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Resilience in early second career STEM teachers employed in public secondary schools

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RESILIENCE IN EARLY SECOND CAREER STEM TEACHERS EMPLOYED IN PUBLIC

SECONDARY SCHOOLS

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by

Donald Selway

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This dissertation, written by

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DOCTOR OF EDUCATION

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DEDICATION

    I was born with a sever speech impediment, and my mom was told that I probably would not graduate from high school. I thank my mom for believing that I would, and I thank my mom for my heart. I thank my dad for my fortitude. I thank my stepdad for his work ethic. I thank my father-in-law for serving God and helping people. I thank my stepmom and my mother-in-law for making family gatherings important. I thank my wife, Julia, for her constant support and for being there every step of the way. I thank my brothers Joe, Ray, Tom, Charlie, and Bruce and my sister, Mary, for being part of my family. I thank Karen for her coaching. I thank Michele and Angel for help with recruitment. I thank Angel and Charles for helping me to transition into becoming a teacher. I thank Joanna and Candice for being great mentors. I thank Craig, Lisa, Desiree, Brody, and Jessica for being inspirational science teachers. I thank my cohort for their friendship and support. I thank Dr. Eric Hamilton for being on my committee and for talking to our class about STEM education. I thank Dr. Doug Leigh for being on my committee and for his quantitative expertise. Lastly, I thank Dr. Anthony Collatos for being my committee chair and his excellence in educational research.

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ABSTRACT

A troubling shortage of K-12 Science, Technology, Engineer and Mathematics (STEM) teachers exists in the United States. One solution to increase STEM teachers involves recruiting STEM professionals to transition from industry to K-12 teaching. Research indicates that fostering resilience is one way to help new STEM teachers' retention and persistence in the field. This study explored individual and programmatic factors that increase early career and early second career K-12 STEM teachers' resilience. Moreover, this research examined how strategic initiatives and programs assisted STEM professionals to build resilience as they transitioned into K-12 STEM educators.

This study utilized mixed-methods design to examine resilience within early career STEM teachers (ECST) and early second career STEM teachers (ESCST). Ultimately, this study describes quantitative measures with qualitative interview data analysis. Quantitative measures intended to include inferential statistics analysis of survey data, one-way MANOVA, but the limited sample size prevented quantitative analysis with a significant level of confidence. Thus, quantitative analysis was limited to descriptive analysis and provided the means to select qualitative participants. Qualitative interviews employed a phenomenological design to collect and analyze the experiences and perceptions of eight early career and early second career STEM teachers.

The study findings indicate that teachers struggled with classroom management, a work-life balance, and leadership's lack of student accountability for learning. In contrast, teachers benefited from professional and emotional support, improved their communication skills through teaching, and felt a sense of purpose in their teaching. These findings suggest that programmatic efforts to assist STEM professionals to transition from private industry into K-12 education can increase resilience.

Future research should include quantitative analysis with a significant level of confidence to confirm that ECSTs truly have higher social competency as compared to ESCSTs, and the role of family support for ECSTs and ESCSTs, examining the mechanisms through which social competency enhance teacher resilience, and investigating sense of purpose and motivation to pursue teaching, particularly among ESCST.

Chapter 1: Introduction

A study by the National Research Council (2010) found that 10–20% of U.S. science and math teachers in secondary schools did not earn a degree in the fields they teach, nor have they earned a certification in their subjects. Moreover, the average elementary school teacher takes only two college math courses. This results in diminished teaching quality as it concerns STEM courses, culminating in a weak pipeline of native-born STEM professionals. In addition, the number of new teacher candidates in California declined by more than half between 2002-2016 (Darling-Hammond et al., 2018).

