situation (Appendix D).

To begin, I initialized contact with potential participants via email, describing the study, and presenting a research-participant consent form (Appendix A). After the participant responded affirmatively, an interview was scheduled and a format for pre-interview form was sent requesting demographic information and a BOTG (Appendix A, C).

Format and protocols for the interviews followed examples given by Creswell (2013) and Yin (2014). The semi-structured interviews lasted 30-90 minutes, helped establish a relationship with the participant as well as provided the opportunity to explore the participant’s beliefs and perceptions as to their success and longevity. Questions prompted each participant to indicate their education level, years of teaching experience (in rural schools and in all schools totally), membership in professional organizations, and awards. Open ended questions asked participants to describe their teaching
experiences and their perceptions of their success and longevity. The face-to-face interviews were held in each participant teacher’s classroom and audio-recorded.

Supervisors and colleagues (as identified by the participants) were also interviewed face-to-face at the school site. A semi-structured protocol, like that of the actual participants, was followed (Appendix D). Specific questions were based on information provided by the participants during their interviews as well as basic school demographics.

**Behavior over time graphs (BOTGs).** BOTGs provided information regarding the participants’ personal and professional events which have been turning points in their teaching career (Anderson & Johnson, 1997; Hobbs, 2004). BOTGs are visual representations of change over time, which in this study illustrated the participants’ teaching career highs and lows (depicted as peaks or troughs) over their time in rural school systems. BOTGs are used in a variety of situations to help depict patterns of behavior. In this study, the research looked for events that have impacted the participants’ teaching (both positively and negatively) during their time in rural schools. The graphs’ axes were identified as time (on the horizontal axis) versus low (negative) to high (positive) events that impacted their teaching career (on the vertical axis). Participants were asked to label the major events, beneficial and challenging, on their graphs. Participants were asked to complete their BOTG prior to our meeting for the interview and field observations (Appendix C). These graphs provided a visual of teachers’ lived experiences and assisted in focusing the participants on those lived experiences. Part of the interview process was the sharing and explaining of these graphs.
**Observations and field notes.** I observed the participants in their classrooms (teaching and interacting with students) and recorded field notes of these lessons (Appendix B). Additionally, after each observation and interview, the researcher summarized the interactions with the participant and associated personnel, noting highlights, challenges, limitations, and other information that stood out from the interaction with the participant. These field notes assisted in keeping me focused and contributing to the understanding of the participants’ narrative.

**Artifacts.** Participants were asked for their resumes as well as the exemplar lesson plan submitted for their nomination for PAESMT. Additional documents were welcomed as secondary data sources if readily available. Public documents such as newspaper articles about the participants’ careers, identifying the school system as rural were also collected for corroboration of the participants’ narratives as well as to assist in data analysis and authenticity of the participants’ professional histories.

**Data Analysis Procedures**

Data analysis occurred simultaneously with the data collection. As Creswell suggested (2014), qualitative data becomes voluminous; cleaning and compartmentalizing duplicated data from the variety of sources helped to streamline the analysis. Interviews, field notes, observations, BOTGs, and other artifacts were identified for each participant and analyzed within each case before any cross-case analysis occurred (Creswell, 2013; Yin, 2014). Analysis began with organizing the raw data by case and type of information, such as directly from the participant or from a supplementary source. Each case was coded using MAXQDA, a software program,
looking for common themes and patterns within each case, before cross-case analysis with the other cases (Appendix F) (Creswell, 2013; Yin, 2014).

As I transcribed initial coding themes emerged and as I reviewed the audio of interviews for accuracy and clarity. After cleaning the data, formal coding and analysis began with MAXQDA software. Inductive analysis followed a general, thematic routine comparing the emergent themes with the interview transcripts and recordings to ensure the themes are an accurate representation of the participants’ beliefs and perspectives (Creswell, 2014).

Field notes provided supplemental data to support the themes identified in the interviews. Classroom observations were included in the field notes as well as the researcher’s summary after interviews and observations.

Behavior over time graphs provided a framework for questions during the interviews and during the analysis and additional evidence for the emergent themes and perspectives of the participants.

Artifacts such as newspaper articles about the participants, participants’ resumes, lesson plans, and activities were also analyzed individually for each case as well as across the cases for similarities and differences.

Cross case analysis occurred after individual case analysis so themes and patterns for each case are identified (Stakes, 2006, 2013). Comparisons of the four separate cases in this study enhanced data interpretation, specifically for this study, but provided implications for future research as well. Cross-case analysis involved comparing the cases for each participant (Yin, 2014). Similarities and differences in each participant’s
perspective of their own longevity and success as well as their school district’s working environment were compared in the cross-case analysis.

**Triangulation of Data**

Triangulation of data enhanced validation and reliability of the research. In a qualitative study, varied forms of data add to the authenticity and validation of the data (Creswell, 2013, 2014). Within each case, the participant’s own narrative formed the foundation of the data analysis. Additionally, interviews with the participants’ supervisors and colleagues provided deeper insight to their stories. Field notes and observations added another dimension to their narratives as well. BOTGs provided both visual evidence and exemplars of the participants’ narrative as well as insight into the participants’ own perspectives. Thus, varied data sources corroborated data interpretation for each case as well as the cross-case analysis.

Reliability is as important as the validity of the study. Reliability addresses the consistency of the researcher’s approach (Creswell, 2014). To ensure reliability, I maintained transparency in the research design and implementation. Interviews were audio-recorded and used to check the transcriptions. Summaries of the interviews were provided to the participants for feedback as to accuracy of transcriptions. Coding categories of emergent themes were described and referenced throughout coding and explanation of the data Appendix F). Use of MAXQDA, a computer program for coding increased consistency as well as reliability; subprograms provided another check for the consistency of the coding.
**Methods for Verification**

Validity and reliability issues are concerns to any research, but even more so to qualitative research (Creswell, 2013, 2014; Merriam, 1988, 2009; Merriam & Tisdell, 2015). Qualitative research relies on interpretation of the data. Ensuring that the interpretation is unbiased, the researcher needs to set aside their own background experiences during data collection, analysis, and use it carefully during interpretation, since it is the participants’ stories, not the researchers. Also, the researcher must maintain transparency from the beginning of the study to the final interpretations. The multiple data sources (field notes, secondary interviews, observations, BOTGs, other artifacts) served as cross-checks to the primary data, the interviews with the participants, increasing the validity and reliability as well.

Establishing protocols prior to data collection and then following those protocols, maintained fidelity to the purpose of the study, and interpreting data regarding the research questions all contributed to the reliability of the data collection, analysis, and interpretation (Merriam, 2009; Creswell, 2013). Reports of the established protocols make it possible for other researchers to use or incorporate said protocols into their own research (Merriam, 2009, Yin, 2014). Following published case study protocols increased the reliability of the data collection and thus the study itself (Yin, 2014).

**Member Checking**

Member checking provided another safeguard from my potentially biased analysis (Merriam, 2005, 2009; Merriam & Tisdell, 2015). Member-checking ensured accuracy, clarity, and truthfulness of the participants’ responses to the interview questions. Summaries of each transcript (and emergent themes) was sent to each participant to
review for possible clarification. If I was unsure on any points, I included specific questions as well as asked each teacher for feedback. Follow up contact may be necessary if there are concerns. Dissertation committee members (and other faculty experts at University of Nebraska-Lincoln, Teaching, Learning, and Teacher Education) provided guidance and verification of the researcher’s methods as well.

**Researcher Bias**

As a former science teacher in a rural setting, I endeavored to set aside my own teaching practices, beliefs, and perceptions during the interview process. Certainly, my experiences provided a check against global rural themes of isolation, school relationships, and community connectedness (Goodpaster et al., 2012; McGhie-Richmond, Irvine, Loreman, & Lupart, 2013). In the end, my experiences added to the richness of the interpretation of data while I maintained transparency.

Transparency in my own possible bias as a former rural science teacher was essential to the quality of the research as well. While I related to the participants and understood their beliefs and perspectives as I collected the data, I listened to and re-told *their* stories. During data analysis, my perspective was more useful in interpreting and identifying inferences as well as suggesting future research possibilities.

**Triangulation of Data**

As mentioned previously, using multiple sources of secondary data to support and complement the participants’ perspectives in their narratives and BOTGs added validity to the data analysis and interpretation (Creswell, 2013, 2014). Multiple data sources were helpful to clarify any ambiguity, aided in identifying emergent patterns within a single case and across the cases, and provided deeper, richer descriptions of each case and the
cases together. As well, varied data sources helped identify both common and data components.

Member-checking and triangulation of data provides construct validity, which is one test used to establish the quality of a case study design (Yin, 2014). Multiple case design increased the rigor of this study by the replication the same design and techniques at more than one location with more than one teacher, contributing to the external validity of this qualitative study (Yin, 2014). Employing cross case analysis, reporting out both the similarities and differences between the participants, enhances the internal validity of this study as well (Yin, 2014).

**Limitations**

A case study, while providing the narratives of the participants’ professional histories, applies only to those participants (Creswell, 2013, 2014). Generalizing beyond these unique individuals and their situations may be tempting, especially based on the researcher’s own lived experiences. Importantly, generalizations would decrease the validity of the study and diminish the overall impact of the findings presented by the data (Merriam, 2009; Merriam & Tisdell, 2015).

One major concern about any type of research, especially qualitative research, is trustworthiness or validity (Creswell, 2013, 2014). Establishing and following standard research procedures as mentioned previously (e.g., triangulating data, member checking data, including an external auditor or research team to analyze data separately and independently) contributed to the trustworthiness or credibility of the data and qualitative approach (Creswell, 2014).
Clearly identifying the research problem and the purpose or need to study that problem was the first step in offsetting the limitations of qualitative research. Explicitly identifying the researcher’s potential bias and accounting for it was another step to decreasing the limitations of qualitative research. Outlining methods that incorporate flexibility but are transparent, and using reliable analysis methods, also offset any limitations of qualitative research approaches (Creswell, 2014).

Summary

A qualitative approach incorporating a multiple case study approach provided a thicker, richer, and deeper understanding of successful, veteran secondary science teachers’ professional experiences in a rural school environment. The research was guided by two central questions and three sub-questions that reported on the career experiences of successful, veteran secondary science teachers in rural schools. I endeavored as an unbiased, observer regardless of my own career experience as a rural science teacher for 26 years. The multiple-case study design increased the reliability and validity of the research by comparing more than one case with the same boundaries and criteria for participant selection.

Data collection procedures began with identification of PAEMST secondary science teachers with ten or more years of experience who teach in rural schools. Interviews followed case study protocol, using a semi-structured interview format. Participants provided a BOTG for further elucidation of their career experiences during the interview and for further reference.

In addition to interviewing the selected teachers, subsequent interviews of their administrators, students, and parents as well as classroom observations, review of their
curricula and C.V.s contributed to understanding their persistence and success in a rural setting.

Data analysis was simultaneous with data collection so that each case was analyzed during and after each case’s site visit. This highlighted the emergent themes from the first case to be compared with subsequent cases as the study progressed and aided in completion of the study in a timely manner. Additionally, simultaneous data collection and analysis improved the validity and reliability of the study.

Verification methods contributed to the construct validity by using multiple sources of data as well as member checking the data. External validity of a multiple case study design included replicating a single case to support or refute emerging patterns and themes in the data. Reliability was based on following case study protocols, using multiple data sources to develop a data base for each case and for cross case analysis. Last and certainly not least, reporting out the results as these participants experiences, and not generalizing beyond the boundaries of each case and the multiple cases, guided my analysis and research conclusions.
CHAPTER IV
Data Analysis and Results

The news headlines continue to focus on the shortage of teachers across the United States of America (USA) (Parthey, 2015). While this is a concern for all school districts, teacher shortage particularly affects the nation’s rural school districts which make-up about one-half of all school systems in the USA.

Rural school systems lack the glamour and glitter of those in large, urban areas and draw from a much smaller pool of potential teachers. Rural school systems are often located in isolated communities defined by a smaller population of qualified teachers. Additionally, these rural systems often provide limited community resources and suffer high-need designations in terms of fiscal resources and classroom equipment. Rural teachers likely face social and professional isolation with limited opportunity to access the membership benefits of professional associations or attend professional development sessions in their content area (Monk, 2007; Thomas & DeVore-Wedding, 2016). Frequently, they are also assigned multiple-class preparations as well as required to teach outside of their disciplinary areas (Monk, 2007; Thomas & DeVore-Wedding, 2016).

Specifically, in the case of science teachers, if the working conditions in rural schools are less than ideal, why do teachers stay? How do rural science teachers manage the isolation and shortage of resources? Some science teachers, who choose to stay-on in rural schools, seem to thrive. In fact, some rural science teachers have received distinctive science teaching awards at the national level, such as the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST) recipients. How do these rural teachers not only persist but gain recognition as award winning teachers?
Restatement of Research Question

This multiple case study was guided by two central questions and three associated sub-questions (Creswell, 2014).

Central Questions

Why do nationally recognized secondary science teachers stay in a rural school environment?

How do nationally recognized secondary science teachers, who have taught in a rural setting for at least 10 years, describe their own success and longevity?

Sub-questions

1. How do these teachers describe any challenges to their success and longevity?

2. What are the common, emergent themes related to success and longevity of the participants?

3. What are the unique, individual themes related to the success and longevity of each of the participants?

Data Collection

Eight rural secondary science teachers from Nebraska and the six contiguous states were identified from the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST) website. These eight rural, PAEMST award teachers had taught ten or more years and were currently teaching at the onset of this dissertation research. Only four responded affirmatively to participate in this study, Josephine Christof, Brand Kent, Rachel Lake, and Sara Wymore (assigned pseudonyms). Each were in Nebraska or one of six states contiguous to Nebraska (Iowa, Missouri, Kansas,
Colorado, Wyoming, and South Dakota) and no two teachers were in the same state as this research began.

Data were collected over three months with two days spent onsite with each of the PAEMST teachers. A semi-structured interview with the teacher began the data collection process, which included questions regarding the peaks (beneficial events and highlights) and troughs (challenging events) of their behavior over time graphs (BOTG) (Appendix D). The interview was followed, usually the next day, by observations in their science classroom and follow-up questions and discussion with the participant. An additional semi-structured interview with an administrator or colleague of the participant took place the second day (Appendix D). The teacher interviews took place on-site in the teacher’s classroom and the additional interviews were in their colleagues’ classroom or principal’s office.

Data was transcribed, cleaned, and coded using MAXQDA. During the transcription process, I noted re-occurring words and phrases for each case to include in the MAXQDA codes such as respect, honors, and resources. I also selected common terms from the current literature pertaining to education, resilience, and retention, such as autonomy, collaborative, cooperative, and passion (Table 2.1) (Appendix F). I initially coded the interviews and my field notes with a code set of resilience terms, re-occurring terms from transcription, and from the literature; then I expanded that code set to separate (a) personal and professional events, (b) benefits and challenges of teaching in general and teaching in rural schools, and (c) instruction, relationships, and resilience categories (Appendix F). Both code sets were used in the individual cases, cross-case analysis and interpretation of findings in Chapter V.
References to the data collected by the researcher were coded by participant and event. The teachers’ initials (JC-Josephine Christof; BK-Brand Kent; RL Rachel Lake; SW-Sara Wymore), followed by the specific collection process (I-interview with participant; O-Observations and field notes; AI-additional interview with colleague or principal; A-artifact such as resume, newspaper article, or photographs from their classrooms). The number at the end of the coding date refers to a page number. For example, RL.O.3 comes from a Rachel Lake observation and the specific reference can be found on the researcher note page 3 (Appendix F).

**Data Analysis**

The following section includes a demographic overview of all four study participants, introduces each participant’s narrative case story, and concludes with results from the cross-case analysis. Data analysis aligned the two central questions and three sub-questions and will become evident in the presentation of conclusions in Chapter five.

Demographic data of these PAESMT awardees’ communities documented that all were located more than 25 miles from an urban center. There was considerable range in the population size of these teachers’ communities and their respective high schools (Table 4.1).

The participants’ career and education background demographics ranged from receipt of a bachelor’s degree to a doctorate of philosophy, completion of 21 years to 44.5 years of teaching in rural schools, and experience over a wide range of teaching assignments (Table 4.2).
Table 4.1. Community and school demographics.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Josephine Christof</td>
</tr>
<tr>
<td>Community Population*</td>
<td>12,362</td>
</tr>
<tr>
<td>Distance to Urban Center**, miles</td>
<td>44</td>
</tr>
<tr>
<td>Current High School Population**</td>
<td>659</td>
</tr>
<tr>
<td>Number of current science</td>
<td>5</td>
</tr>
<tr>
<td>teachers*** (9-12 grades)</td>
<td></td>
</tr>
</tbody>
</table>

*U.S. Census Bureau, 2014
**https://www.usnews.com/education/best-high-schools/
***Individual interviewees and school websites

Participants were initially selected based on their PAEMST recognition. However, these outstanding teachers had also received other awards and recognition.

Table 4.3 lists the awards and recognition these four teachers have received in their teaching career through May 2017.
Table 4.2. Educational and career background information from participants’ resumes and interviews.

<table>
<thead>
<tr>
<th></th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Josephine Christof</td>
</tr>
<tr>
<td></td>
<td>Brad Kent</td>
</tr>
<tr>
<td></td>
<td>Rachel Lake</td>
</tr>
<tr>
<td></td>
<td>Sara Wymore</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Number of Years Teaching</strong></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>44.5</td>
</tr>
<tr>
<td></td>
<td>28</td>
</tr>
<tr>
<td><strong>Total Number of Years Teaching in Rural Schools</strong></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>44.5</td>
</tr>
<tr>
<td></td>
<td>28</td>
</tr>
<tr>
<td><strong>Number of Rural District Experiences</strong></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>B.S. Science Education</td>
</tr>
<tr>
<td></td>
<td>M.S. &amp; Ph.D. Entomology with an emphasis on molecular genetics</td>
</tr>
<tr>
<td></td>
<td>B.A. Biology</td>
</tr>
<tr>
<td></td>
<td>B.S. Biology, M.S. Science Teaching</td>
</tr>
<tr>
<td></td>
<td>B.S. Agricultural Education, M.S. Curriculum &amp; Instruction</td>
</tr>
<tr>
<td><strong>National Board Certification</strong></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Current Teaching Assignment</strong></td>
<td>Physics*, Botany*, Zoology*, Special Topics in Research, Advanced Biology*</td>
</tr>
<tr>
<td></td>
<td>Earth &amp; Space Science, Chemistry, Environmental Science, Biology</td>
</tr>
<tr>
<td></td>
<td>Biology*, Chemistry, Physical Science</td>
</tr>
<tr>
<td></td>
<td>Biology, Natural Resources, Environmental Science</td>
</tr>
</tbody>
</table>

*Dual Enrollment Course
Table 4.3. Awards and recognition of the four participants.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Josephine Christof</th>
<th>Brad Kent</th>
<th>Rachel Lake</th>
<th>Sara Wymore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awards &amp; Recognition prior to PAEMST</td>
<td>State representative for Toyota International Teachers Program; State Recycling Agency Educator of the Year; State Arboretum Educator and Young Planters Awards; NSTA HS Teaching Award; Entomology Society of America Presidential Award for Academic Excellence in the Secondary Classroom; State Forestry Environmental Educator Award; State Capitol District Teaching Excellence Award; Outstanding Rural Science Teacher Runner-up; State Outstanding Biology Teacher Award; State Wildlife Federation Outstanding Steam Team of the Year; State Business Teacher Achievement Award for Excellence in Classroom Teaching</td>
<td>Masonic Lodge TOY (County); Outstanding Biology Teacher Award (state); Two National Companies TOY; National Company's National Fellowship; Radio Shack National Teacher; State Math &amp; Science TOY; Salle Mae Outstanding 1st Year Teacher semi-finalist; School District Principal's Choice Teacher award; State Science Business TOY</td>
<td>School District TOY; State PAEMST finalist (twice)</td>
<td>State Game &amp; Fish TOY</td>
</tr>
<tr>
<td>Awards &amp; Recognition post PAEMST</td>
<td>State Science Award for Service to Science Education</td>
<td>Outstanding Teacher-State Energy Center; State Science &amp; Technology Fair Teacher Hall of Fame; State TOY** runner-up; Distinguished Alumni Award for Professional; State Science Fair Star Award; Achievement; Masonic Lodge TOY (Second time); School District Principal's Choice Teacher award; State Science Business TOY</td>
<td>School District TOY (second time); University Outstanding Alumna Education; State Physical Science TOY</td>
<td>State Conservation District TOY</td>
</tr>
</tbody>
</table>

*TOY = Teacher of the Year*
Case Studies

The Sara Wymore Case

Sara Wymore has taught in the same school district all her 28 years of teaching. Wymore grew up in a larger, urban community but prefers living and teaching in her current rural community. Her education background includes agricultural science as well as curriculum and instruction (see Table 4.2).