Consequently, the United States of America lacks a sufficient native-born STEM educated workforce able to fulfill the occupational roles needed for our economy to perform at its highest level (President's Council of Advisors on Science and Technology, 2012). One contributor to the lack of a STEM-educated workforce is the small number of STEM-educated college graduates who are U.S. citizens. Absent this workforce, national economic competitiveness and stability suffers. The lack of a STEM workforce can be traced back to a weak K-12 educational pipeline, which leaves high school graduates ill-prepared to do well academically in STEM college courses (Morrell & Salomone, 2017). While the K-12 STEM curriculum must be focused, rigorous, and coherent; an equally if not more critical component is having qualified, committed STEM teachers who have deep content knowledge and the ability to teach that content in accessible ways to students. The nationwide shortage of STEM teachers makes this objective difficult to achieve (President's Council of Advisors on Science and Technology, 2012).

One solution to decrease the shortage of STEM teachers involves attracting STEM professionals to transition from industry to K-12 teaching. Yet, finding willing candidates does not mean they will successfully overcome the many hurdles they face in their journey to become a credentialed teacher (Johnson et al., 2014). These challenges include a rigorous, potentially multi-year credentialing process (Commission on Teacher Credentialing, 2019) and insufficient pre-service education and onboarding (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006). These aspects can be harmful to the success, well-being, and morale of teacher candidates (Bezzina, 2006). Additionally, excess idealism that clashes with the day-to-day realities of teaching in the classroom is a common problem for STEM professionals entering K–12 education (Abbott–Chapman, 2005; Day & Gu, 2010), and there are not enough personal and contextual factors to support success, resilience, and retention (Andrews et al., 2007; Kanpol, 2007). When STEM professionals transition to the classroom, the result is often a "sink-or-swim" experience (Howe, 2006) characterized by stress and burnout (Goddard & O'Brien, 2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007), leading to untenable levels of attrition in early career teachers (House of Representatives Standing Committee in Education and Vocational Training, 2007).

Teacher resilience is critical. Research indicates that enhancing resilience—the ability to bounce back and even grow from challenge—is the best way to help teacher candidates to attain success in the classroom and their careers (Allison, 2012; Johnson et al., 2014; McGarry et al., 2013; Peters & Pearce, 2012; Richardson, 2002). Furthermore, research shows that personal factors, contextual factors, mechanisms, and processes impact teacher success and resilience (e.g., Johnson et al., 2014;

Mishra & McDonald, 2017). However, research is lacking on the population of early second-career STEM teachers (ESCSTs) navigating career transition and entering the demanding profession of teaching (Gu, 2014; Mackenzie, 2012; Mansfield et al., 2014; Zukas & Kilminster, 2014). In particular, more research is needed to better understand resiliency amongst ESCST and early career STEM teachers (ECSTs) and the nature of these associations between the personal factors, contextual factors, and processes within this unique population of teachers.

Moreover, the impacts of the COVID-19 pandemic on [k-12] teaching need to be evaluated. The COVID-19 pandemic significantly affected schools, teachers, and students, as all [k-12] school districts shifted to online instruction in March 2020, resulting in dramatic shifts in how teachers engaged with their students and taught course content (Hidayati et al., 2020). Teachers faced new mandates regarding the use of virtual instruction tools and approaches (Hoang et al., 2020), experienced significantly increased workloads, reported a heightened sense of isolation, and decreased opportunities for collaboration and consultation with colleagues (Voglezon, 2022). Students' attendance, class participation, and performance on homework dropped significantly (Hidayati et al., 2020). Furthermore, Pressley (2021) concluded-based on his examination of the impacts of COVID-19 on schools-that the pandemic-related teaching requirements significantly and adversely affected both educators and students. While emerging research describes the impact of COVID-19 on teachers and students, these studies have not focused on the unique experiences of new teachers or ESCSTs.

Study Purpose and Research Questions

The purpose of this mixed methods, phenomenological study was to examine resilience in ESCSTs in public secondary school settings as compared to ECSTs. An ESCST is defined as an individual with at least 2 years of STEM-related work experience who transitioned into a public secondary, STEM educator role and who is within the first 5 years of teaching. The transition describes having a full-time job in a STEM-related field and then moving into a STEM-related teaching job. An ECST is a public secondary STEM educator who is within the first 5 years of teaching. This study examined three research questions:

1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?