Community and School

Sara Wymore, a PAEMST recipient, teaches at Wesley High School, in the Meadows School District. Wymore moved to Wesley thirty-two years ago. As a newly-hired agriculture science teacher, she settled into the community, married a local farmer, raised her family, and established her teaching credentials.

The town of Wesley is the agrarian hub for the northwest corner of the state and includes a small community college with a student population of approximately 1,090 (U.S. News & World Report, 2017). Wesley is located 23 miles from the country seat, a town with 9,740 residents. The nearest urban center (108,869) (U.S. Census Bureau, 2014) is approximately 94 miles away in the neighboring state. The closest urban center (60,086) (US Census Bureau, 2014) within the state is 236 miles away.

The Meadows School District in Wesley includes four elementary schools, one junior high, one traditional high school, and an alternative learning center for high school students. The school population includes a total of 1,761 students in the district, with 447 students in the high school and 30 students in the alternative learning center. The National Center for Education Statistics classifies its locale as remote (2014). Total expenditures are less than the district’s total revenue in 2014, with a capitol reserve just
over $1.2 million (NCES, 2016). The school population is primarily Caucasian (86%) with Hispanic or Latino students making up the predominant non-Caucasian population (NCES, 2016).

Wesley High School is on an eight-period day. The high school is located on the northeastern edge of town, bordering fields of corn, sugar beets, and hay. The building itself is only 11 years old. The school is built on a pod system with a central hub, cafeteria, and administrative offices located at the main entrance to the school. Surprisingly, the doors are not locked although visitors are directed to check in with the office staff. In each pod, there are student study areas with computers, tables, and seating. Wymore’s pod houses the vocational and art classrooms as well as the second biology teacher’s room. One classroom is dedicated to computers for all classes to use although the school district has adopted a 1-to-1 technology and students purchase insurance to cover the cost of their computer. Students may also check out a computer for the day if they forget theirs at home or cannot afford the insurance.

Teacher Background

Wymore grew up in one of the larger urban centers in another corner of the state (approximately 32,000 population) (U.S. Census Bureau, 2014). During high school, she was active in Future Farmers of America (FFA) and competitive swimming. After graduation, she attended the state’s land grant university, starting out as a pre-veterinarian major. As a varsity swimmer, though, her course load and adviser’s expectations were at odds with her swimming training and competition (SW.I.1). While she substituted as a teacher at the local high school, both her former agriculture teacher and science teacher suggested she turn to teaching instead as she was “a natural” at teaching (SW.I.2). Thus,
she majored in Agricultural Education with a minor in Biology. After graduation in May, Wymore was hired in Wesley as the second Agricultural education teacher the next fall. Wymore wasn’t entirely new to Wesley as her brother had worked there during summers and she had visited him several times. Since she had participated in FFA during high school, she already knew people from Wesley who still resided there. As she stated, I knew some people who lived here [that] I talked to. Wyoming is small enough you do know people [from] all over the state. I knew the ag [sic] teacher here too in HS [and] when you are a girl in agriculture you meet a lot of people. (SW.I.1, 2).

Wymore student taught in another small town within the state, preferring the smaller communities for her future teaching career, explaining, “Oh, I think [student teaching in a rural location] made a difference, I knew I wanted to stay in a smaller place” (SW.I.2).

Currently, Wymore teaches biology, environmental science, and natural resources. Her passion for the outdoors is evident surveying her room and storage space. Along the sides are cabinets with student work and news articles about her students’ science outreach posted on the cabinet doors. On top of the cabinets and in displays cases are animal and plant specimens, rock samples, and science equipment.

Although she started her teaching career as an agricultural teacher, she moved to science only in 1993. While agriculture science was her first love, science is a close second. Wymore stated,

Science and ag [sic] go hand in hand, so much of it is the same type of material, just thinking differently. I still help with the ag [sic] classes [and FFA]. It isn’t
like I am not with ag [sic] kids anymore. I have most of those ag [sic] kids in my environmental and natural resources [classes]. (SW.I.1).

Wymore has taught only in Wesley, except for her student teaching. Her teaching style is place-and project-based activities that are relevant to her students. She limits lecture to include more hands-on application of the content she teaches. She is fortunate to take her students on field trips despite budget restrictions. She has established working relationships with local and regional government agencies overseeing the plentiful natural and agricultural resources. The scientists in these agencies are often guest speakers in her classroom. Living in a smaller community, she knows her students’ interests and background, which she incorporates into her instruction and projects.

The morning I spent observing in Wymore’s classroom, students were working on a final project showing their knowledge of the habitat and environmental needs for survival of a local animal. After starting class by reviewing the objectives of the project, Wymore worked her way around the room, talking to each group of students. Often asking them how their extra-curricular jobs, interests, or family were doing, but always bringing back the focus onto their project. One student was absent from class but in attendance at the school; students asked, and Wymore reminded them that he was working with the art teacher on a badger that he had brought in to mount (SW.O.3). This helped me learn how Wymore collaborates with the art teacher on taxidermy projects, which explained the presence of the many mounted animals in her room as well as the wolf and other animals in the student study areas in her pod.

Wymore’s husband even collaborated with the art teacher in preparing coyote pelts for a fur coat that he gave her one Christmas. As we prepared to leave that first
night I visited her school, Wymore brought out the coyote coat to show it off. As she put it on she laughing asked, “Why wouldn’t I want to teach in a rural school? Where else would a teacher be able to wear a fur coat?” (SW.I.10).

**Honors**

The PAEMST is a nationally-recognized award for excellence in teaching, yet Wymore was seemingly prouder of her state and local awards. She remarked,

Being a presidential award winner . . . that was awesome! But I also got a couple other awards that I was really excited about. Being recognized by your local community shows their respect for you [as a teacher]” (Table 4.3) (SW.I.10).

By way of example, Wymore was recognized by the state’s Game and Fish agency for her assistance with their summer educational opportunities for students and adults. She was named the state’s conservation teacher of the year a few years after her PAEMST. In Wymore’s thinking, this award was less an award for her teaching and more of an acknowledgement of her students’ work with the local conservation district.

**Behavior Over Time Graph**

Wymore identified only one low point in her teaching career in Wesley: being RIFed (or let go due to budget cuts) three years after she started teaching (Figure 4). In fact, she “was devastated.” The principal at the time called all of the high school teachers that were going to be RIFed that afternoon and said, “Don’t worry. You know you’ll be safe. I’ll back you up” (SW.I.1; SW.BOTG). When they arrived at the school board meeting and were informed of the Reduction in Force (RIF), the principal did not speak up at all. Regardless of what the principal had promised, Wymore did lose her job. As she remembered this board meeting, she explained: “He didn’t stand up for us one bit.
That was really tough” (SW.I.1,9). In fact, this was her only low point on her graph (SW.BOTG). This low point may have influenced her trust of administrators throughout her career. When asked if she shared with her principal when she applied for the PAEMST, she said, “I didn’t even tell him that [I] had been nominated let alone submitted [my] application” (SW.I.9).

Wymore took what seemed as a devastating situation and turned it into a positive next few years. She worked as a substitute teacher (which included one long-term position) and taught an Agriculture Economics course at the local college while the professor was on sabbatical leave. Additionally, she spent time with her family. She later realized she could devote her attention to other, family medical concerns without having to take time off from teaching. Overall, Wymore painted a positive picture of her

Figure 4.1. Wymore’s behavior over time graph showing one low trough but primarily high points over her teaching career.
teaching career in a rural school and community as is evidenced by her record of continuous high marks for events spanning the recent 25 years.

**Benefits of Teaching in Rural School**

**Autonomy.** One main benefit for Wymore to stay in a rural school was the freedom to make her own decisions about curriculum and instruction while meeting the state standards. As she explained,

> We’re pretty lucky here though, our curriculum coordinator wants to know what we are doing and when we are doing it but he pretty much lets us teach when we want to teach those ideas, but we know we have to hit those state standards. (SW.I.4).

Wymore develops curriculum, lessons, activities, and assessments that cater to her students and the local geographical area. With her students in mind, her master’s degree in curriculum and instruction focused on the natural resources available in their state. She explained, “I wanted to make sure they understood more about natural resources and specifically coal as it is very important in our state’s economy” (SW.A; SW.I.3).

**Collaboration.** Although she is the only teacher for natural resources and environmental science, she does share the teaching load for biology with a second teacher. They collaborate on the curriculum, but each teacher is free to use their own strengths and strategies to teach the content.

> I need to coordinate with the other biology teacher so that we teach about the same pace, but we teach our own way. Like right now, we want to teach about cells. We know there are certain things about cells we have to teach which is fine. I teach one way, she teaches it another way. (SW.I.4)
As previously mentioned, Wymore collaborates with the art teacher who also does taxidermy. Wymore’s room showcased students’ work of mounted birds and small animals with larger animals on display in the study pods in the hallways. A wolf and mountain lion were on display in her wing of the high school—all part of student projects with assistance from the art teacher.

Another teacher Wymore collaborates with is the family and consumer science instructor, Diane Lane. Wymore and Lane designed a Dutch oven project for late spring before school is out. Wymore’s students prepare wild animal meat, butchering and prepping with Lane in their cooking classes. Lane says it helps to clean out her freezers while teaching students how to prepare wild food common to the area. Wymore’s students have learned about the animal resources available locally such as habitat, hunting seasons, and sustainable practices for the wildlife.

Wymore and her students also collaborate with federal biologists on two data collection programs—gathering water samples and observing pika populations over time. When federal funding decreased for the biologist’s research projects, these researchers asked if she and her students could pick up more sampling sites—and she readily accepted the opportunity.

In another instance of collaboration outside of school, Wymore and her students assist the state game and fish biologists annual survey of bighorn sheep in the mountains near Wesley. Wymore and her students have been involved with these surveys for six years—assisting in capture and sampling of the sheep. The students have learned to swab nasal canals, throats, and ears and to radio collar individual sheep. One year, a student
performed ultrasounds on the does with a portable machine. Another student sutured an ear of one of the sheep. Wymore stated,

That’s cool stuff that I don’t think kids in other places ever get to do that stuff.

We are just lucky. And I just have some good people to work with and who are willing to work with my kids. (SW.A; SW.I.8).

Another once-in-a-lifetime experience involved the state’s paleontologist, whom Wymore met while working on her master’s degree. He was going to be on-site at a dig about 110 miles from Wesley and the paleontologist invited her to bring her students over to watch. Taking advantage of this real-world science opportunity, she not only brought along her current students but invited others to fill six buses of high school students.

When she arrived, the scientist in charge asked her if she would like to join the crew in the pit. Of course, she jumped at the opportunity. Later students would come to talk about watching her work and realizing “she really did know science” (SW.O.2). Other students wanted to take her class and “learn from the teacher in the pit” (SW.O.2).

Wymore uses her freedom to develop her own curricula, lessons, and activities to match her students’ needs to the content instruction. Her collaborations with colleagues enhance classroom instruction with authentic content and activities providing the students with real-life skills and knowledge. Her collaborations extend outside of the school to connect her students to real-world scientists and their research projects. Wymore takes advantage of the resources outside of her own expertise and classroom to ensure her students have applications of the content in her classes. However, teaching in a rural school and community also presents challenges.
Challenges of Teaching in Rural School

**Geography.** Wymore uses place-based projects to connect content knowledge to local applications. Her frustration is that this practice limits those students who are interested in science careers not found in the geographical region. Wymore felt this was her primary challenge, providing students with experiences and interactions with scientists in content areas not readily available in her geographical area. For example, oceanography: “I had a student who wanted to be an oceanographer when we are 1000 miles from an ocean. So, I am limited to what I can actually show my students, and have them work on” (SW.O.2).

**Diversity.** Wymore identified another challenge from a rural point of view: providing her students with a diverse background beyond Wesley. She expressed her concern in this way,

We are just a dot in the middle of nowhere; our kids just don’t know a lot about anything outside of the town or even our state. A lot of them have never even gone out side of Wesley other than to go shopping or something in towns within 100 miles of here. They don’t know anything about the real world out there or how other people live or what it would be like to be in a different type of community. (SW.I.6)

She tells her students, “. . . you guys [have] got to get out and see the places and be in other places” And explains, “. . . they just need to travel and get away from here sometimes” (SW.I.6, 9). While she can provide her students with science opportunities beyond the classroom, she cannot provide them with non-science, real-world diverse situations.
**Funding.** Budget cuts and restrictions on student travel have become an issue in the past few years. Wymore continues to take her students on field trips as well as data-collection projects with the federal biologist and the state game and fish scientists. She took six busloads of students to the paleontological field site. She challenged the principal by pointing out there were funds for sports and other state-sanctioned activities, so why not for academic purposes? She continued by pointing out that if they were paying bus drivers to travel all day long and then sit around and wait for students, then those drivers can travel with her. “Oh, they kind of get it. They know I will push the envelope. I will approach the school board and I will take it to the public if they push back on my field trips” (SW.I.4)

**Characteristics of resilience**

When Wymore was RIFed, she was “devastated” as much about being RIFed as she was that “the principal just sat there and didn’t speak up at all.” However, the basic trait of resiliency is overcoming obstacles. Wymore turned this situation into a positive opportunity. She cared for a family member requiring medical attention. The year of travel and lengthy stays in a hospital did not impact her employment. As she explained, “I didn’t have to depend upon a sub to teach my classes. I didn’t have to prepare lesson plans or worry about my students” (SW.I.10). One of Wymore’s colleagues described her in terms of challenges,

I would say challenges are just part of her life. I mean, it's like...a challenge is like one more learning opportunity for her. It's not necessarily a challenge--I don't know what to do. I can't do this. It's like, okay, I've got to figure out how to do this. (SW.AI.5)
Autonomy. More than once, Wymore expressed her “freedom” (SW.I.2-4) to develop her own curriculum if she “met the standards” (SW.I.2-4) and informed the district curriculum coordinator. “We’re pretty lucky here though, our curriculum coordinator he wants to know what we are doing and when we are doing it but he pretty much lets us teach when we want to teach those ideas” (SW.I.4).

Wymore has control of her classroom curriculum, textbooks, resource materials, and even guest speakers for her students. Her instructional methods and assessments are hers to develop as well. These freedoms are another reason she chooses to teach in a rural school. Wymore’s knowledge of her students outside of the classroom gives her opportunities to adapt her curriculum to better fit their interests and strengths.

Adaptability/Flexibility. While Wymore was RIFed, she used those four years to learn about the Wesley community and its’ citizens. When a professor at the local college went on sabbatical, Wymore taught his Agriculture economics course. She was a presence in the district, working as substitute teacher, helping students with their agricultural projects in FFA and 4-H, and sharing her own expertise which provided her with a job later when the district was hiring again. She contributed to the local FFA program as a mentor, sponsor, and 4-H leader (again remaining a positive contributing member of the community).

Resourceful/Collaboration. Wymore utilizes the local community as resources for her students, bringing in the game warden, soil conservation officers, and federal employees. Reaching beyond her community, she works with scientists from the state university, state agencies, and federal agencies as well. Wymore is resourceful, using her students’ interests and her own connections to provide students with real-world learning
experiences as well as assisting with data collection for state and federal science agencies.

**Support Systems.** Wymore enjoys the support of her family, her spouse and his family. He encouraged her to complete the PAEMST application and supported her summer professional development opportunities. Her colleagues provide support professionally within the school system as well. Her connections to the science community provides her with opportunities for herself and her students to do authentic science and to learn outside of the classroom. Wymore also enjoys the support of the community based on her years of involvement in the schools, in 4-H, and as an active rancher/farmer.

**Summary**

Overall, Wymore presents a positive view of teaching in a rural community. Her early-career RIF, while devastating, provided her with opportunities to interact with her family and the community outside of the school district. She was rehired by the school district, although only in science four years after the RIF. Instead of reacting negatively to that, she found that agricultural and science education are pretty much the same (only one comes from a different point of view). Wymore values the benefits of designing her own curriculum, the freedom to teach it as she chooses, and the ability to bring the real-world of science to her students compensate for the challenges of funding and the limitations of regional opportunities. These benefits, as well as Wymore’s resilient characteristics, have contributed to Wymore’s success and longevity in rural science teaching. According to Wymore, the community’s respect for her knowledge provides the necessary capital to continue students’ field research opportunities with state and federal
science agencies. With this support, as well as the confidence of her family and colleagues, Wymore has learned that, when the administration attempts to block her efforts to provide learning opportunities for her students, she can “. . . go directly to the schoolboard and community” to acquire the permissions she seeks.

The Rachel Lake Case

Rachel Lake grew up in a rural community much like the two different communities she has lived in since becoming a science teacher. Her education background is in biology and science education (see Table 4.1).

Community and School

Rachel Lake, a PAEMST recipient, teaches at Pure Prairie school district, in the Two Rivers School District. Lake has lived in this community for 39 years, when she was hired to teach and coach in the high school grades.

The town of Dover is the county seat. Metal fabrication and welding, health care, agriculture, and the school district itself are the major employers in town. The nearest urban center is 37 miles away and is home to the states’ land grant university.

Pure Prairie school district has one school building that houses the elementary, middle, and high school, each in their own section of the building where all levels share the gymnasium, cafeteriaw, and library areas. The National Center for Education Statistics (NCES) identifies this school district as rural and remote (2016). There is a total of 534 students, with 153 high school students, 9-12 in the Pure Prairie school district (NCES, 2016). The school district had an income in 2013-2014 of $17,562,000.000 and expended only $13,317,000.000 that year. The school population is primarily Caucasian as is the community (99%) (NCES, 2016).
Pure Priaire school district is on a four-day school week, with Fridays off for students but not the teachers. Grade level, district, and other staff meetings are held on Fridays and a two-hour block is set aside for student tutoring in the mornings (RL.O.4). The school building is located in town, approximately 4 blocks from the main street, and surrounded by the county courthouse and offices, two churches, and residential housing. Fourteen years ago rooms were added to the high school section of the main building. The science room was one of these additions with an enlarged classroom-laboratory combination as well as an improved equipment and chemical storage area. Each grade level has their own main entrance although one can access any classroom from any entrance. On the days I visited, I found the doors were locked and required me to buzz into the office to unlock the doors. The school has a 1-1 initiative with Google Chromebooks for the high school students (RL.O.5).

Teacher Background

Lake grew up in a rural community within 50 miles of Dover, although no immediate family lives there currently (RL.I.2). Lake’s grandmother lived with her family while she was young; her grandmother loved the outdoors and would take Rachel out to explore their surroundings. Lake’s grandmother encouraged her to continue exploring when she could no longer go with Lake. Thus, Rachel attributes her interests in exploration and discovery to her grandmother (RL.I.2).

Lake’s mother worked at the local high school and she would go with her during the summer months. The high school science teacher piqued Lake’s interest as he was tall, laughed a lot, and seemed to have fun, which encouraged her to explore science (RL.I.2). When she went to high school, the district had hired a “brand new” science
teacher (RL.I.2) who was passionate about biology. She loved biology as well which encouraged her to go into biology in college. At first Rachel wanted to be a veterinarian but knew her “grades weren’t high enough” (RL.I2) so she turned to science teaching as her second option.

Rachel majored in biology at the state university which was approximately 100 miles away from her hometown. She wanted to teach in a rural school district, but was assigned to a larger town for her student teaching experience. As a student teacher, she taught four sections of the same class. This experience strengthened her desire to teach in a rural community as she found teaching the same class to be “boring and not challenging.” (RL.I.2).

Lake’s first teaching assignment was in a small town and school district, where she was the only science teacher (RL.I.3). Her first year of teaching, she only had two preparations and coached track and basketball. After that first year, she was scheduled to also teach German, as she had eight-semester hours of German language in college. By the end of her fifth year, her teaching load increased to nine preparations as well as head coach of track and basketball. Overwhelmed with this work load, she left the district. She found a new home in Dover (her current school district) (RL.I.3; RL.O.2).

Although Lake has taught as many as six preparations, she currently teaches chemistry and a dual enrollment college biology class for a nearby four-year college (two preparations). Only juniors with a GPA greater than or equal to 3.5, and seniors with a GPA greater than or equal to 3.25 may enroll in the college biology course (RL.O.2). Her last class period of the day is a study hall with a mixture of students (freshmen through seniors).
Walking into Lake’s classroom, I first noticed her two wall lengths of storage cabinets and work areas. On one side were height-adjusted cabinets for microscope work and the other was height-adjusted for using electronic and triple-beam balances. In the back of the room were plants, a turtle, and Lake’s desk.

Lake’s students were ready to go when the bell rang, she began reviewing the previous days’ work, answered questions, connected to current events (some more personal to the students but still connected to science) and then demonstrated the set-up for the investigation students would be conducted that day. During the lab, students set up their own lab areas (walking to and from the custom-made cabinets) and were attentive to their investigation. After they completed the lab, students cleaned up and put their equipment and materials away. During this time, Lake worked her way around the room, talking with each group of students, asking questions about their reactions: what they were looking for, what they were seeing, and what their data meant. The students were trusted to be safe, follow lab protocols, and they respected Lake’s expectations (RL.AI.2; RL.O.5).

Honors

Lake was twice named her school district’s teacher of the year, once before the PAEMST and once afterwards. Notably, Lake applied three times before she was selected as her state’s recipient of the Presidential Award for Excellence in Mathematics and Science Teaching (RL.O.1; RL.A.2). After receiving her PAEMST award, she was named Outstanding Alumna in Education at her alma mater, the state’s land grant university and her state’s Physical Science Teacher of the Year as well.
Lake stated that the “. . . PAEMST was the most exciting award thus far, it was the highest honor, as she felt so (Lake’s emphasis) appreciated” (RLO1). As exciting as it was for her, the support from her principal was even more appreciated: “I am just a “country gal” so dressing up was a big deal” (Lake’s emphasis); in fact, her principal at the time gave her money to go to the local dress shop to buy a “fancy dress” (RLO1). She has continued to stay in touch with those in her PAEMST cohort and has become her state’s coordinator for PAEMST nominees and applicants (RLO1; RLA2).

Receiving the PAEMST and associated recognition gave Lake a boost in confidence as well as the financial means to pursue her master’s degree in Science Teaching for the state university (RLI5; RLO1). A former student who now teaches with Lake was impressed with Lake’s professionalism and recognized the work she went through to become national board certified (RLA1).

**Behavior Over Time Graph**

Rachel Lake’s behavior over time graph (BOTG) of her teaching career shows an overall upward trend until the recent few years (Figure 4.2). The two valleys in her graph were readily explained, and these stories follow in the next two paragraphs.

The first low point was at the end of her fifth year of teaching when she was assigned nine preparations for the next school year in addition to her head coaching responsibilities (RLI2). When faced with this overwhelming work load, she looked for another teaching position and moved on.

Looking at the BOTG (Figure 4.2), Lake’s trend line rises with her move, even though her second major challenge (trough) of her teaching occurred, not just the first year at her new school, but the first day she reported to work. The chemical storage room
at that time was a renovated goat shed moved onto the school grounds. It was seated on a wooden pallet floor. In surveying the inventory of chemicals, she noticed a rusting can with potassium metal inside. She knew it needed to be removed but since school in-service days would begin the very next day, so she isolated it from the other chemicals until she could dispose of it properly. When she arrived to work the next day, white smoke was coming from the chemical storage area (the goat shed). The volunteer fire department had been called; she waited for them. The three men, two older and one younger arrived at the scene. The older firefighter appeared to be in charge, so they sent the youngest man in to check on the fire as they had only one gas mask and he didn’t have any children. There didn’t appear to be any flames as they decided to put water on it. Lake said, “Oh no” (RL.O.3), and the man in charge told her to step back. When they began to release water she again said, “No, don’t do that!” (RL.O.3). They again asked

Figure 4.2. Rachel Lakes behavior over time graph of her 44.5 teaching career.
her to step back and let them do her job. Shortly thereafter, the superintendent arrived, and Lake explained her concern to him. The superintendent stepped in and told the firemen to listen to Lake: she not only knew what was in the shed but how to handle those chemicals (RL.O.3). She said, “Absolutely no water!” (RL.O.3). On Lake’s suggestion, the fire crew opened the windows to let the smoke clear, so they could secure the rusting can. She had to leave to go to basketball practice (as she was a coach) and then inservice meetings and training. Though she was exhausted by the end of the school day, she continued to be concerned about the smoking goat shed. These worries prompted her to drive the 35-mile distance to her home town to get some advice from the jolly, high school science teacher she had admired in her youth. As Lake started her story, she burst into tears. Her former high school science teacher (now her mentor science teacher) listened patiently and assured her she had done well but asked, “Now what kind of floors are in this shed?” (RL.O.3). When Lake told him, they were made of wood he made her call the principal immediately and encourage him to go back to the shed and check the floor. Sure, enough there was still some smoldering going on. At this point, instead of quitting the daunting task of teaching chemistry as a person trained in biology, Lake looked to her mentor science teacher who connected her with a chemist (Dr. G.) at the state university who helped clean up and secure the goat shed for chemical storage. She continued a professional relationship with Dr. G.—eventually enrolling in classes he taught and partnering with him on several grants through the years (RL.O.3).

The second trough incident was primarily personal but took place in her classroom. A student was twisting and playing with a faucet in her classroom as a custodian was fixing it; the custodian grabbed the student and twisted his elbow when the
student refused to stop “fiddling” (RL.O.2) with the faucet. The next day the student’s parents came in for a meeting; both the mother and the school secretary wanted to blame Lake for the incident and insisted that the father spend the day observing in her classroom. This was very stressful as she had no control over what had happened to the student but was being blamed for this incident. As Lake was teaching and moving around the room, she noticed the father was counting his tolls (as he was an over-the-highway truck driver) and, since she had a brother who did a lot of travel, she knew about toll roads and struck up a conversation with the father about his cross-country travel. As the day progressed, their conversations came to center on Lake’s teaching and students’ experiences in her classroom. By the end of the day, they were fast friends, much to the chagrin of his wife and the secretary. In fact, the day this father spent in Lake’s classroom turned him into a vocal advocate of Lake (as a teacher and person) in the community. The student’s mother and the school secretary backed off and let Lake be after this (RL.I.4; RL.O.2; RL. A).

As we follow the upward trend in Lake’s graph, we come to a peak when she received her PAEMST and again when she received her master’s degree and began teaching the college biology. The BOTG plateaus are when Lake received her national board certification and state physical science teacher of the year awards. Additionally, Lake served on a national science organization’s governing board and helped write state and national standards before the trend line begins to fall (RL.I.2-3; RL.O.3; RL.BOTG).

The downward trend involved working with national science standards as a curator, the expectations of her to travel to discuss one section of one standard was too much burden for too little work (RL.I.3; RL.O.4; RL.BOTG). Additionally, the
administration was implementing “new 3-letter acronym projects to do or learn every year” (RL.BOTG). The latest fad was mass, custom learning (MCL) where students would work at their own pace with implementation at the middle school first. This MCL was not going well as some students were progressing to the next grade without completing the previous grade’s curriculum. Lake was concerned about the push to bring the program to the high school (RL.O.4).

Another concern involved changes in her science budget. When she first arrived, her science annual budget was $10,000.00. With the advent of a new superintendent 13 years ago, her annual budget shrank to $2,300.00. This new superintendent did not understand science--its equipment or its materials -- and had issues with Lake’s large classroom and quantity of storage cabinets as well.

As it happened, the new building addition (which increased Lake’s storage area and replaced the renovated goat shed) was completed the summer prior to this new superintendent’s hiring. He had not been in on the planning or rationale for the cabinets and storage space for Lake and the sciences. When the new superintendent first visited Lake’s classroom, she proudly showed off her storage area, and walls of storage cabinets with chemical-resistant counter tops. His response was, “If you didn’t have so much shit, you wouldn’t need all of this storage” (RC.I.1-2). As a result, the new superintendent removed six of her eight storage cabinets for other classrooms in the new addition (RL.O.2). The up side to this situation is that a school father (the father of the previously mentioned misbehaving student) enlisted himself to rebuild her classroom cabinets. As it happened, this father was now retired, did woodworking, and came in after school to
build custom-made cabinets of varying heights (as per Lake’s specifications) to accommodate microscopes and electronic balances (RL.O.1-2).

**Benefits of teaching in rural school**

**Autonomy.** Lake loves teaching; she loves teaching in a rural community. Lake has enjoyed the responsibility of developing and implementing her own curriculum. She has the freedom to teach her students content, applications of content, prepare them for their future career choices, and to connect with her students personally.

**Support Systems.** Even though she teaches in a rural community, she has benefitted from two mentors within 50 miles (her high school chemistry teacher mentor and Dr. G. at the state university). She has reached out to both for support, assistance, and developed collaborative relationships with other scientists at the state university.

Lake appreciates the community support she has earned over the years as well. She listens to her students’ feedback and parents’ feedback to improve her own teaching, which she sees as part of meeting her “clients” needs while doing her job (RL.I.5; RL.O.2). Betsy Hansen, her former student who now teaches mathematics, valued Lake’s high expectations not only of her students but of herself as a teacher and a citizen in the community. As she explained,

Mrs. Lake modeled the behavior that she expected of her students, in the lab, and in her own professional life. When I took my first college science course with a lab, I was appalled at how unsafe and messy the lab was. I realized then how much Mrs. Lake had “trained” me to do good, safe lab work (RL.A.I3).

As Lake found, community and colleague support, knowledge of her students and their families, all contributed to the benefits of teaching in a rural school. Lake also noted
the benefit of varied teaching (more than one preparation), and opportunity to adapt to
her students’ interests and strengths (RL.I.2-4).

Challenges of teaching in rural school

Teaching assignment. The first challenge Lake mentioned was the potential to
have multiple preparations and simply not enough time to teach them all well. Lake left
her first teaching position due to this stressor (RL.I.3; RL.A). At Pure Prairie high school,
she has had up to six preparations but now has down-sized to two preps. Even though she
was the only science teacher for 30 of her 44.5 years of teaching, she now has a colleague
who teaches one of these other science classes (RL.I.3).

Isolation. The professional isolation, of being the “only” science teacher, also
posed a challenge (RL.I.3). Hansen, a former student and now one of her colleagues,
also raised the concern of professional isolation (RL.A.I4). Hansen was teaching
mathematics and misses having another mathematics teacher to bounce ideas off--to
collaborate. Now as a colleague to Lake, Hansen has learned how Lake uses her
participation in professional organizations and summer classes as her method of
overcoming this isolation (RL.A.I4). Lake admitted that the years spent serving on the
national science governing council alleviated some of the isolation and kept her in the
teaching profession as she was discouraged now with a variety of issues within her school
district. This opportunity encouraged her to stay as she interacted with teachers from
across the United States that she collaborated with and built a science community that
was supportive (RL.I.4). Lake become actively involved promoting and providing
professional development on the new national science standards. Lake also uses the
Internet as another way to overcome this isolation now as well (RL.I.4).
Community. One last challenge Lake noted was the need for novice teachers to establish themselves. To Lake, it seems new teachers are challenged to establish themselves in the community—more so than what she remembers she needed to do herself. These experiences have helped her to realize that in her own case, her years in the community have all given her “capital” with parents and students that novice teachers do not have (RL.I.3-4). This concerns Lake because she worries about how rural schools like hers will be successful in recruiting new teachers who become established in the community.

Funding. Another challenge was funding (as mentioned previously). Her budget had been $10,000.00 for twenty-six years, and it was cut to $2,300.00. This impacted what she could provide for her students (RL.I.3; RL.O.2).

Characteristics of resilience

Autonomy. Lake specifically appreciated the rural school advantage of being able to choose her curriculum, develop and adapt her lessons and activities to her students. She also appreciated the ways student feedback worked to improve her instruction and lessons. She was involved in designing her new classroom and store room, as well as her custom storage cabinets that double as working spaces in her classroom as well (RL.O.1).

Resourceful. Lake likes to start new things, to take on new adventures and projects and to continue “exploring” like her grandmother encouraged her (RL.I.1-2). When she was assigned nine teaching preparations, she used her connections through her coaching and the state university to find a teaching position in another school district where she would have fewer preparations. She used the state university connections to
manage her own professional development, to find resources to supplement her own budget deficits, and to enable completion of her master’s degree (RL.BOTG).

**Isolation.** To overcome her professional isolation, Lake reached out to professional teaching science organizations to become actively involved in helping other teachers, and increasing resources for her own students as well. She explored the resources available and took advantage of what different science organizations offered to teachers. (RL.I.5; RL.O.3-4: RL.A.I4).

**Adaptability/Flexibility.** Adaptability goes hand in hand with resourcefulness. Lake adapted to the situation with the new superintendent (who moved some of her classroom cabinets to other classrooms) by turning to her community connections (RL.O.1). The parent who built her new cabinets followed her specific classroom needs for the design and volunteered his time and the materials as well. That same parent became her supporter after he sat in her room and watched her teach and interact with the students. She adapted to his presence even though it was stressful even when they found common ground (RL.I.4; RL.O.2).

**Collaboration/mentors.** When the fire occurred in her goat shed chemical storage room, Lake contacted her own high school chemistry teacher, who assured her that she “would be fine and could teach chemistry safely” (RL.O.3). She continued to rely on his expertise for her first year of teaching. He also put her in contact with a safety expert at the state university, that she relied on to correctly and safely manage her chemical inventory. From this relationship, Lake developed a professional collaboration that continued for decades (RL.O.3-4; RL.A).
Relationships. Lake values relationships with her students, parents, community, colleagues, and administrators. She benefited from a principal that believed in her enough to tell firemen to listen to her and one who gave her the money for a nice dress to wear to the PAEMST ceremonies in Washington, D.C. As Lake said, “administrators and colleagues can enhance or obstruct you but those that enhance you are worth their weight in gold” (RL.I.5; RL.O.1, 2, 6; RL.A.I2-3).

Summary

Rachel Lake grew up in a rural community and school system; after student teaching in an urban school system, she knew she wanted the challenge and variability of teaching in rural schools. When she chose teaching as her career, she knew it would be science and she used her own experiences with her grandmother and high school science teachers to fuel her own enthusiasm and passion for science and teaching.

Lake loves teaching, inspiring students to attain their potential, and using their feedback to reach her potential as a teacher. Lake models the behavior she expects of her students and colleagues. She holds high expectations of her students but believes in helping each student to achieve those expectations and potential.

She thrives in a rural school system because of the independent opportunity to design and implement her own curriculum focused on maximizing student achievement. Her ability to collaborate, to work with others, and to seek out opportunities beyond her community contribute to her success and longevity. She has established her “track record” with the community she serves and is able to benefit from that capitol.

Receiving the PAEMST increased her confidence as well as the principal support she received at that time. Lake benefited from her increase in confidence to obtain her
master’s degree, her national board certification, and to eventually serve on a national science education board and council. Her involvement with the state university professor, the state and national science organizations, and colleagues in other subject areas, all decreased her professional isolation. These professional connections provided both support and opportunities to explore beyond her rural community and school.

A former student who is now a colleague, well explained Lake’s success and longevity:

Lake is confident, stands up for what she is doing, speaks up and out, backing up her expectations with evidence and her own behavior. She supports her colleagues and students alike, expecting them to attain their full potential and will help them do so. (RL.AI.3-4)

In sum, Lake herself pointed to the fact that in “. . . 44 years of teaching I have had only three students repeat a class due to flunking” (RL.O.4). Lake believes her students and colleagues will be successful and she will do what is necessary to help them help themselves. Clearly, Lake sees their success as her success.

The Josephine Christof Case

Josephine Christof’s teaching career spans two rural schools: 1) Bugaboo Consolidated School District, a P-12 one building, rural school system that eventually closed due to diminished funds, and 2) Monument High School, Monument School District, in the town of Monument. Due to her husband’s farming occupation, she was limited in her choices of schools, but said she would have chosen a rural school regardless.
Christof raised her family and ran a successful business before her health required her to find another vocation. At the suggestion of her doctor, she went back to school to complete an education degree in natural science and mathematics and then began her 21-year teaching career.

**Community and School**

Josephine Christof, a PAEMST recipient, currently teaches at Monument High school, which is a 22-mile commute from her home.

The town of Monument is the county seat. Manufacturing and agriculture were once the main occupations in Monument. In the past ten years, the largest manufacturing factory closed, affecting the local economy and school finances (JC.AI.7). While the school and community remain financially stable, the future does not look bright with stagnant growth in population and the economy (JC.AI.7-8). In addition, the state school funding formulas favor growing communities, which Monument is not (JC.AI.7). As Christof’s assistant principal explained, “Whenever we lose a student for enrollment then that’s a chunk of money that’s going away from our state aid” (JC.A.I7).

Monument school district has one PreK3 and PreK4 school, three elementary schools, one middle school, and one high school. The high school is located on the eastern edge of town, with agriculture fields on the three adjacent sides, and residential housing located across the main highway. The school benefits from its location as it includes a nature area with indigenous trees and grasses on school grounds and an industrial grade greenhouse which Christof utilizes for instruction and student projects. Monument school district has approximately 2,144 students, with 659 of those students in the high school (see Table 4.1).
The National Center for Education Statistics identifies the Monument school district as a town, but it has been included in this study as its students come from a rural, agrarian environment as well as the town of Monument for its educational community. As per the selection process for this research, the town itself is located at least 25 miles from an urban center (Figure 1).

Monument High school is on an eight-period school day with a ninth period on Fridays. This schedule allows students in good academic standing to be released early if they choose (JC.I.23). There are computer classrooms for students and Christof has a classroom set of Google Chromebooks for her students, but the district has not invested in 1-1 technology for its students. Christof has a computer and projection system in her classroom as do most other classrooms.

Teacher Background

Christof grew up in a “very small town” located 31 miles from Monument and attended schools in another small town just 19 miles away from Monument (JC.I.1). She met her husband during her junior year of high school, graduated in May, and married in July (JC.I.7). While raising her children, she had her own business but, after 20 years, the work had taken a toll on her back. The doctor said she had a choice, “you can walk or continue your business,” so she chose walking and went back to school (JC.I.7). “I took two classes that summer just to see if the brain still worked” and it did so she enrolled that fall fulltime in the education program (JC.I.8; JC.A.1). Christof majored in Natural Science with Chemistry and Mathematics endorsements.

Christof began teaching in a very small school district, Bugaboo Consolidated School District, which housed P-12 grades in one building located 45-miles away from
her residence. For five years, she was the only science instructor 7-12 grades which did present challenges (to be discussed later). During this time, she completed her master’s degree at the state land grant university campus. She was fortunate to begin her degree just as the College of Natural Resources was piloting distance learning degree programs. Online classes allowed her to continue teaching full time while she attended classes digitally during the school year and summer. However, living only 45 miles from the University allowed her to spend some time on campus as necessary.

After completion of her master’s degree, Christof was asked to continue for a Ph.D. Christof expected that decreasing student enrollment and funding at Bugaboo school would eventually lead to a reduction in staff; she further reasoned that, once she completed her Ph.D. program “. . . I wasn’t in a place that was going to be here for long and people probably wouldn’t hire me because I’d be too expensive” (JC.I.2). This led her to apply for and accept a science teaching job at Monument high school (JC.I.2).

Christof started her Ph. D. and her new teaching position in the same year. Fortunately, distance courses were available during the school year and she would be able to take classes and do research on campus during the summers. Her first three years at Monument high school she shared a classroom with another teacher; in her fourth year, she moved into her own classroom by volunteering to teach physics. As she explained, “When the physics teacher retired . . . I found out . . . that I was the most qualified to teach physics because I had taken extra classes” (JC.I.5). She decided even though physics was not her strong suit, that she would teach the class to have her own classroom (JC.I.5). Ironically, she had taken physics as a high school student herself but decided not to take high school chemistry in her senior year as she disliked physics so much (JC.I.6).
Nonetheless, she came to minor in chemistry as an undergraduate college student, and now she was teaching physics and enjoying it. She remains in that physics classroom today and does not have to share with other teachers.

Currently, Christof teaches four dual enrollment courses: biology, physics, zoology, and botany, and a fifth course, addressing special topics in a research course, (JC.I.1). Biology and physics are one-semester courses at the college, but she teaches them over the entire school year. Her other preparations, zoology and botany courses, are one semester courses and the special topics course continues for a full year.

Christof’s classroom is well-organized and filled with science equipment, materials, and a few living organisms, plants and insects (JC.O.2). One wall of her classroom houses cabinets with drawers full of equipment for laboratories, each labeled clearly with its contents. Other shelves have three-ring binders of her curriculum and lessons for each class she teaches and has taught (JC.A). Student work is displayed around the room as well as current student projects for her special topics course as well as physics experiments. In the back of the room are hissing cockroaches and their food supply with Scentsy to cover the odors of the insects (JC.O.2; JC.A).

**Honors**

Christof has been the recipient of numerous awards (Table 4.3), culminating in her PAEMST and her state science teachers’ organization’s Service to Science Education award (JC. BOTG, JC.A). Though her curriculum vitae and BOTG list many awards, she described the Toyota International Teachers Program to Galapagos as a dream come true (JC.BOTG).
A parent nominated Christof for the PAEMST, which she considered as an honor (JC. BOTG). Christof has taught both of this parent’s children, who were state science fair winners and who went on to compete at the national science fair accompanied by Christof their parents. (JC.I.27).

Christof said when she first looked over the application she was not sure she wanted to take the time to complete it, but the parent nominator and the state science fair coordinator encouraged her. Even though it was time consuming, Christof was not selected the first two times she applied and, when she decided to give it one more chance, she was selected. Since then she has encouraged other teachers to apply and to re-apply if not selected the first time (JC.I.27).

**Behavior Over Time Graph**

Christof’s BOTG has four deeper troughs and two shallower troughs, with several related to personal situations more so than professional circumstances (Figure 4.3).

![Behavior Over Time Graph](image)

*Figure 4.3. Josephine Christof’s behavior over time graph of her 21-year teaching career.*
Christof’s returned to education as a student in college was rewarding; she received scholarships, internships, as well as successful completion of her degree. The first low trough in the graph, prior to her graduation and subsequent beginning of her teaching career, was the death of her father. Even though she started back to college almost 20 years after graduating high school, her father had instilled his own life-long learning philosophy in Christof. As she explained, “My dad really valued education and had a great respect for teachers. He was only able to go to school to the eighth grade . . . because his family needed the extra money” (JC.I.7). She remembered him as a self-taught radio/TV repairman, who learned his trade by reading manuals because he was intrigued by the new technology. As Christof continued, “Both of my older sisters are teachers, and so it was a low point that he has not been around to see me as a teacher either” (JC.BOTG). Her mother’s death was the second deeper valley, the fourth valley in chronological order on the BOTG (Figure 4.3)

Her next two troughs included the onset of her master’s degree and her Ph.D. degrees as she was still teaching. The second of these troughs, when she moved to Monument was coupled with leaving the Bugaboo Consolidated school district, because she had loved teaching and working there. However, she knew that it was only a matter of time before Bugaboo would be out of funds and close completely (JC.I.2, JC.BOTG). Also, with a Ph. D. it would be harder to find employment as a teacher, so she found the position at Monument (JC.I.2) before she started her Ph. D. program. She had written a technology grant to earn $117,000.00 to bring computers and related technology to the school district. To show their gratitude, even though the school didn’t close until the year after she left, they told her to take her teaching laptop with her (JC.BOTG; JC.I.22).
Christof’s first three years at Monument high school were stressful due to sharing a classroom with another teacher whose teaching style was completely different than her own (JC.I.5). Budget issues again reared their ugly head. This time, it wasn’t about losing funds but how funds were distributed. In this year, the assistant principal in charge of overseeing department budgets told the science teachers to write down everything they would need to teach the next year; teachers complained about the unequal distribution of funds because they only budgeted for items within that previous year’s allotment while Christof requested $1500.00 more than others (JC.I.19-20). As this issue continued, Christof had a stress/anxiety attack which resulted in her seeing a cardiac specialist. Realizing she had no physical problems, Christof persisted in fighting for the funds she needed to teach well. Over a period of four years, the situation evened out and the funds came to be equitably distributed on a needs basis (JC.I.21).

Peaks in Christof’s BOTG included completion of her Ph.D., subsequent teaching awards, her Toyota International Teachers Program to the Galapagos (which fulfilled a life-long dream), and her PAEMST (JC.BOTG; JC.O.2). The upswing at the end of her BOTG includes a maker space project she initiated with the media specialist in the high school. As it happened, one student’s science project was too large for her classroom, so he was building his wind tunnel in the media center. Christof had suggested the empty space above the media center in a loft study area might be a good work place and the media specialist thought a maker space would be a great idea. Given the combination of a series of grants, the ninth period on Fridays, and the media specialist’s new after-school program, the maker space will begin in the coming school year. (JC.I.22; JC.O.2).
Benefits of teaching in rural school

**Relationships.** Christof listed knowing your students, and seeing your own impact on their education and lives as major benefits of teaching in a rural school. Christof’s nomination for the PAEMST came from a parent of two students who had participated in her special topics in research class. Both students qualified from their state science fair performance to go on to national science and engineering fairs where students share their research with peers rather than compete. Christof’s investment in these students led the mother to nominate Christof for the PAEMST (JC.I.27).

Christof feels that knowing the Monument students outside of her classes and science club is more difficult than getting to know her students at Bugaboo (where there were 400 students in P-12 grades as compared to Monument (where there are 659 students in the high school). An advantage at Monument, however, is that Christof sees the same students in more than one class (and often over multiple years) which increases her ability to help the students move forward with their goals (JC.I.23).

Christof realizes her reason for teaching is the students especially when former students come back and thank her for preparing them for college (JC.I.24). Last December, Christof had minor surgery, but returned for the last three days of the fall semester. She said she had so many former students drop by that she was exhausted “because they don’t just drop by for ten minutes” (JC.I.24) and they were so excited to share how she had helped them succeed. As Christof acknowledged, “That is the rewarding part” (JC.I.24).

**Funding.** Although students are the reason she continues to teach, Christof mentioned the professional benefit of financial security in the Monument school district
Here, even though the budgeting within her department had been anxiety-ridden (JCI19), it wasn’t due to lack of funds but rather distribution of funds.

**Challenges of teaching in rural school**

**Teaching assignment.** Multiple preparations were one of the challenges that overwhelmed Christof when she taught at Bugaboo Consolidated Schools as she was the only science teacher at the 7-12 grade levels for five of the seven years she taught there (JC.I.22). In the last two years, a second science teacher was hired that decreased her teaching and preparation load (JC.I.22).

Teaching dual credit courses requires extra preparation and work. Though Christof is teaching three dual enrollment laboratory courses each semester (JC.I.14), and has heard that teachers in larger school systems have extra planning periods if they teach dual enrollment courses (JC.I.14), she prefers this teaching assignment.

Christof and her science colleague at Bugaboo worked together quite well, with similar teaching styles and interests, providing hands-on authentic opportunities for their students (JC.I.22). On the contrary at Monument she did not enjoy the same camaraderie with her science colleagues (JC.I.22). In her first three years of teaching at Monument, Christof shared a classroom with a teacher who had an opposing teaching style and they often clashed over the room itself (JC.I.15). By way of example, Christof included many hands-on activities and labs which led to personal stress in trying to keep the room clean enough for the other teacher who had a “clean, sterile room now that we do not share the same space” (JC.I.5).

**Funding.** Another challenge that Christof faced at Bugaboo was funding. The student population dropped from 385 students to 150 in her last year (JC.I.2). This
decrease in enrollment coincided with a decrease in funding. Christof, seeing the writing on the wall after talking to the superintendent, felt fiscally challenged, and compelled to seek employment in another, more stable school district. In the Monument school district, although they are also facing a decline in student population has remained financially secure due to good fiscal management, and there is no immediate concern about her employment (JC.AI.7).

**Characteristics of resilience**

**Adaptability.** Resilience could easily be Christof’s middle name. Her first major obstacle was the end of her private business and the need for a second income (JC.I.7). Being a problem-solver and a life-long learner, she followed the advice of acquaintances and pursued her teaching degree 20 years after graduating from high school (JC.I.8). Christof knew teaching as a career. Her older sisters were teachers, her father valued education, and she had worked with children in 4-H as well as tutoring her own children in mathematics, so teaching was not completely foreign to her (JC.I.7-8).

Pursuing graduate degrees was possible due to Christof’s adaptability. She could establish residency during the summer months since the state university was only 45 miles away from home and during the school year, she took online courses (JC.I.7, 10). The university professor, who encouraged her to follow her master’s degree with a Ph. D., also convinced her she could complete a Ph. D. by taking classes online during the school year and doing her research in the summers. As Christof explained, “He [was] really good at thinking outside of the box and taught me to do so as well” (JC.I.7).

**Support Systems.** In addition to her family’s encouragement and support, Christof also gained strength from mentor relationships with her high school physics
teacher, her college advisers for all three of her degrees, her student teaching supervisors, and several parents (JC.I.6, 8, 12, 18).

Christof did not enjoy physics class in high school, so she completely skipped chemistry class altogether. When she went to college for her bachelor’s degree, she turned to her high school physics teacher for help with chemistry; he laughed and told her he knew she would regret it (JC.I.6). Now that she has taught physics for ten years, Christof understands how good her high school physics teacher explained abstract physics concepts to concrete-thinking high school students. She recognizes that he differentiated instruction for all his students—and that her personal learning struggles and his patience with her (even as she went on to college) had prepared her to be a better teacher (JC.I.6).

Another mentor who helped her improve her teaching skills and strategies taught her to think like this: “If a kid can’t see something then you have to figure out a way, a different way to explain is so that they can get it” (JC.I.6). This experience also complemented Christof’s commitment to adaptability as she endeavors to reach the students from their own point of view—not hers. This commitment means Christof intends to be adaptable to her students’ needs regardless of her lesson plan for the day (JC.O.2).

Christof has also joined education and science organizations that support her professional development (JC.I.26). Not only has she participated in their conferences by presenting, she has also received several awards acknowledging her contributions (JC.A.5).
Problem-solver. Christof is an excellent problem-solver which allows her to overcome obstacles. When she was evaluating her future after closing her business, she weighed her options, listened to others advice, and decided on a best fit according to her family’s needs as well as her own (JC.I.5-8). When she taught at Bugaboo, she wrote grants to supplement their annual budget to the tune of almost $1,000,000.00 over the seven years that she taught there (JC.I.22-23; JC.A.2). These monies went for technology, an arboretum, a greenhouse, and even the preschool (JCA2). Christof continues to use her grant-writing skills to supplement her budget at Monument high school as well, even writing grants that will benefit the entire science department, and the student body (JC.I.22; JC.A.2). Over her teaching career her grants have totaled about $1,400,000.00 (JC.A.2).

Humor. Christof has a dry sense of humor, which also helps her cope with challenges. When the medical specialist told her she would have to quit her private business or not walk again, she said, “Well what could I do? Because I [know] the kids [will] need braces and all this stuff.” He said, “Well, have you thought about teaching?” Christof replied, “Oh brother!” (JC.I.7). Growing up with two older sisters who taught, she was not at all interested in teaching, and instead Christof married after high school graduation, with no plans for college (JC.I.2). Here she was now considering it.

As a mother, she helped her own children with their homework. One son was gifted in mathematics, but was bored in his mathematics classes. The teacher did not think he was capable and balked when Christof said he would be taking advanced math the next year (JC.I.8). Christof put her foot down and he did take advanced math the next year and went on to study electronics (which is mathematics heavy) (JC.I.8). With her
third child, the teacher told her that her daughter knew more mathematics than the teacher (JC.I.8). While this didn’t inspire confidence in the teacher, it did for Christof who thought, “I know I can do better than that and so that started me on the math and science route” as a teacher (JC.I.8).

Christof mentioned that teachers, in larger school systems who teach dual enrollment courses, receive an extra planning period and only teach 1-2 dual enrollment courses a semester (JC.I.14). In Christof’s thinking, as she appreciatively reviewed her own four course loads (and unscheduled planning), “You know that just adds to the teaching experience” (JC.I.14).

**Summary**

Christof overcame several challenges to become the award-winning teacher she is today. She ended a private business due to physical health concerns and turned to education, for herself first and then for her students. To whet her appetite for learning she also earned two graduate degrees in a science content area, which also taught her research skills as she challenged herself to push beyond her own knowledge. She feels strongly that being a student and taking the same risks that she asks of her students improves her teaching and their learning.

Christof utilized her writing and problem-solving skills to procure grants to push beyond local school budget limitations and enrich her students’ learning opportunities. Christof’s ability to adapt opened teaching and learning opportunities for herself as well as for her students.

Christof’s numerous awards and grants are a testimony to her teaching ability. Her own abilities have provided her with success in teaching and weathering the
challenges of teaching in a rural environment. However, Christof is quick to credit her students who, she says, make it all worthwhile (JC.I.24).

**The Brad Kent Case**

Brad Kent’s career encompasses one year of teaching English in Asia and the rest of his time teaching secondary science (primarily Biology) (Table 4.2). The teaching bug bit him while teaching in Asia although he turned down a second year of teaching overseas to return to the United States to earn his teaching credentials. After a year of taking education courses and student teaching he started his science teaching career in earnest.

**Community and School**

Brad Kent, a PAEMST recipient, teaches at a combination junior and high school, which houses grades 7-12 in Sutton. He attended a nearby private college after graduating from a rural town in an adjacent state.

Sutton has a population of 1,017 and is 60 miles from the nearest urban center (U.S. Census Bureau, 2014). Prior to his hiring he hadn’t heard of or visited Sutton. Farming is the main industry in Sutton which includes the machine shops and vehicle maintenance industries necessary for this agrarian community to sustain itself. A nearby state park does provide recreation and tourism opportunities that contribute to the local economy as well.

Sutton County School District has one elementary school located in the county seat and the combined junior and high school in Sutton. The National Center for Education Statistics classifies Sutton school district as rural and remote (2014). The school population is primarily Caucasian (> 99%), although there have been influxes of
nomadic students who are enrolled October through March that changes this mix slightly (<1%) (BK.O.1). Sutton County School Districts revenue exceeds its expenditures by approximately $710,000.00 (NCES, 2014).

The Sutton County junior and high school schedule is organized according to an eight-period day. Students are scheduled into study halls that rotate through the eight class periods over eight days of school. Each teacher has one study hall assigned to them daily (BK.O.3).

Teacher Background

Kent attended a private university located in a nearby town, 27 miles from Sutton. He earned a bachelor’s degree in biology with a minor in chemistry. After graduation, he had the opportunity to travel to Asian countries to teach English as a second language for a year. The institution where he taught offered him a second-year teaching position, but he found that he enjoyed teaching and returned to the private university for his education degree (BK.I.1).

Growing up, Kent loved all things science from exploring the river near his hometown to watching Mr. Wizard and then Bill Nye on TV (BK.I.2). When he first left for college, he planned to be a medical doctor, and was in a pre-med degree program but after attending several weekend retreats at one of the state’s large universities, he realized that medicine just didn’t “feel” right and left that plan behind (BK.I.2). Returning from Asia, Kent realized he wanted to combine his new-found interest of teaching with his childhood passion of science and math (BK.I.2). Moving forward, Kent completed his secondary science education bachelor’s degree and student teaching within one year
When he began applying for teaching jobs, he restricted his search to a 50-mile radius of his degree-granting university (as his wife was still working on her bachelor’s degree in elementary education) (BK.I.2). He wasn’t particularly looking for a rural teaching position, he was looking for a school that would keep him close to his wife (BK.I.2).

Kent said it was his love for science that led him to pursue it in college and, after he began teaching, he met other science teachers that inspired him (BK.I.1). After meeting a former state teacher of the year, he realized how important attending conferences and professional meetings would be to improve his teaching, to “keep expanding and getting better at your craft, instead of being mediocre and a file folder teacher” (BK.I.1).

His teaching philosophy is based on instilling the love of learning in his students through science. As he explained, “I only have them for a short time. And they’re not going to remember all the science I teach them. But I want them to love learning” (BK.I.2). As Kent further explained, he wants his students to connect science to their lives and their surroundings, to understand what is going on around them in nature (BK.I.2).

Kent is one of three science teachers in the 7-12 grades, which are housed in the same building in Sutton. One teacher is responsible for the 7-8 grade sciences; the other is the physical science, and he is the life science teacher (BK.I.7). When Kent started teaching at Sutton County high school, he was handed five textbooks for five
preparations; he thought he had to teach every chapter in each textbook, which worked out to a chapter a week. As he reflected, Kent explained, “I was a horrible teacher, I am sure of it. And I taught the way I was taught in college” (BK.I.4). Although his student teaching supervisor had not instructed him to cover a specific number of chapters or do anything specifically (i.e. finish this unit, do that worksheet, or do a specific lab), he still felt he had to cover each chapter in the texts those first years in his own classroom (BK.I.4). Instead, he told Kent: “You do whatever you want as long as you teach in this content area. Succeed and fail and see what works and find out how to teach” (BK.I.5). Kent appreciated this, even though he was scared, it felt this guidance had trained him for later in his teaching career after he survived those first few years and met award-winning teachers (BK.I.1, 5).

Early on in Kent’s career, he realized that he could take his students outdoors and on field trips if he had a bus driver. Taking this opportunity one step further, he obtained his bus driver’s endorsement, so he could, “. . . go across the street, jump in any bus I want and take my kids out to our lake and state park” (BK.I.5). At the lake, students would study fauna and flora, but even closer to the school, Kent has an outdoor classroom that he reclaimed from a “wasteland” twenty years ago (BK.I.6). His students have planted native flora and study the insects and native fauna that have returned to his outdoor classroom (BK.I.6).

While Kent does have to answer to his administrators and school board, he is in complete control of his curriculum and has the freedom to teach what he wants, when he wants, and how he wants (BK.I.5). His students’ test scores are always good (though he is not instructed to teach to any test). As Kent explained, the longer he teaches, the less
meaningful the state test scores are to him (BK.I.6). Rather, Kent’s focuses on helping his students to love to learn (BK.I.2). Frank Johnson, a former student and non-science teaching colleague in Sutton County School District, explained, [Mr. Kent] “... was my favorite teacher in high school and I have virtually no understanding of science and no interest in science” (BK.AI.2). Johnson explained that Kent was his favorite teacher because Kent believed in relationships; in fact, his own teaching philosophy “rigor and relevance without relationship fosters rebellion” developed from being in Kent’s classroom (BK.AI.2). Kent modeled this personally in the classroom, when he would talk to each student as if they were all a “sports” star, not just those out for basketball, the sport Kent coached (BK.I.2). Kent also promoted project-based learning, which Johnson has incorporated into his social studies classes (BK.AI.3). As Johnson remembered: “... of the four things I remember from high school, two were from Mr. Kent’s class. One involved basketball and the other a DNA lab” (BK.AI.2-3).

On the day I observed, Kent began class with a personal question “Who’s having a really good week and why?” Students were not allowed to answer with one word or a short phrase, but a compete sentence with an explanation backing up their response (BK.O.1). After giving every student the opportunity to respond, encouraging them to “use their lingo,” he demonstrated the laboratory set-up the students were going to use in class that day, using a basketball, temperature probe, and a glove light (BK.O.1). After querying the students for understanding or questions, he gave them time and space to “Engineer their set-up” (BK.O.2). While keeping his eyes on this students’ progress Kent stepped back, sharing with me and the classroom paraprofessional, how wonderful basketballs were as Earth models with lines for the equator, the Tropics of Cancer,
Capricorn. Kent began this lesson with the lab protocols projected on the lab’s whiteboard. After allowing 5-8 minutes of students’ activity, Kent went to each station to approve, suggest modifications, or to give struggling students specific instructions, (BK.AI.1-2). As students completed their data collection and cleaned up their work area, they were excused to return to the classroom section of his two-room lecture and lab set-up. Kent reminded these students of their other work, and continued to assist those students still collecting data. The atmosphere in both rooms were of trust and excitement to be doing science (BK.O.2).

Frank Johnson, a former student and current colleague of Kent’s, emphasized that Kent trusted and respected his students and they in turn did the same due to the relationships Kent built with each student BK.AI.2). In his own case, Johnson admitted, “At a young age, 14 years old, when was I really immature, I could pick up on the sense that he trusted me, and that Kent did this with all of his students regardless of their ability” (BK.AI.3). As Johnson indicated, both the students and community hold Kent in very high esteem (BK.AI.1-11).

Honors

Kent was selected to participate in this study because he was a PAEMST awardee, however, that is not the only award he has received (Table 4.3). Prior to this award he received the state’s Outstanding Biology Teacher Award, the state’s Academy of Science Outstanding Award, and several state industries awards (BK.A.1-2). After his selection as the state’s PAEMST, he was selected as his state’s energy center outstanding teacher, his state’s Teacher of the Year runner up (“not just for science but for my teaching” (BK.I.16), and inducted into his state’s science fair teaching hall of fame (BK.A.1-2).
But, as Kent remembers, the PAEMST was “probably my biggest highlight” (BK.I.16). He does not know who nominated him. Kent completed the application on his own. He did need to submit a video, so he told the principal about it and no one in the school even knew what the PAEMST was (BK.A.15). He told the principal he needed to be videotaped and brought in an old, large VHS camera and completed the application. The principal came to his room months later to congratulate him and traveled with him to Washington D.C. for the awards ceremony. While at the White House ceremony, Kent spoke with the President of the United States of America and remembered, “It’s pretty surreal when the President is sitting where you are, and you get to chat with him” (BK.I.15).

As Kent remembered, the awards “just kind of snowballed.” When he would receive invitations or nominations in the mail, he would “just send stuff in” and then he would be selected. As Kent wanted to explain, “It’s not that I’m this outstanding teacher. I just reaped the benefits of being a PAEMST winner. . .I am just blessed” (BK.I.16). One of these benefits was to be selected as one of the final 100 teachers (out of 9000 applications) for the NASA Network of Educator Astronaut Activities (NEAT) (BK.I.17; BK.A.3-4). He was delighted to remember that, “NASA even flew me in for an astronaut physical, two days of probing and prodding, only to be eliminated because I was too tall” (BK.I.17) though I had been allowed to participate in NASA NEAT regional and national conferences over a three-year time at their expense (BK.I.17; BK.A.4). During these years, Kent remembers NASA would call him, and ask when do you want to come down, and what’s your nearest airport, and they would send him his ticket, pay for all his
expenses, “Holy cow” Kent stated, “you know teachers are not used to being treated like that!” (BK.I.17).

**Behavior Over Time Graph**

Kent’s BOTG shows his continued excitement about teaching through his PAEMST and NASA NEAT program, before it begins to trend downward (Figure 4.4). He labeled his first five years as “survival” with a small trough before he began attending conferences, developing curricula and working on standards writing teams (BK.BOTG; BK.I.7-9). Although Kent stated that the PAEMST was “probably my biggest highlight” (BK.I.16), being his state’s teacher of the year runner-up was equally impressive; not because the award was for his science teaching but for his teaching overall (BK.I.16). The descending graph reflected leadership struggles in the Sutton school district, where Kent feels “the teachers have no voice” and the school board and administrators “do not

<table>
<thead>
<tr>
<th>TOY Runner-Up</th>
<th>Teacher Awards, Trips</th>
<th>*</th>
<th>PAESMT</th>
<th>NASA Teacher in Space (Superior Group)</th>
<th>Teacher Awards, Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Encouragement</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Leadership struggles...</td>
</tr>
<tr>
<td>Las Vegas, Philadelphia</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Leadership lows</td>
<td>*</td>
</tr>
<tr>
<td>San Francisco</td>
<td>*</td>
<td>Children in School...</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>BioTech Design Team</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Budget Cuts--no conferences</td>
<td>*</td>
</tr>
<tr>
<td>Lab-Based Curriculum</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Family changes</td>
</tr>
<tr>
<td>Survival :)</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>First Child Born</td>
<td>*</td>
</tr>
</tbody>
</table>

Figure 4.4. Brad Kent’s behavior over time graph includes the chronological year in the second row of numbers beginning with 1987. The row of numbers is the years he has
The descending graph reflected leadership struggles in the Sutton school district, where Kent feels “the teachers have no voice” and the school board and administrators “do not want to change anything because this is the way we’ve done things for 25 years” (BK.I.11). Johnson echoed this sentiment, calling it “educational complacency” and further indicated how it frustrates Kent (BK.AI.6). In one instance, one of Kent’s students went to the White House science fair and returned to the school district with a $2,000.00 award. The administration deposited this students’ award into the general fund (not even the science fund) and the principal did not even stop by Kent’s room to express his gratitude (BK.AI.5-6). Johnson seemed to further admire Kent for not becoming complacent with the lack of administrative leadership and innovation (BK.AI.6).

**Benefits of teaching in rural school**

*Autonomy.* Kent stated that the top two benefits of teaching in a rural school were autonomy and relationships (BK.I.12,14; BK.AI.3, 6; BK.A.3). Kent has had the freedom to design, implement, and teach the curriculum of his choosing since his first 3 years at Sutton, when he realized teaching was more than his textbook (BK.I.14). He has developed an outdoors classroom adjacent to the football field which he has used for 20 years to teach authentic biology (BK.I.6). Kent obtained his own bus driver’s license, so he can drive his students on field trips close to Sutton as well (BK.I.5).

*Relationships.* Kent values relationships with his students. This impressed Johnson (a former student and now current colleague) who had personally witnessed Kent’s investment in relationships with his students by asking how their day or week was going, talking to them about disappointments, and even using his own money to ensure students had a positive learning experience (BK.AI.2-3).
Kent spoke of the relationships he has built with his colleagues and the community when he may need materials for a lab or science project; he puts out an “all call” through the staff, email (BK.I.9-10). By way of example, Johnson explained that Kent may need balloons or soda cans and he tells the staff who then spread the word, and by the “next morning he has more than he needs” because “we help each other with needs in the classroom, because we are in the same boat” (BK.I.10).

Challenges of teaching in rural school

Professional development. While funding is a concern, Kent stated that his “pet peeve is having professional development in the school that is worthless” as he does not like wasting time-his or others. According to Kent’s preference, “If I want to become a better teacher I will go to science conferences or talk to other teachers (BK.I.11).

Funding for professional development that is relevant to his curricular area and for equipment and supplies is another challenge (BK.I.9). Johnson felt that Kent was on the cutting edge of teaching strategies and equipment because of his award opportunities, but the administration has not supported him financially (BK.AI.2). Kent’s “all call” system is one way he and his colleagues have mitigated this challenge. Community people donate time and things to help teachers offset the lack of funds (BK.I.9). By his own account, Kent sometimes purchases needed classroom items out of his own pocket to the tune of $100.00 a month. Having recently completed his taxes, Kent realized he had spent $1700.00 on school supplies the previous year (BK.I.9).

Administration. Kent believes institutional complacency leads to a school where teachers have little or no voice (BK.I.11) (BK.AI.6). This complacency maintains the status quo as change is not appreciated (BK.I.11). Kent feels the eight-period school day
is “too canned” (BK.I.11) especially when he leads an “inquiry lab-based classroom” (BK.I.11) but the administration and school board do not understand why it isn’t still a good model. According to Kent, his board and administration do not keep up with instructional advances (BK.I.11).

Kent was also troubled by the lack of diversity in a rural community, not necessarily in terms of race and ethnicity, but in the culture of the community (BK.O.3). As Johnson explained, “. . . in this rural community there is one set of values and one way of thinking” (BK.AI.3).

**Characteristics of resilience**

**Autonomy.** Kent deals with the challenges discussed above by teaching what he wants, how he wants, and when he wants, and adapting to the schedule the school district has established. He has the freedom to select his curriculum, no longer relies on textbooks (but uses them as references), and provides project-based, inquiry instruction for his students even though this pedagogy is not mandated by the district administrators and school board (BK.I.11).

**Adaptability.** Kent appreciates the opportunity for “shower” thinking (BK.I.4). As he explained, one has this kind of thinking while taking a morning shower and going over the day’s lessons. Shower thinking allows one to think of something else, or connect with an incident on the news, or situations (beyond his control) that will disrupt the school day. Shower thinking helps him finalize his lesson plans to accommodate current events, a student’s question, or even his own “I wonder” (BK.I.4). He says I am not “. . . that curriculum guy who has to be on page 71 by October 1st” (BK.I.4).
**Relationships.** Kent draws on his colleagues, the school staff, and the community to help meet his students’ learning needs. His “all call” system only worked because he and his colleagues are all in the same situation of needing supplies at the last minute or accommodating a change in plans (BK.I.9-10). He relied on the expertise of community people such as a “beekeeper guy who comes in and talks bees, a water testing guy who comes in, [and] an organic famer” who talk to his students (BK.I.9). His all call isn’t always for supplies but for local experts as well.

Johnson iterated the importance of relationships as he identified Kent’s ability to form personal connections with his students--to not just ask them how their day is going, but to really care about their answer (BK.AI.2). As Johnson explained, Kent listens attentively to each student as if that student was the star basketball player (BK.AI.2).

**Competence.** Kent’s project-based inquiry instruction methods prompted Johnson to teach social studies lessons that way as well. As Johnson stated, “Mr. Kent was doing that before it was popular” (BK.AI.3) and was “always on the cutting edge” (BK.AI.3) because of his professional development and self-reflective practices (BK.AI.7).

**Summary**

Brad Kent, as a nationally recognized teacher, realizes his strengths come from his love of science and teaching in a rural school system. He uses his science skills of inquiry to teach and to seek out ways to improve his teaching. The challenges of workload, funding, lack of teacher voice offset the benefits of free-wheeling opportunities for continuous learning resources and opportunities for himself and his students. His frustration with his first few years teaching, led him to pursue extensive
resources—people, conferences, programs, materials to improve his students learning environment and his teaching.

Kent was realistic about his students remembering content after they leave his classroom, so his driving goal is to instill a love of learning about their surroundings (BK.I.2). In so doing, he has established relationships with his students, colleagues, and community that provide him a support system for materials and equipment, expertise in areas outside of his own, and authentic learning for his students.

Kent’s adaptability and autonomy enabled him to overcome the challenges of rural teaching as well. His continual motivation to seek new ways to engage students enhances their learning and contributes to his competency as a teacher and as a scientist as well. His success and longevity in Sutton schools evidence his resiliency and desire to continue his own learning as well as that of his students.

**Cross-Case Analysis**

The four cases were analyzed through the lens of resiliency and comparing the benefits and the challenges of teaching in a rural school system. These four PAEMST winning teachers taught in four different schools each in a different state with their own set of standards, teacher expectations, and community differences. Yet, there are commonly shared themes running through their stories exemplifying their resilience and their successes, which have contributed to their longevity in these schools. One was RIFed early in her career, Sara Wymore, another just fought to survive those same first three years, Brad Kent, another left her first school when assigned nine different preparations, Rachel Lake, and the last one left a flourishing private business to teach,
Josephine Christof. Their behavior over time graphs provide a quick and yet detailed story of their teaching careers (JC.BOTG, BK.BOTG, RL.BOTG, SW.BOTG).

Individually, each case tells a story of success and longevity in rural schools, often as the only science teacher or as the only science teacher in their discipline, inspiring both their students and colleagues. Collectively, these teachers represent 124.5 years of teaching experience (Table 2), developing their own curriculum and implementation, innovation and problem solving to provide their students with up-to-date science technology, skills, and knowledge. Individually or collectively, these four teachers exemplify “excellence in science teaching,” which is why they were selected for this study.

It became clear that the lens of resiliency provided the best view for this cross-case analysis. From the perspective of resiliency, I linked teachers’ stories according to their behavioral characteristics. Common themes emerged during the initial data preparation as well as with the code sets used in MAXQDA (Appendix B). Through the conceptual lens of resilience, I identified links across their demonstration of adaptability and autonomy; reliance on the support of family, mentors and colleagues; and established resourcefulness. (Table 4.4). In addition, I related these behavioral characteristics as well as the benefits and challenges of teaching in rural schools to the two central questions and the three sub-questions guiding this study. For example, while autonomy is a resilience characteristic, the participants also used it as one reason they preferred teaching in rural schools, thus autonomy applies to resiliency and answers the question “Why do nationally recognized secondary science teachers stay in a rural school environment?”

Frequently, the stories illustrated more than one theme, such as Lake’s chemical storage
event: problem-solving, resourceful, connected, collaborative themes are all show-cased in that one incident.
Table 4.4. Resilient emergent themes from the four case studies. Numbers are frequency values from the first and second code sets (Appendix F).

<table>
<thead>
<tr>
<th>Resilient Themes</th>
<th>Josephine Christof</th>
<th>Brad Kent</th>
<th>Rachel Lake</th>
<th>Sara Wymore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptable/Flexible</td>
<td>14</td>
<td>4</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Autonomous</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Collaborative</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Competent</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Connected</td>
<td>23</td>
<td>16</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Problem-solver</td>
<td>18</td>
<td>7</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Resourceful</td>
<td>30</td>
<td>5</td>
<td>11</td>
<td>18</td>
</tr>
</tbody>
</table>

*Note.* The mentor code was combined with the collaborative code since working with their mentors, these teachers collaborated. Relationships and support systems were combined into the single theme of connected as both show connections to students, colleagues, community, and family.

**Resilient Themes**

**Adaptable/Flexible.** Kent’s shower thinking each day, reviewing his lessons and adapting to current events, nationally, regionally, or locally, exemplify adaptability (BK.I.9). All four teachers talked about the freedom to adapt to community issues or opportunities, such as Wymore’s invitation to bring students to a nearby archaeological dig, and she ended up bringing the entire high school (SW.A, SW.O.2). When Lake’s new superintendant removed her excessive storage cabinets, she adapted by having custom-built cabinets thanks to her community connections (RC.I.1-2). Christof was flexible when sharing a classroom for three years with a colleague who had a completely opposite teaching style (JC.I.5).

**Autonomy.** Freedom was commonly used by the participants to describe their ability to teach, while they all followed national and state standards, they were free to develop and implement their own curriculum as well as to teach using their own methods. The additional interviews with administrators or colleagues also emphasized that these
teachers’ autonomy was based on their strengths (competence) (JC.I.13; BK.I.11; RL.O.1; SW.I.4). They also used their freedom (e.g., adaptable and flexible) to adjust their daily schedules to accommodate guest speakers, to incorporate current science events, or as in Wymore’s case, to allow a student to work with the art teacher preparing an animal skin for taxidermy (SW.O.3).

**Collaborative.** Each of the participants talked about working with colleagues in their school, across their state, or even nationally, to improve their instruction and to provide more resources for their students. Wymore provided her students with authentic science research and projects, from taxidermy to ongoing federal science research projects due to her collaboration with colleagues and science researchers near Wesley (SW.O.2-3). Lake collaborated with a chemistry professor at the state university to increase the safety of her chemical storage, obtain equipment through a grant program, and work on professional projects over time which all contributed to reducing her isolation as the only one or one of two science teachers as well as increasing learning opportunities for her students (RL.BOTG). Christof’s ability to collaborate with grant-funding agencies provided much needed funding for her first school district and enhances her current teaching situation (JC.A.2). Kent as the only life science teacher, 7-12, in his district, reaches out across his state to collaborate with other biology teachers, serving on state standards and curriculum writing teams, and serving on several state science education advisory boards (KB.A.3-4).

**Competent.** Several examples of competency have already been shared regarding these four teachers. Their recognition as PAEMST winners speaks to their competency. Two are nationally board certified, one has their Ph.D. in a science content,
and all work with state science and or education agencies to improve science instruction in their states (Table 4.2) (SW.I.4, 7-8). These teachers not only decide what is taught in their classroom, they also decide how, when, and then develop the curriculum and lesson plans necessary to carry out effective instruction.

**Connected.** These teachers connect with their students, colleagues, the community they live in, and professional communities. Each have a story demonstrating their community support, such as Kent’s all-call when supplies are needed for a project, Lake’s superintendent who trusted her knowledge of chemical safety, Christof’s first school district giving her one of the laptops she had made possible through her grant-writing when she left that district, and Wymore’s ability to secure funding for her academic field trips (BK.I.9-10; RL.O.3; JC.I.22; SW.I.4).

**Problem-solving.** When Lake was faced with a new superintendent who did not understand the need for as much storage as she had, she used her connections to solve the problem of having storage cabinets removed from her room. Her relationship with the community, specifically with, a parent with construction skills, enabled her to replace the cabinets the principal removed and distributed to other classrooms. She was adaptable to this situation as well, instead of expecting the same chemical resistant counter tops, she managed with what was available, and adapted to the custom-built cabinets (RL.I.1-2).

Similarly, in Wymore’s district, the administration told the teachers that they would have to cut back or even stop with field trips. Using her problem-solving skills, she said that if a bus driver was sitting in a bus waiting on students, that driver could be waiting on her students as well. Her connections to the community as well as their respect for her competence provided her with the confidence to stand up for field trips that would
enhance student learning. Wymore also used her collaborations with federal and state scientists to justify the need for field trips. Her rationale for continuing field trips was accepted so much so that when she was invited to bring her students to an archeological dig near Wesley, she brought the entire high school, six busloads of students (SW.A, SW.O.2).

While Kent solved the problem of field trip costs by obtaining his bus driving permit, so he could “walk across the street and pick up a bus” to take his students into the field (BK.1.5). He could express the freedom (autonomy) to adapt his instruction daily, even hourly, as he did not have to request a driver and transportation to take his students outdoors on the spur of a moment.

Christof’s problem-solving skills complemented her resourcefulness in that when she needed equipment for her students or even her school district, she wrote grants for technology, an arboretum, and greenhouses, even to save the preschool at her first school district. She laughed, saying, “I write words and they pay me” to the tune of almost $1,000,000.00 (JC.I.22; JC.A.3).

**Resourceful.** From Christof’s grant-writing skills to her taking advantage of space in the district media center, her resourcefulness is evident in providing for her students and school (JC.A.3; JC.I.22). Wymore turns to her local and regional science agencies to provide authentic learning for her students (SW.I.4). Kent realized he could provide authentic learning for his students if he could take them out into the field, so he obtained his bus driver’s endorsement (BK.I.5). Lake replaced the removed cabinets by turning to her parent connections (RL.O.2).
These resilience characteristics in each of these teachers presented in a variety of ways led these teachers to remain in the rural school districts and communities they thrived (JC.I; BK.I; RL.I; SW.I).

Benefits themes for Teaching in Rural Schools

Common emergent themes of the benefits of teaching in a rural school include autonomy and relationships (Table 5).
Table 4.5. Emergent themes regarding benefits of teaching in rural schools. Numbers are frequency values from the first and second code sets (Appendix F). These values were taken only from the benefit codes.

<table>
<thead>
<tr>
<th>Emergent Benefit Themes</th>
<th>Josephine Christof</th>
<th>Brad Kent</th>
<th>Rachel Lake</th>
<th>Sara Wymore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy/Freedom</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Relationships</td>
<td>5</td>
<td>7</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(Students)</td>
<td>(Community; Colleagues; Students)</td>
<td>(Community; Colleagues; Students)</td>
<td>(Community; Colleagues)</td>
</tr>
</tbody>
</table>

**Autonomy/Freedom.** Autonomy in the classroom, the freedom of curriculum development, the freedom to choose what, when, and how you teach, the lessons, outdoor activities, field trips, every non-fiscal aspect of their instructions was their responsibility (JC.I.14; BK.I.12, 14; RL.I.2-4; SW.I.3-4). Christof and Lake are somewhat restricted with their dual enrollment courses as those curricula are prescribed by the private universities and their school districts’ matriculation agreements; however, they are free to teach in their own classrooms as they choose (JC.I.14; RL.I.1).

**Relationships.** These teachers identified relationships with students, colleagues, and community people as a major benefit of teaching in a rural school district and community. Wymore could provide authentic science instruction by reaching out to local scientists; her students sampled waters and monitored small mammal population on federal lands, assisted the state game and fish agency with their annual Bighorn sheep survey, and learned about wildfire science from a hotshot crew in town (SW.I.4, 7-8; SW.A).

Student feedback was a strong component of relationships with students. Wymore talked about inviting former students to talk with her juniors and seniors about post-
graduation, whether it be college, vocational schools, armed forces, or careers, the students will listen better to those closer to their age (SW.A.I2). Christof fondly recalled the school days before holidays when former students will drop to visit with her, thank her for preparing them for college, and share stories with her. In one instance, a student was proud to say she was the only one to raise her hand (JC.I.9) when her college biology instructor asked if anyone knew about the micro pipette she was setting up. This story gave rise to shared memories of their high school lessons in biotechnology and genetics that Christof and a retired medical doctor taught (JC.I.8).

**Challenges of Teaching in Rural Schools**

While there are common challenges mentioned by the participants in this study, it should be noted that when I reviewed their BOTGs, there are more peaks and plateaus than there are troughs (BK.BOTG; JC.BOTG; RL.BOTG; SW.BOTG). Their resilience provides them with the confidence to problem-solve obstacles and to enjoy the benefits of their teaching environments. A wider variety of challenge themes reflects the individuality of these teachers. All themes are listed in Table 4.6; however, only on those unique to these four teachers and their rural environment will be discussed.
Table 4.6. Emergent themes regarding challenges of teaching in rural schools. Numbers are frequency values from the first and second code sets (Appendix F). These values are from the challenges code only.

<table>
<thead>
<tr>
<th>Emergent Challenge Themes</th>
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<td>Funding</td>
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<td>Professional Isolation</td>
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<td>5</td>
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<td>Teaching Assignment</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Diversity.** This was expressed as a concern with the culture of the community, and not in the sense of ethnicity and race. Frank Johnson, a colleague of Kent, felt there was an inhibition to different cultures or set of values as in Sutton, there was one set of values, “rural way of life” and “one way of thinking” (BK.O.3). Wymore also brought up the lack of diversity with the town and school district being primarily Caucasian, restricting her students outlook and experiences beyond the town of Wesley. She mentioned that some of her students had never traveled further than a 100-mile radius of town (SW.I.6). Christof’s principal was more concerned about the economic diversity than racial or cultural diversity, as population growth was stagnant, if not decreasing which impacted economy. When three large manufacturing companies closed their doors, the student percentage of free and reduced students increased from 17% to 55% over the last 15 years (JC.AI.8). Lake’s concern with diversity relates directly to the science teaching staff, that is being the only science teacher, 7-12, or the only teacher of a specific science content which led her to leave her first rural school district (RL.I.3).

**Funding.** Two of the four teachers had adequate funding, but the distribution of that funding was of concern. When Lake first came to the Dover school district her
annual budget was $10,000.00; however, 13 years ago, the new superintendent who thought she had too much storage space also reduced her budget to $2,300.00 (RL.I.3). Distribution of monies was the problem with Christof; for the first years at Monument high school, each science teacher received the same budgeted amount. However, one year, the principal asked the teachers to budget for what they needed to teach the following year, Christof’s request was higher than her colleagues (JC.I.19-20). She fortunately, has supplemented her district budget with grants to the tune of almost $400,000.00 (JC.A.3).

The other two teachers discussed the decrease in funding overall within their school district. At the time of their interviews, their instruction had not been negatively impacted. Wymore was faced with decreased or no field trips, but with community support, has continued her academic field trips (SW.I.4). Kent obtained his bus driving endorsement to offset those costs (BK.I.5).

**Professional Isolation.** While three of the four teachers identified professional isolation as a concern, the fourth teacher, Christof, obtained her master’s degree and Ph.D. taking online classes during her first 10 years of teaching; she can reach out to colleagues electronically, and is one of 5 science teachers (JC.I.7-9). Lake reached out to her state’s science organizations and served in leadership roles; after her PAEMST, she served on a national science education’ board and council as well (RL.I.1; RL.AI.4; RL.A.2). After Kent went to his first conference and realized he needed to change his teaching style, he fed his professional development needs by attending any science conferences, workshops, regionally and nationally, he could find, even after his school district quit supplementing travel funds (BK.I.1,4, 9, 12). Wymore attends state science
and agricultural education conferences, courses, workshops, and assists with instruction for her states’ outdoor education programs for her professional connections; occasionally she has had the opportunity to attend national conferences, but her mainstays are within her state (SW.I.8, 10; SW.O.3).

**Teaching Assignment.** Science teaching requires the setting up and taking down of laboratory equipment, ensuring the students are safely working, and time. Multiple courses with their preparations are common is rural schools, but in science it can be challenging. After five years of teaching, still a novice, and head coach of two sports, Lake was assigned nine preparations, including German; that was a breaking point, and she left that school district (RL.BOTG; RL.O.2); in her current teaching position, she has two courses and two different preparations but with an extra planning period as one is a dual enrollment course. Christof teaches dual enrollment science courses as well, 3 each semester and does not have an extra planning period. She can just keep up with it because of her experience and small class sizes (JC.I.14). Christof said that she could not teach any more courses and still deliver quality instruction for her students (JC.I.14).

**Summary**

All four teachers loved science before they became teachers. Avocation was one of the MAXQDA code terms (Appendix B) based on their love or passion for science learning when they were young and their continued passion for science. Each teacher told at least one story of their passion for science or outdoor explorations: from grandmothers who loved exploring outdoors (JC.I.1), to growing up in the country around horses (RL.I.5), to agriculture and science teachers in high school who encouraged her passion for biology and wildlife (SW.I.1), and to fascination with bugs as a young child (4 years
old) when she started her first bug collection, gluing the bugs to cardboard which freaked out her mother (JC.I.4). Their enjoyment of science manifests itself through their longevity in the science classroom and their successes (Table 4.2; Table 4.3).

These four nationally-recognized science teachers share common themes in their teaching careers, although the expression of these themes is unique to each of them; their individual differences are discussed in their separate case study sections. Their students reap the rewards of these teachers’ successes, their autonomy, adaptability, their resourcefulness, and the students are part of the support system that sustains these teachers as well.

While the two central questions and three sub-questions will guide the discussion in chapter five, I can begin to understand why these teachers have stayed in a rural teaching environment: autonomy, relationships, and their own successes.

How these teachers describe their own successes and longevity becomes evident as well. They describe their own success through their students: the ability to provide authentic science experiences, preparing the students for their future careers, and they barely mention their own successes. I had to specifically ask about their PAEMST experience to find out how that affected their careers. While all have received numerous other awards as well, their ability to meet their students’ needs is how they describe their successes. They describe their longevity simply by saying they love science, they love teaching, and they could not imagine doing anything else.

Individual strengths included resourcefulness, problem-solving, and self-efficacy. As these teachers successfully overcame career challenges, they became more confident and were recognized with the Presidential Award for Excellence in Mathematics and
Science Teaching (as well as numerous other local and regional recognition of their excellence). Their relationships within their communities, professionally and personally, provided support for their professional and personal needs as they provided the same support for their students, colleagues, and families. Beyond the city lights --far from the regimen of district-mandated curricula, easy access to science teaching supplies, and readily available professional development--these teachers exemplify lives well taught.
CHAPTER V
Summary, Conclusions, Future Research

Summary

The news media keeps us in the know about teacher shortages throughout the United States (Partelow, 2015; Phillips, 2015). To date, most researchers have focused on the specific shortage-related problems of recruiting and retaining novice teachers (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2008; Falk, 2012; Gray & Taie, 2015). Some researchers have reviewed unique, teacher shortage problems in rural schools. These researchers have described rural schools as poorly funded, inadequately staffed, and unable to meet the professional needs of their teachers or the academic needs of their students (Monk, 2007; Goodpaster, Adedokun, & Weaver, 2012; Thomas & DeVore-Wedding, 2016).

If the working conditions in rural schools are less than ideal, then why do teachers stay? Why do rural science teachers stay in rural classrooms? How do they manage the isolation and shortage of resources? It seems some science teachers who choose to stay in rural schools also thrive. In fact, some rural science teachers have received distinctive science teaching awards at the national level, such as the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST) recipients. How do these teachers not only persist but gain recognition as award winning teachers?

In this study, I sought to understand why PAEMST awardees stay in rural schools and how they describe their success and longevity in rural schools. Criteria for participation in this study included residence in Nebraska or a contiguous state, receipt of
a PAEMST award, currently teaching in a rural school, and ten or more years of teaching experience in rural schools.

Four of eight potential teachers identified as rural, secondary science PAEMST awardees, agreed to participate in this study. Each of the four teachers resided in different states within region defined by Nebraska and its contiguous states. These PAEMST awardees service ranged from 21-to 44.5 years. These teachers have remained in the same rural region for the duration of their careers.

A critical lens of resilience provided a framework for viewing their career histories in terms of overcoming any challenges common to rural schools: geographical, personal and professional isolation, lack of fiscal and physical resources such as insufficient equipment (safety and other), demands on time with teaching multiple science and other classes daily, and lack of relationships with colleagues, administrators, students, (Hadfield, 1992; Barrow & Burchett, 2000; Harmon, 2001; Goodpaster et al., 2012; Avery, 2013).

Gibbs and Miller (2014) found that teachers need more than persistence to succeed and remain in these schools, and resiliency explains this phenomenon. As Bobeck (2002) explained, resilient teachers overcome these obstacles by mitigating the isolation through professional engagement, connecting with the community (both personally and professionally), and developing collaborative relationships with colleagues. Research has shown teachers with strong self-efficacy as well as strong altruistic characteristic can develop strong resiliency as well as the ability to increase their resiliency over time (Malloy & Allen, 2007; Beltman et al., 2011). Given this perspective, resilient teachers are known as happier and more effective as teachers (Gu &
Day, 2007; Beltman et al., 2011; Pretsch, Flunger, & Schmitt, 2012). One rural school that adopted a resiliency culture increased teacher retention and reported that their teachers expressed satisfaction in their teaching assignments, felt valued as employees, and wanted to continue their employment in that district (Malloy & Allen, 2007).

A multiple-case design provided the opportunity to collect a variety of data, which allowed for a deeper, richer interpretation of the participants’ stories. Each case study was bounded by setting (rural school systems); by time (as all participants had 10 or more years of experience teaching in rural schools); by context (all participants were secondary science teachers). A replicative process organized sequenced data collection which included a behavior-over-time graph (BOTG), an initial interview with the participating teacher, an additional interview with a colleague or administrator, and classroom observations. After the observations, a follow-up discussion with additional questions occurred.

The interviews and field notes were transcribed and coded using the software, MAXQDA. Code sets were derived from the literature on education, resilience, rural teachers, and retention (Appendix F). Additional words and phrases that re-occurred during the interviews and transcription process helped to initiate additional codes. After coding with the original code set of 25 terms and phrases, a second code set of 48 more terms and phrases was added to differentiate personal and professional events, expand benefits and challenges categories, and to separate relationships into administration, colleagues, community, and family (Appendix F). The two code sets were merged for data analysis of the individual cases, cross-case analysis and interpretation of findings in this chapter.
This research tells the story of how four exemplary teachers have chosen to lead long, successful careers in rural schools. These teachers turned to their community (family, parents, local businesses, and local/state/federal agencies) to overcome the challenges of limited resources (both physical and fiscal) referenced by Monk (2007) and Oliver (2007). These teachers came to understand their communities, what their communities valued, and adapted their instruction to utilize available, community resources to meet students’ learning needs. Their ability to collaborate and cooperate contributed to their acceptance within their school’s community. Their ability to adapt and problem solve also contributed to their success in securing funds and equipment as well as experts to assist their students’ learning. These resilient behaviors contributed to their longevity and recognition as excellent teachers (Malloy & Allen, 2007; Bobeck, 2002).

The following section provides an overview of each of these cases and the individual teachers in this study.

**Sara Wymore**

Wymore began her education career as both an agricultural science and a science teacher: enthusiastic and excited to be in a rural community. Within her first years, she married into an established local farming and ranching family (SW.A.1). Three years in, she was RIFed, which she described as “devastating.” However, her additional comment, “. . . the principal brought us in that afternoon and said don’t worry, I will take care of you . . .” tells the deeper story. When he didn’t speak up at the school board meeting that night as she was RIFed, she felt betrayed. When you look at Wymore’s BOTG (Figure 4.1), this incident is the only trough. That administrator’s betrayal colored her
relationships with future administrators, particularly principals. By way of example, she
did not let her administrators know she had been and had applied for the PAEMST
(SW.I.4).

During the four years, Wymore was not teaching, she took advantage of
opportunities to connect with her community, personally and professionally. She took-on
substitute teaching opportunities which included a long-term position in the school
district, taught an agricultural economics course at the local community college for a
professor on sabbatical, worked at local horticultural business, and she devoted time to
her growing family.

Wymore’s community connections proved valuable to her when she was re-hired
as one of the high school’s science teachers, where she continues to teach today. She had
connected with local, state, and federal agency scientists which provided opportunities
for her students to participate in science projects. She had also connected with
community members who now support her students’ educational endeavors outside of the
classroom.

Wymore “loves science” (SW.I.1) and the freedom she has designing her
curriculum, implementing her own lessons, and providing real-world science
opportunities for her students. While her PAEMST award was a career highlight,
allowing her to travel and present at a national science conference, local recognition of
her successful teaching brought more pride in her voice when she spoke of her two
teacher-of-the-year awards from state science agencies. These were the people she
worked with over the last 28 years, these awards meant her acceptance into their
community of science researchers and educators. Her love of science, extends beyond
her students as shown when she was invited to bring students to an archaeological dig, and she arrived with the entire high school population. This demonstrated that her administration supported her and her connections to local science agencies for student learning opportunities (SW.O.2).

The benefits of designing her own curriculum, the freedom to teach it as she chooses, and the ability to bring the real-world of science to her students far outweigh the challenges of funding and the lack of diverse opportunities. The respect the community has for her knowledge provides the necessary capital to continue her students’ field trips, and provides the support her students’ gain from working with local and state science agencies.

**Rachel Lake**

Rachel Lake grew up in a rural community and school system. Her grandmother and two high school science teachers fueled her interest in science and encouraged her to become a science teacher. After student teaching in an urban school system, she knew she wanted the challenge and variability of teaching in rural schools.

Lake loves teaching and welcomes the challenges of inspiring students to attain their potential and stimulating herself to improve her teaching. In this, Lake values her students’ feedback and models the behavior she expects of her students and colleagues; has high expectations but believes in helping one to achieve those expectations and potential. Her respect for her students is reciprocated by their respect for her as a person and as their teacher.

She thrives in a rural school system where she has autonomy to design and implement her own curriculum, designed to maximize student achievement. Her ability to
collaborate, to work with others, and to seek out opportunities beyond her community all contribute to her success and longevity. She has established her “track record” with the community she serves and is able to benefit from that capital (RL.I.6).

Handling the chemical fire on her first day at the school she currently works in with the support of her principal and her former high school science teacher, provided her support that led to collaboration with a professor at the state university (RL.O. 3). Not only did it help her own content and pedagogy, she was able to work with teachers across her state. She developed a professional community beyond her small school district.

Receiving the PAEMST increased Lake’s confidence as did the principal’s support she received at that time. Lake benefited from her increased confidence as she went on to complete a master’s degree, her national board certification, and eventually serve on a national science education council. Her professional support community not only extended beyond her community and state, but became national. When a new superintendent challenges her need for storage area and cabinets, she responds confidently with custom-built cabinets, provided by one of her community advocates. Hansen, former student who is now a colleague, sums up Lake’s success and longevity by focusing on Lakes’ confidence—she is not afraid to speak up for what is right, using data to support her concerns. Lake also supports her colleagues and students alike, expecting them to attain their full potential. Lake herself was proud that in her 44.5 years of teaching, she only had three students repeat any of classes due to failing. She believes her students and colleagues will be successful and will do what is necessary to help them help themselves. She sees their success as a reflection of her own success.
**Josephine Christof**

Christof overcame several challenges to become the award-winning teacher she is today. She ended a private business due to physical health issues and returned to education, for herself first as a student, and then for her students as a teacher (JC.I.7; JC.BOTG). To whet her appetite for learning she also earned two graduate degrees in science, which helped to develop her research skills as she challenged herself to push beyond her own knowledge (JC.A.1; JC.BOTG). She was confident that her own experiences as a student (taking the same risks that she asks of her students) improves her teaching and their learning (JC.I.26).

Christof utilized her writing and problem-solving skills to procure grants to supplement equipment and materials, not just for her classroom and students but for her science colleagues and their students (JC.I.22-23, JC.A.2). While at her first small, rural school, she wrote a technology grant to bring the school district, K-12, into the 21st century, and to enrich her students’ learning opportunities (JC.A.2). She also secured funding to keep the preschool program in this district as well (JC.A.2). She has written grants for the science department and specifically for her classroom at Monument High School. With administrative support, she has written grants to the tune of almost $1,000,000.00 between the two school districts she has taught (JC.A.3).

Christof’s numerous awards and grants are a testimony to her teaching ability. Her own abilities have provided her with success in teaching and weathering the challenges of teaching in a rural environment. While the awards speak volumes of her own ability (Table 4.3), she firmly believes that it is the students that make teaching
worthwhile (JC.I.24). Her ability to adapt to a new career path opened teaching and learning opportunities for herself as well as for her students.

**Brad Kent**

Brad Kent, suspects his notable strengths come from his love of science and teaching in a rural school system (although that wasn’t were he intended to spend his future career when he began college). He began college as a pre-med student but was not satisfied with the internships (feeling that science and discovery were being overlooked for fiscal gain) (BK.I.2). After a one-year stint of teaching English in an Asian country, he knew he wanted to teach science (BK.I.1).

As Kent explained, he followed his own curiosity and science skills of inquiry to teach and to seek out ways to improve his teaching (BK.I.1). The challenges of workload, funding, lack of teacher voice have been offset by the benefits of life-long learning daily in his classroom and opportunities for professional development. Early frustration in his first few years of teaching, led Kent to find resources—people, conferences, programs, materials—he could use to improve his students’ learning environment and his own teaching skills (BK.I.1, 4).

Kent learned to be realistic about his students’ content memory as he came to expect instilling a love of learning in his students (BK.I.2). In so doing, he has established relationships with his students, colleagues, and community that provide him with a support system of resource materials and equipment, expertise in areas outside of his own, and authentic learning opportunities for his students (BK.I.5; BK.O.1).

Kent’s adaptability and autonomy help him to overcome the challenges of rural teaching. His continual motivation, to seek new ways to engage students, both enhances
student learning and contributes to his competency as a teacher and as a scientist. His success and longevity in Sutton schools are the result of his resiliency and desire to continue his own learning as well as that of his students.

Conclusions

This multiple case study was guided by the central questions “Why do nationally recognized secondary science teachers stay in a rural school environment?” and “How do nationally recognized secondary science teachers, who have taught in a rural setting for at least 10 years, describe their own success and longevity?” The additional sub-questions provided a platform to dig deeper into these teachers’ career experiences:

1. How do these teachers describe any challenges to their success and longevity?
2. What are the common, emergent themes related to success and longevity of the participants?
3. What are the unique, individual themes related to the success and longevity of each of the participants?

These research results are described in the following section.

1. Why Do Rural PAESMT Teachers Stay in Rural Schools?

To answer question one, I identified two consistent themes of resiliency (Table 4.4) that exemplified these secondary science teachers’ satisfactions with rural school settings and why they stayed.

Autonomy. These four teachers identified themselves as highly autonomous. As they explained, freedom to design, develop, and implement their own curriculum was paramount. From Wymore (who takes her students into the field to collect data for government science agencies) to Kent (who has developed an outdoor classroom where
his students are restoring indigenous prairie fauna and flora) they prefer authentic, place-based and project based instruction for students’ learning. Christof and Lake both teach dual enrollment courses where the students receive both high school and college credit (JC.I.14; RL.I.1). These semester-long college courses (taught over two-high school semesters) come with specific curricula expectations but also allow these teachers the freedom to add more laboratory experience to enhance the lecture component of the courses. Christof took the opportunity to write grants to supplement district funding because there were no district funds. Her financial outreach prevented the preschool from closing at one school; provided computers for her students; and even built an industrial greenhouse for students’ projects (JC.A.2-3). All four teachers used their state’s science standards as guidelines for instruction but also incorporated local community resources for authentic learning opportunities. Feedback from students (current and past) colleagues, and community continued thoughtful revisions and extensions of their curricula, lessons, activities, and instruction.

**Connections.** Relationships, personal and professional, sustained these PAEMST teachers in their rural schools and communities. Two teachers married into local, established families within their community, which could explain why they stayed, however, that wasn’t the reason they stayed in education and continued to teach locally. Wyomore laughed when she explained “[I’m] pretty well stuck here but part of that is my choice too” (SW.I.8). She loved being involved in her family farm, helping with 4-H, connecting with the local science agencies, and bringing all her experiences to her students to extend their connections beyond their colleagues in the school district. Lake married after she began teaching in her current school system, but her husband was also a
teacher in the same system (RL.I.4). Together they coached, taught, and built their respective teaching careers. Their combined connections to the community provided even more resources for Lake’s instruction and consequently support within her community (RL.I.5).

In summary, the PAEMST award-status helped to connect these teachers with science communities at the local, regional, and national levels. These supportive professional organizations provided much needed collaboration and support that assisted her through some difficult times. Lake’s involvement in her state science association led her to serve on a national science organization’s council; the teachers she met and worked with rejuvenated her and encouraged her to continue teaching despite administrative changes at her school.

Through Wymore’s connections with a state science agency, she was introduced to Citizen Science programs that complemented her teaching style and gave her ideas for future student projects (SW.O.1). The opportunities these teachers found were translated into opportunities for their students, which were as important to them if not more important than their own professional benefits.

2. How Do Rural PAESMT Teachers Describe Success and Longevity?

Regarding question two, I identified four consistent resiliency themes (Figure 4.4) that organized these secondary science teachers’ designations of success and longevity in rural school settings: autonomy, competence, connected, and resourceful. Their own curiosity provided a foundation for their learning and desire to provide the same excitement to their students, but their continued learning and growing success (linked to collaborations with colleagues, local science agencies, and state universities) provided
professional growth for these teachers and authentic learning for their students. These support systems enabled rural PAEMST teachers to overcome professional and personal challenges.

Adaptable and collaborative are two resiliency skills that I find are a running thread through the themes I discuss separately (Table 4.4). That is adaptable is a component of resourcefulness, collaborative, autonomous, competent, and a problem-solver. Collaborative is also a component of competent, connected, resourceful, and a problem-solver. These teachers adapted to their communities, their school district and its changes over the years, as well as changes in education. They adapted their instruction to their communities and students. Adaptation contributes to their autonomy, competence, connections, and resourcefulness. Collaboration is expressed through their connections and resourcefulness, but is also present within their autonomy and competence. Therefore, I have not discussed these two themes separately.

**Autonomy.** The freedom to develop their own curriculum, to be able to adapt to current science events, and to bring in community and student interests also was a strong common theme among these teachers. The “shower thinking” of Kent which often took him away from the planned lesson to bring in a recent event within the school or community (BK.I.9). Similarly, Wymore had to bring not only her students but they entire high school student body to an archaeological dig for their learning opportunity (SW.A; SW.O.2).

Lake enjoys the variability of teaching several different courses instead of six sections of one course based on one preparation (RLBOTG; RL.O.2). She appreciates the
challenge of several preparations if there are not more preps than there are classes in the school day (RLBOTG; RL.O.2)!

Christof’s grant-writing ability provides her with materials and equipment beyond regular budgetary items (JC.A.2-3; JC.I.24). She can provide her students and her science colleagues with current technology and authentic learning opportunities that students at larger schools or schools closer to research institutions have due to their location (JC.I.24).

**Competence.** Accumulating awards built confidence and validated rural PAEMST teachers teaching efforts and thereby contributed to their sense of competence. Lake turned to a mentor in time of uncertainty when dealing with the chemical fire; his belief in her ability to teach chemistry safely gave her the support she needed to go back and teach chemistry that year (RL.O.3). This same mentor introduced Lake to a professor at the state university; this connection increased her confidence as she not only took classes from the professor but also collaborated with him on grants, research projects, and professional development for teachers in her state (RL.O.3).

Students helped to define these rural PAESMT teachers’ sense of competence—largely since all identified students as the reason they continue to teach. Their respect for their students, as learners and persons, was evident in their endeavors to define multiple learning opportunities for their students. Christof anticipated holiday visits from her former students; their stories of their experiences at school or work, validated her own teaching efforts and informed her of possible changes to her content or instruction that would help future students success in college or the workforce (JC.I.8-9).
Connected. Each of these teachers described the personal and professional importance of their support systems and communities. Their relationships with colleagues, local science agencies, professional scientists, professional science organizations, their own families, and the parents of their students provided learning opportunities (for their students and themselves), collaborative opportunities, and materials to enhance their curriculum (both instruction and assessments).

All four PAEMST teachers identified mentors before or after they started teaching. These mentors encouraged and provided them with confidence to become the teachers they have become. Wymore went into science teaching at the suggestion of her high school agriculture and science teachers; as she struggled to meet her pre-veterinarian course load, competitive swimming training, and substitute teaching to support herself through college, they encouraged her to become a teacher (SW.I.1). Kent sought out mentors at state science conferences and workshops after his first years of teaching, because he was sure he was a horrible teacher (BK.I.4). His success at connecting with state teachers of the year encouraged him to continue reaching out to other teachers and opportunities for professional development (BK.BOTG, BK.A.1-6). Lake’s mentors included her high school science teacher and a university professor as described above (RL.O.3); and after receiving her PAEMST, she stayed connected with her cohort as she began building her professional learning community (RL.O.1). Christof’s primary mentor and role model was her high school physics teacher, who himself was an award-winning teacher as well (JC.A). Throughout her own years as a student and then as a teacher herself, she relied on his advice and assistance with her education and then her teaching (JC.I.5).
**Resourceful.** Their own desire to improve their teaching skills and content knowledge provided the springboard to connect with experts in a variety of fields which led to collaborative ventures for themselves and their students. They recognized their deficiencies and used that to seek out professional development to supplement gaps in their own knowledge (JC.I5; BK.I4; RL.O.3). While they were seeking out learning and student opportunities, they were also sharing their knowledge with others, again building a professional support system to offset being the only science teacher in their content or the only science teacher at all. For example, Lake presented workshops within her state with Dr. G at the state land-grant university as well as presenting at regional and national science conferences (RL.BOTG; RL.I.3). Christof provides information regarding science fair, science research, and science education pedagogy at state science conferences and meetings (JC.A.3-6).

Day-to-day operations also required these teachers to be resourceful. Kent initiates an “all call” through his school’s secretary for materials for lessons or even local experts to come to his classroom to enhance instruction (BK.I.9-10). Lake used her community connections to replace cabinets taken from her room by a new superintendent (RC.I.1-2). When Wymore’s principal suggested they would have to cut her field trips due to lack of funds, she also turned to the school board and community connections to ensure there was funding for her academic field trips (SW.I.4). Christof’s writing skills and professional contacts provided her an avenue for funding via grants (JC.I.22-23).
2a. What Common Themes Defined Success Challenges for Rural PAESMT Teachers?

While these rural PAESMT teachers experienced disappointments over the time of their careers (such as RIF policies and the betrayal of a principal or a parent), they identified few deep troughs in their BOTG. Rather, these teachers’ BOTGs show more peaks, plateaus, and rising slopes than troughs or decreasing slopes. Wymore’s colleague summed it up nicely when she said that, for Wymore, “…a challenge is like one more learning opportunity” (SW.AI.5). The data suggest, this could have been said about any of the four teachers as well.

Wymore used her years (between full-time teaching employment) to connect to her community and to care for her family (SW.BOTG; SW.I.10). Lake found a common interest with the parent sent to observe her which resulted in support that she could depend on later in her career (RL.O.5). Christof wrote grants to overcome lack of equipment (JC.A.2-3). Kent connected with his teacher association to improve the voice of teachers in his district (BK.I30). For these teachers, challenges became opportunities to problem-solve and move forward via a different route.

Using their research skills and their support systems, these rural PAEMST teachers sought out information and provided answers to challenges, and often shored-up their colleagues’ school districts with their found solutions. To be certain, these rural PAEMST teachers did not linger with the challenges: our discussions focused on the peaks of their careers and included only brief mention of a few troughs or challenges.
2b. What Common Themes Defined Success for Rural PAESMT Teachers?

The common, emergent themes are found in Tables 4.5 and 4.6. Autonomy and relationships (support systems) were identified by all four participants as the benefits to teaching in rural schools. Their freedom to teach their own curriculum their way, following their own timeline was dominant in the discussion of their success and longevity in rural schools. Kent spoke at length about how he could not teach in a school system that was so scripted that he would have to teach the same thing on the same day as all of the other biology teachers in a larger district. His “shower thinking” was one strength that allowed him to adapt his teaching to current community events (e.g. using a basketball game loss as a discussion starter the next day in class) which he did not feel he would have been able to do in a larger school system (BK.I.4).

Both Christof and Lake emphasized multiple preparations, the challenge of teaching more than one preparation six times a day, which Lake essentially said would be boring; “. . . and if I was bored, so would my students” (RL.I.3). Christof liked multiple preparations as it provided more learning opportunities for her students and she could connect the basic science content that was found in all the sciences, providing a science foundation as much as a content foundation (JC.O.22).

All four teachers loved science, being outdoors, exploring, and following their curiosity (BK.I.2; JC.I.7; RL.I.2; SW.I.1). They based their teaching on encouraging and maintaining that same love of science or at least learning in their students. After Kent’s first few years of teaching science, he realized he needed to do better (BK.I.4). He connected with an award-winning science teacher at a state science conference, and learned from him that his own love of learning and science needed to shine through, and that was when his teaching changed as well as his students’ success (BK.I.4-5).
Community relationships provided support and encouragement which contributed to their success and desire to stay in their current schools and community. Even with administrations that did not listen to the teachers’ voice (BK.I.12, BK.A.8), the collaboration and support of their personal and professional communities helped to balance these teachers’ careers. Kent’s “all call” to the community for materials needs in the classroom (such as liter bottles, or egg cartons, or even experts to come share with his students) showed his dependence on his community and their support of his teaching (BK.I.9-10). Wymore’s advocacy for academic field trips when budget cuts were being discussed (SW.I.4). She went to her community support systems to ensure her field trips and authentic learning opportunities were not cut by administration. When Lake’s chemical storage cabinets were removed and allocated to other classrooms by a new superintendent, she turned to her relationship with community parents for replacement cabinets (which were customized according to her specifications and needs) (RL.I.1-2). Christof’s trusting, respectful relationships with her students provided her with feedback to improve and validate her teaching and directed her methods of student-centered, hands-on learning opportunities (JC.I.29).

3. What Unique Traits Defined Success and longevity of each participant?

While there were similar common themes, there were also unique emergent traits for each teacher (Table 4.6).

Kent’s discontent with his own teaching led him to seek out meaningful professional development to improve his instruction and students’ learning. Kent felt the professional development provided by his school district was inadequate, especially his first few years of teaching (BK.BOTG) and especially for a science teacher. His own
enthusiasm for science was not coming across by the traditional lecture and cookbook lab experience he was giving his students. His frustration led him to state science conferences and workshops where he connected with award-winning” teachers; so, 27 years ago, Kent initiated his own professional learning community which extended beyond his classroom to include other high school teachers, instructors at higher education institutions, and science business organizations (BK.I.3-4). His teaching changed to student-centered, project-based instruction and not only did he become more engaged, so did his students. Kent stated that his main goal was to instill the love of learning in students as they probably wouldn’t remember much of the science unless they went into a field of science themselves (BK.I.4).

Christof pursued advanced degrees in science content areas which could have led her from the classroom, however, she knew teaching was where she was meant to spend her professional time. Christof turned down employment with a science industry that would have paid her more than twice what she makes as a teacher, but she said, “I knew I was meant to be in the classroom” (JC.I.10). She continued with, “Students are the reward for putting up with it [decrease of respect for teachers and teaching profession, lack of collegiality, funding, etc.] (JC.I.22).

Wymore benefited from the support of her community and family. Her distrust of administration was replaced by the support of her husband and his family, as well as the community she connected with during her RIFed years. Her pride of the family business and her husband was evident when we ended our first interview, she said, “and how many science teachers do you know have their own fur coat?” showing me her beautiful coyote pelt coat, that her husband had made for her (SW.I.11). Her confidence came
from the validation from her community, personally and professionally, and she wore it well.

**Limitation of the Study**

As a former secondary science teacher in a rural school, I attended to limiting imposition of my own experiences onto these rural PAEMST teachers’ stories and experiences. Although, during each interview, I identified with many of challenges and benefits these rural science teachers described. While listening to their words gave me the opportunity to reflect on my own experiences, it also allowed me to remove myself from my own past and focus on their experiences, especially as we reviewed their BOTG and explanations of the peaks and troughs. The similarities brought smiles to my face; the differences intrigued me and pushed me to look with an unbiased eye to their unique situations.

Qualitative research covers an array of interpretative techniques which allows the researcher to describe, decode, or otherwise explain the meaning of naturally occurring phenomenon in the world (Merriam & Tisdell, 2015). A multiple-case study provides the opportunity to collect more data [which may allow for a deeper, richer interpretation of the participants’ experiences (Yin, 2014)] but it also can provide so much data as to overwhelm and drown the researcher in minute details. Stake (2000, p. 441) suggested, researchers should report less than was learned, but select the components that tell the case’s story, rather the researchers” dressing” of the story, to “winnow and consolidate” the main ideas from the data.

Given the time constraints of completing a degree, I selected the highlights and representative components of each teacher’s case. Limiting this study to one or two
teachers may have allowed for an even deeper interpretation of the data, yet it would have
decreased the trustworthiness of the findings (Creswell, 2013; Yin, 2014). Four
individual cases helped to increase the generalizability of these results, yet I recognize the
need to be careful not to overgeneralize, even with the cross-case analysis (Stake, 2000;

These four teachers are a select group based on specific criteria. Their stories
exemplify the benefits of resilient teacher skills that are aligned to the characteristics of
rural school communities. However, I would be remiss to generalize these results.

**Recommendations**

Drawing on the successes of these teachers, school administrators and
communities might look for ways to enhance teacher recruitment and retention in rural
areas by using these teachers’ experiences as a guide. One might expect teachers who
identify with these teachers’ experiences, would be a good fit for teaching in rural areas.
Teachers who display resiliency tendencies (altruism, strong sense of self-efficacy
(Malloy & Allen, 2007; Beltman et al. 2011) may be better equipped to face the unique
teaching requirements and inherent challenges of teaching in a rural school system
(Carlsen & Monk, 1992; Bobek, 2002; Monk, 2007; Gu & Day, 2007; Goodpaster,
Adedokun, & Weaver, 2012).

Administrators may use the results from this study to enhance professional
development opportunities of current and new teachers. They may include resilient skills
training of current faculty to enhance those exhibiting resilient tendencies and to
encourage the development of resilient skills in all staff. Processes might include
assessing for these skills or tendencies during recruitment and induction programs followed by resiliency training, by modeling resilient skills and themselves.

**Professional development.** Malloy and Allen (2007) found that teachers with personal traits of altruism and strong self-efficacy also displayed strong resiliency or the ability to increase their resiliency over time. Given that these four teachers demonstrated resilience throughout their careers (of 21 to 44.5 years) resilience training, that is teaching resilient skills, might be included as professional development in rural schools.

Administrators in rural schools may benefit by screening for resilience tendencies using an instrument such as the Assessing School Resiliency Building instrument, which assesses stressors, risk factors, and resiliency building (Henderson & Milstein, 2003). Using results from such an instrument, programs could be developed to address the teachers’ needs and strengths to further develop their resiliency skills. Currently, research focuses on the resilience tendencies or developing resilience skills in novice teachers to increase their retention (LeCornu, 2009; Castro, et al., 2010; Huisman et al., 2010; Muller, Gorrow, & Fiala, 2011; Mansfield, Beltman, Price, & McConney, 2012; Doney, 2013). As these results suggest, resilience skills were evident and essential to these four teachers’ success and longevity. Administrators might expand their focus to mid-career teachers (post-first five years of teaching) for resilience tendencies and skills, and then provide training to promote and build their resiliency skills to increase retention (Elfers & Plecki, 2006; Gu & Day, 2007; Malloy & Allen, 2007; Beltman et al. 2011; Pretsch et al. 2012; Doney, 2013; Gibbs & Miller, 2014).

**Rural teacher recruitment.** Additionally, these four teachers’ experiences suggest that administrators could assess job applicants for their ability to adapt to a rural
community and its unique culture. Rural communities and schools depend on successful relationships among the staff as well with the community. If the culture of the community is foreign to the applicant, the applicant will need to adapt as it is unlikely the community will change. Certainly, retention of rural school teachers would decrease recruitment costs and increase teacher effectiveness (Gu & Day, 2007; Boyd, et al. 2008; Falk, 2012).

Implementing resiliency training in preservice programs would be a first step in providing support for early teachers as resilience is not an inherent but learned trait (Gu & Day, 2007; Doney, 2013). Administrators from rural schools might increase the retention rate if they would screen potential new teachers during the recruitment period for resiliency tendencies and reduce recruitment and retention costs (Boyd et al. 2008; Gray & Taie, 2015; Philips, 2015).

Australia, with its many rural schools, developed a preservice program that placed teachers in rural communities for a week-long stay, where they would meet with the community as well as spend time in the local schools (Hudson & Hudson, 2008). Here in the USA, we could implement similar programs for preservice teachers in rural communities and schools. Preservice programs have practicums in place already, adding the option of a weeklong visit to rural communities and the schools in those rural communities might increase the interests of preservice teachers as well as introducing them to potential employers. Screening for their resiliency tendencies could increase successful recruitment and consequentially, retention (Monk, 2007; Hudson & Hudson, 2008; Sullivan & Johnson, 2012).
Implications and Future Research

Resiliency develops over time as individuals face adversity, that is one’s resiliency is not inherent but depends on intrinsic and extrinsic factors (Gu & Day, 2007; Doney, 2013). Rural school districts may be able to increase their recruitment and retention of teachers by developing resiliency culture through training programs (Malloy & Allen, 2007; Beltman et al., 2011). The themes identifying successful characteristics of these rural teachers could be used to develop school districts’ policies on induction, and mentoring programs for new teachers but as important in providing support for mid-career teachers in rural schools such as discussed in the research previously done with novice teachers (Collins, 1999; Harmon, 2001; Monk, 2007; Goodpaster et al., 2012; Wong & Luft, 2015).

While this research study focused on rural science teachers, the same design could also guide a study PAEMST recipients in urban schools, to see if those teachers’ also have similar resilience characteristics and similar challenges. This would provide data on at least two fronts. First, are all PAEMST teachers resilient, successful, and continue their careers in only one type of school system for their entire career? Secondly, what are the benefits of staying in urban schools? Do all award-winning science teachers share similar characteristics?

This study will add to the research literature regarding rural science educators (Harmon et al., 2003; Coladarci, 2007) while also presenting the need for further research. Several studies suggest rural schools lack fiscal and physical resources (Carlsen & Monk, 1992; Monk, 2007; Oliver, 2007), yet these results suggest teachers might also
be positively challenged by such workplace limitations. Certainly, the PAEMST award program seemed to add impetus to teachers’ success.

My search on the PAEMST website of past winners in Nebraska and the six contiguous states showed that most winners are from urban schools and communities (NSF, 2016). For example, in Colorado approximately two-thirds of the PAEMST recipients were urban (NSF, 2016). Confidence was one part of these teachers’ becoming resilient and successful, which contributed to their longevity. Lake stated that receiving the PAEMST gave her the confidence as well as the fiscal resources to pursue her master’s degree as well as her national board certification (RL.BOTG). All four of these teachers are confident, partially from the recognition they received from outside their school districts. They stood up for what they needed in their classrooms to provide educational opportunities for their students, their multiple awards validated them as effective and successful teachers. Future research would include looking at the demographics of PAEMST recipients as well as providing additional support and encouragement for rural teachers’ applications. They may need assistance finding awards that are applicable as well as assistance completing the application.

These teachers received support from their students in completing their PAEMST applications. Two teachers mentioned that they were nominated more than once before they won, which means they required encouragement and support from their administration, colleagues, family, and/or students several different years. However, if an outside person could provide support in application completion, perhaps more rural teachers would apply for and win recognition for their teaching successes. This would be one area of research for future consideration. Research questions might focus on the way
Resilience enables people to overcome obstacles and succeed (Gu & Day, 2007; Doney, 2013). Using the emergent themes across the cases and within each individual case, along with resilience data, a survey for resiliency traits could be developed to screen preservice teachers for placement in rural schools like the resiliency survey already developed by Henderson and Milstein (2003). Malloy and Allen (2007) used Henderson and Milstein’s survey, Assessing School Resiliency Building, to correlate personal traits of teachers who displayed resiliency. Therefore, a new survey instrument may not need to be constructed.


Another future research study could extend the concept of resilience to other rural teachers such as teachers of other subjects, and elementary teachers would be interesting. Some researchers have studied the effects of teaching resilient skills to preservice teachers and early-career teachers to increase their success and retention (Huisman, Singer, & Catapano, 2010; Beltman et al., 2011; Doney, 2013). Why not extend their studies to teaching resilient skills to other rural teachers, not just preservice and novice
teachers, but teachers who have been in the community for five or more years--perhaps especially to teachers who do not display resilient characteristics or who are thinking of leaving their school.

**Concluding Statement**

This study has only scratched the surface of how teachers develop their resilience and live up to their potential. Digging deeper into the data already collected and then streamlining the findings into a survey or to modify developed surveys could provide a follow-up to this study. Comparing the resiliency themes and individual strengths from this study to developed survey instruments such as the Assessing School Resiliency Building survey (Henderson & Milstein, 2003) or a modified version of this survey (Mansfield et al. 2012) for alignment would provide quantitative data for screening teachers for their resiliency skills and possible need for resiliency building training. Both survey instruments use a Likert Scale. Use of such a survey to identify teachers who may be successful in a rural school would help rural schools’ recruitment and retention.

As a former rural science teacher, I am particularly concerned about science teacher shortages. I left the school system after 28 years of teaching (two years in an urban school and 26 years in a rural school) to pursue my doctorate. While I have begun a new phase of my professional life, there are times when I long for the days of organizing 3-4 preparations for my 100 rural community students and igniting their love of learning in science. However, now I want to provide opportunities for rural school teachers that help them flourish in their settings, draw on their own expertise, connect with local resources, and recognize their capacity for excellence.
Resilience played a major role in these four teachers’ success and longevity in their teaching careers. Their positive outlook on their own teaching careers; challenges did not deter them from staying and their overall satisfaction with their personal and professional lives led to their recognition as award winning teachers. Even though several of these rural PAESMT teachers indicated that the awards gave them confidence, their colleagues, former students, administrators, and resumes indicated they were already on the path to teaching excellence. My role, of retelling these teachers’ stories of teaching science beyond the cities’ bright lights, leads me to conclude they lead lives well taught.
References


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Appendix A

Recruitment Correspondence

1. Volunteer Participant Letter
2. Selected Research Participant
3. Additional Interview Contact
   Email Script
1. Volunteer Participant Recruitment Email Script

Dear Teacher and PAEMST Awardee

I am conducting research on the success and longevity of secondary science teachers in rural schools who have been nationally recognized. I used the PAEMST awardee database to identify teachers in Nebraska and the six contiguous states. From there I found your contact information on your current school’s website.

I am a doctoral candidate at University of Nebraska-Lincoln. As a former high school science teacher in rural Colorado, I know the trials and tribulations as well as the success and benefits of teaching in a rural school. Though I am not a PAEMST awardee, I have chosen to focus my dissertation research on the characteristics of teachers like you who achieved long-term success as a rural science teacher.

With this email, I invite you to be a participant in my research study. Participation in this study should take no more than 3 hours of your time outside of the regular school day to include a recollection of your experiences as a rural science teacher, a classroom observation and a personal interview (to be scheduled at your convenience).

I have attached an informed consent form. If you have ten or more years teaching experience in rural schools and are interested in participating in this study, please return the informed consent form signed by [deadline date].

Thank you for considering participation in my research project. I look forward to hearing from you.

Beverly R. DeVore-Wedding

Bev DeVore-Wedding
2. Selected Research Participant Email Script

Dear Teacher,

Thank you for willingness to participate in my doctoral research on rural secondary science teachers. You have been selected as a participant.

I will be sending you a Doodle poll with times I am available to visit you and your schools. If none of the suggested times work, please add times that do work for you. I would like to interview you for 30-90 minutes after school preferably on a Wednesday or Thursday, although Friday is definitely open. I would also like to observe you teaching a class after our interview. While I am at your school, I would like to schedule an interview with your principal or another supervisor/colleague that you have chosen who can tell me about you. Would you send me this individual’s name and contact information, so I can schedule an interview with them as well? Thank you!

Prior to my visit, I’d like to have you spend some time (30-45 minutes) recalling your personal and professional experiences over the time of your career as a rural science teacher. I’ll send along some more detailed instructions once we confirm an interview and visitation date and time.

In addition to interviewing you, I would like to observe you teaching. My intent is to observe and take field notes, no digital recording. Attached is an informed consent form related to observing your instruction.

To thank you for your participation in my research project, I would like to give you an NSTA press book of your choice. As a veteran of both the NSTA Council and Board of Directors for NSTA Press, I have access to a wide variety of books from the inventory. We can confirm your book selection when I visit you at your school.

Again, thank you for agreeing to participate in my research project. I look forward to working with you.

Bev DeVore-Wedding
3. Additional Interview Contact Email Script

Dear [person identified by selected participant],

[Selected participant] has consented to participate in my doctoral research on the successes and challenges of secondary science teachers in rural schools. They have identified you as someone who could provide additional insight into [selected participant] career history. We have scheduled an interview [date]. Would you be available for a 30-60-minute follow-up interview later that day or the next day? If so, when would this fit into your schedule?

Attached is an informed consent form. When you reply with your availability for this interview, please return the consent form with your signature.

Thank you for willingness to participate in my doctoral research on rural secondary science teachers.

Bev DeVore-Wedding

Bev DeVore-Wedding
Appendix B

Consent Forms

1. Participant Informed Consent Form
2. Additional Personnel Informed Consent Form
3. Classroom Observation Informed Consent Form
1. Participant Informed Consent Form

Title: Rural Science Teachers Success and Longevity

Purpose: This research project aims to identify characteristics influencing the longevity and success of secondary science teachers in rural schools. You are invited to participate because you are a PAEMST awardee teaching in a rural school district with 10 or more years of teaching experience in any rural school.

Procedures: You will be asked to graph your career’s successes and challenges in a rural school prior to meeting for a semi-structured interview, 30 – 90 minutes, at your school location. The interview will be audio-recorded. Additional information such as your CV, curricula and lesson plans you have developed, and related news articles detailing accomplishments in your career.

Benefits: Your participation will help identify characteristics of successful, veteran secondary science teachers in rural schools.

Risks and/or Discomforts: There are no known risks or discomforts associated with this research.

Confidentiality: Any information obtained during this study which could identify you will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator’s office and will only be seen by the investigator during the study and for 10 years after the study is complete. The information obtained in this study may be published in scientific journals or presented at scientific meetings but the data will be reported as aggregated data anonymously or with pseudonyms.

Compensation: Selected participants will receive a NSTA press book of their choice, provided by the primary investigator.

Opportunity to Ask Questions: You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. Or you may contact the investigator(s) at the phone numbers below. Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 to voice concerns about the research or if you have any questions about your rights as a research participant.

Freedom to Withdraw: Participation in this study is voluntary. You can refuse to participate or withdraw at any time without harming your relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy: You are voluntarily deciding whether to participate in this research study. Your signature certifies that you have 10 or more years of teaching experience in a rural school environment and decided to participate having read and
understood the information presented. You will be given a copy of this consent form to keep.

**Participant Feedback Survey:** The University of Nebraska-Lincoln wants to know about your research experience. These 14 questions, multiple-choice survey is anonymous; however, you can provide your contact information if you want someone to follow-up with you. This survey should be completed after your participation in this research. Please complete this optional online survey at: [https://ssp.qualtrics.com/SE/?SID=SV_aVvlNCf0U1vse5n](https://ssp.qualtrics.com/SE/?SID=SV_aVvlNCf0U1vse5n).

**Signature of Participant:**

____________________________________________  ____________________________
Signature of Research Participant                              Date
Title: Rural Science Teachers Success and Longevity

Purpose: This research project aims to identify characteristics influencing the longevity and success of secondary science teachers in rural schools. You were recommended by a research participant for this project in your capacity as a supervisor of the research participant. Your participation will provide perspective on the research participant’s success and longevity.

Procedures: You will be asked to describe the teacher participant’s successes and challenges, their ability to overcome obstacles, and the support system provided by the school district and yourself. This interview will be scheduled for 30-60 minutes during a visit to your school and will be audio-recorded.

Benefits: Your participation will help identify characteristics of successful, veteran secondary science teachers in rural schools.

Risks and/or Discomforts: There are no known risks or discomforts associated with this research.

Confidentiality: Any information obtained during this study which could identify you will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator’s office and will only be seen by the investigator during the study and for 10 years after the study is complete. The information obtained in this study may be published in scientific journals or presented at scientific meetings but the data will be reported as aggregated data anonymously or with pseudonyms.

Compensation: Selected participants will receive a NSTA press book of their choice, provided by the primary investigator, for their staff professional development library.

Opportunity to Ask Questions: You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. Or you may contact the investigator(s) at the phone numbers below. Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 to voice concerns about the research or if you have any questions about your rights as a research participant.

Freedom to Withdraw: Participation in this study is voluntary. You can refuse to participate or withdraw at any time without harming your relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy: You are voluntarily making a decision whether or not to participate in this research study. Your signature certifies that you have 10 or more years of teaching experience in a rural school environment and decided to participate.
having read and understood the information presented. You will be given a copy of this consent form to keep.

**Participant Feedback Survey:** The University of Nebraska-Lincoln wants to know about your research experience. These 14 questions, multiple-choice survey is anonymous; however, you can provide your contact information if you want someone to follow-up with you. This survey should be completed after your participation in this research. Please complete this optional online survey at: https://ssp.qualtrics.com/SE/?SID=SV_aVv1NCf0U1vse5n.

**Signature of Participant:**

______________________________
Signature of Research Participant

______________________________
Date
2. Classroom Observation Informed Consent Form

Title: Rural Science Teachers Success and Longevity

Purpose: This research project aims to identify characteristics influencing the longevity and success of secondary science teachers in rural schools. You are invited to participate because you are a PAEMST awardee teaching in a rural school district with 10 or more years of teaching experience in any rural school.

Procedures: Researcher will observe teacher participant teaching, with permission from school supervisor, recording in field notes the participant’s teaching strategies and style. There will be no photographs or audio-recordings, only the researcher’s field notes. Observations will be less than an hour of instructional time.

Benefits: Researcher observations of participant’s teaching will help identify characteristics of successful, veteran secondary science teachers in rural schools.

Risks and/or Discomforts: There are no known risks or discomforts associated with this research.

Confidentiality: Any information obtained during this study which could identify you will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator’s office and will only be seen by the investigator during the study and for 10 years after the study is complete. The information obtained in this study may be published in scientific journals or presented at scientific meetings but the data will be reported as aggregated data anonymously or with pseudonyms.

Compensation: Selected participants will receive a NSTA press book of their choice, provided by the primary investigator.

Opportunity to Ask Questions: You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. Or you may contact the investigator(s) at the phone numbers below. Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 to voice concerns about the research or if you have any questions about your rights as a research participant.

Freedom to Withdraw: Participation in this study is voluntary. You can refuse to participate or withdraw at any time without harming your relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy: You are voluntarily making a decision whether or not to participate in this research study. Your signature certifies that you have 10 or more years of teaching experience in a rural school environment and decided to participate.
having read and understood the information presented. You will be given a copy of this consent form to keep.

**Participant Feedback Survey:** The University of Nebraska-Lincoln wants to know about your research experience. These 14 questions, multiple-choice survey is anonymous; however, you can provide your contact information if you want someone to follow-up with you. This survey should be completed after your participation in this research. Please complete this optional online survey at: https://ssp.qualtrics.com/SE/?SID=SV_aVvlNCf0U1vse5n.

**Signature of Participant:**

_________________________________________  ________________________________  
Signature of Research Participant  Date
Appendix C

Behavior over Time Graph Instructions
Dear [Selected Participant],

Thank you for confirming our interview date, time, and location. [Date, time and location of interview]. I look forward to working with you. If any changes should occur, please contact me as soon as possible. My cell phone number is XXX.XXX.XXXX and my email address is [email redacted].

Before our scheduled interview, please construct an X-Y line graph of your career history, called a behavior over time graph (BOTG). This will allow you to reflect and recall the events, both beneficial and challenging, of your career in rural schools. The **x-axis**, will be time from your first-year teaching in rural schools to the present. You may decide how to divide up the scale of this axis. The **y-axis** will be a qualitative scale of the range of highs and lows in your personal and professional experiences during your time teaching in a rural school. Please label all peaks, troughs, and plateaus. There is no correct way to construct this graph—so make it your own. I look forward to viewing your graph and hearing your stories when we meet face-to-face.

To the right is an unlabeled example of a simple BOTG. This is your story, so construct it to best fit your experiences and history that have influenced you throughout your career teaching science in rural schools.

In addition to the BOTG, I would also like some background information. The background information is:

- length of time in current position:
- total years of teaching experience:
- total years of rural teaching experience
- subjects currently teaching:
- connections to interviewer, school, and community:
- education background

If this information is on your CV/resume, great! Thank you for agreeing to participate in my study!

Bev DeVore-Wedding
Appendix D

Semi-Structured Interviews Protocols

1. Participant Interview Protocol

2. Additional Interview Protocol
1. **Participant Interview Protocol**

After initial contact with a description of the project, participants who return a signed letter of informed consent, will be contacted to confirm interview time, date, and location. Interview length goal is 30-90 minutes.

1. Time of Interview:
2. Date of Interview:
3. Location:
4. Interviewer:
5. Interviewee:
6. Background of interviewee:
   i. length of time in current position:
   ii. total years of teaching experience:
   iii. total years of rural teaching experience
   iv. subjects currently teaching:
   v. connections to interviewer, school, and community:
   vi. education background
7. Questions: *(These will be guidelines for initiating discussions and probing about their specific working environment, their own successes and challenges; participants will be asked to identify their successes and challenges during their career on a behavior over time graph; the highlights and challenges will provide a springboard for the following questions).*
   i. What events/experiences led you to choose science teaching as a career?
a. Who were your mentor/role model(s) that guided you into science and/or science teacher?

b. Did you always want to be a scientist? A science teacher?

c. Where did your own pk-12 education take place?

d. Did that influence your choice to teach in a rural school?

ii. Where did you do your student teaching?

a. Did that influence your decision to teach in a rural school?

iii. Are you in charge of the curriculum you use in your classroom?

a. Are you involved in curriculum development within your classroom/building? District? State? Nationally?

b. Are you involved in standards’ development in your district? State? Nationally?

iv. As a rural teacher, what do you perceive as your challenges?

a. How do you deal with challenges in general—do you have a support system within your building? District? Community?

b. What would you say is the most difficult challenge/issue you have dealt with?

i. How does this [named issue] challenge you?

ii. What have you done to overcome this challenge?

iii. Do you know of other teachers with similar concerns? Do they handle this challenge similarly? Differently?

c. Do you think your challenges are unique to your situation? Other rural teachers?
i. Explain how these are the same or different to teachers in non-rural schools?

v. As a rural teacher, what do you perceive as benefits?
   a. Do you think your challenges are unique to your situation? Other rural teachers?
   b. Explain how these are the same or different to teachers in non-rural schools?

vi. Teaching in a rural school, why have you been active in professional organizations beyond your district?

vii. Did you self-nominate for your [state, national, or both] award?
   a. If you did not self-nominate, who nominated you?
   b. Who encouraged you to complete the application process?

viii. Tell me about [one highlight and one challenge on the behavior over time graph].
   a. How did this event contribute to your career?
   b. How did this event detract from your career?
2. Additional Interview Protocol

After confirmation with participant, I will contact via email the named supervisor, colleague, or community member, the selected participant has identified to schedule an interview during the same visit when researcher is interviewing and observing participant. This interview is to contribute to information regarding the successes and challenges of the participant and will be scheduled after the participant’s interview. This interview would be 30-60 minutes in length.

8. Time of Interview:

9. Date of Interview:

10. Location:

11. Interviewer:

12. Interviewee:

13. Questions: *(These will be guidelines for initiating discussions and probing about the selected participant. This interview will focus on corroborating and supplementing information provided by the selected teacher as well as describing the unique characteristics of this teacher.)*

1) [selected participant] identified you as their [supervisor, colleague, community person]. How long have you known the participant and in what capacities?

2) What characteristics have you observed that you attribute to [Selected participant]’s recognition as a PAEMST awardee?

3) Do you see [Selected participant] as being different here at [name of school]? *(Probe: Can you give me an example?)*
4) Are there additional characteristics that you have observed that you attribute to [Selected participant]’s longevity as a rural teacher? (Probe: Can you give me an example?)

5) What characteristics have you observed that allows [selected participant] to be successful even in challenging situations? (Probe: Can you give me an example?)

6) What are your thoughts on how and why [Selected participant] has been so successful as a rural science teacher? (Probe: Can you recall a specific instance or story that is particularly telling about [Selected participant]?
What one word would you use to describe [Selected participant] and why?)

7) How have you been able to sustain [Selected participant]’s success and longevity at [name of school]?

8) What do you perceive as benefits of teaching in [name of school]? (Probe: Can you give me an example/examples?)

9) What do you perceive as challenges of teaching in [name of school]? (Probe: How does [Selected participant] seem to deal with the challenges of teaching science in rural schools?)
Appendix E

Institutional Review Board Approval Letter
Official Approval Letter for IRB project #16585 - New Project Form

November 14, 2016
Beverly DeVore-Wedding
Teaching, Learning and Teacher Education

Julie Thomas
Teaching, Learning and Teacher Education
215A HENZ, UNL, 68588-0355

IRB Number: 2016116585EX
Project ID: 16585
Project Title: Rural Science Teachers

Dear Beverly:
This letter is to officially notify you of the certification of exemption of your project for
the Protection of Human Subjects. Your proposal is in compliance with this institution's
Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of
Human Subjects (45 CFR 46) and has been classified as exempt.

You are authorized to implement this study as of the Date of Final Exemption:
- Review conducted using exempt category 2 at 45 CFR 46.101
- Funding: N/A

The stamped and approved form(s) have been uploaded to NUgrant. Please use the
stamped form(s) to make copies to distribute to participants. If changes need to be made, please submit the revised form(s) to the IRB for approval prior to use.

Once you have determined the schools where you will be conducting class observations, school district permission letters/emails will need to be submitted to our office prior to conducting the class observations. Schools can be added to your approved list of sites on a case by case basis as permission letters are received by our office. Please email the letters/emails to me at larneson2@unl.edu once they are obtained. However, if the observations will be conducted within Lincoln Public Schools, the project will be sent by our office to Dr. Leslie Eastman for review, so you will not need to submit a permission letter from LPS via email. In this case, please submit a change request form to indicate LPS involvement in the study and we will move forward with the LPS school permission process.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,
Becky R. Freeman, CIP
for the IRB
University of Nebraska-Lincoln Office of Research and Economic Development
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Appendix F

Coding

1. Reference Coding

   MAXQDA Code Sets

2. Original Code Set

3. New Code Set (second expanded set)
Reference Codes for Participant Data

JC-Josephine Christof
BK-Brad Kent
RL-Rachel Lake
SW-Sara Wymore
I-Interview
O-Observation
BOTG-Behavior of Time Graph
AI-additional Interview
A-artifacts: newspaper articles, photographs, and resumes.

Coding Examples

JC.I.#-Josephine Christof Interview page #
BK.BOTG-Brad Kent Behavior Over Time Graph
RL.O.2-Rachel Lake Observations page 2
SW.AI.4-Sara Wymore Additional Interview page 4
2. First Code Set: resilient terms or phrases from literature are: mentor, resourceful, cooperative, self-efficacy, and autonomy. The other terms came from the literature, interview questions, guiding central questions and sub-questions (Table 2.1).
3. Second Code Set allowed me to tease out specific components of challenges and benefits as well as resilience. I still used resilient terms from literature. Avocation came from the participants “loving” science and doing science for fun.