2. How do ESCSTs and ECSTs describe their resilience?

3. How do ESCSTs and ECSTs build resilience?

The quantitative part of this mixed-methods research has a null hypothesis and a hypothesis. They are as follows.

H_o: There are no differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs.

H_1: It is hypothesized that differences exist in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs." Make sure to apply this globally throughout the document.

Study Setting

      All research participants for this study were recruited from two sites, *Second Act* and *The California Science Educators*. Second Act is a nonprofit located in California that provides a range of offerings (e.g., teaching fellowships, gatherings, Google classrooms) to create opportunities for networking, support, and credentialing guidance to assist STEM professionals' transition into teaching. At the time of the study, Second Act served 185 teachers within their first 5 years of teaching and more than 1,000 transitioning STEM professionals had been helped.

      California Science Educators is a non-profit membership organization of California-based science educators, administrators, and policy makers. This organization raises awareness about issues relevant to science education. It was anticipated that some of its 11,000 members would be ESCSTs.

      Participants were recruited from these organizations using an email invitation or an ad placed in their bimonthly newsletter. Participation consisted of an online questionnaire and survey that (a) gathered respondents' informed consent, (b) confirmed they met the selection criteria based on self-report, and (c) gathered their responses. The survey utilized Friborg et al.'s (2005) *Resilience Scale for Adults* (RSA). The measurement tools were determined to have sufficient validity and reliability. The minimal necessary sample size comprised of two groups and five predictor variables with 80% power at a significance of 0.05 is 206, and there were only 27 respondents to this survey. The limited sample number prevented inferential quantitative analysis with this level of significance. The results describe how to complete a proper quantitative analysis with sufficient significance. A total of 27 ESCSTs and ECSTs completed a

questionnaire. All survey respondents were asked to volunteer to complete an interview and 25 volunteered (eighteen ESCSTs and seven ECSTs). From these, eight ESCSTs and seven ECSTs were randomly selected and randomly assigned as an interviewee or a backup interviewee within each grouping. Four ESCSTs and four ECSTs completed a 45-minute to 1-hour interview.

This study employed a convergent, mixed method design wherein quantitative and qualitative data sets were collected and analyzed separately before being combined and examined (Creswell, 2018). The quantitative portion of the study gathered data using an online self-report survey and applying descriptive statistics for a multivariate analysis of variance (MANOVA). As described in the previous paragraph, the sample size was limited, and the results describe how to do a quantitative analysis with sufficient significance. The qualitative phase of this study was conducted as a descriptive phenomenological inquiry (Moustakas, 1994). Interviews gathered rich descriptions of the participants' experience as an early career STEM teacher, and the analyzing of the interviews consists of horizontalization, thematizing, textural and structural description, and intuitive integration.

Study Significance

A troubling gap in the supply of STEM teachers in the U.S. exists. One solution involves narrowing the gap by attracting STEM professionals to transition from industry to K-12 teaching. However, this endeavor is fraught with challenges and knowledge is lacking about how to do this. Programs to help recruit STEM professionals to K-12 teaching and to bridge this process exist, and it is believed that fostering resilience is one way to help new STEM teachers (Friborg et al., 2005). However, insight is lacking

regarding which aspects of building resilience seem to help and little is known about how ESCSTs and ECSTs describe this process, and what conditions or experiences help to foster resilience in them.

Support is needed to promote their success, retention, and persistence in teaching. Enhancing teachers' resilience is a likely strategy for doing so, and this study explores individual and programmatic factors that increase ESCSTs' resilience and how their resilience is developed. When these factors and processes are better understood, programs and approaches may be developed to assure that those individuals who attempt the transition from STEM professional to STEM educator may be successful.

Definition of Terms

The following definitions are relevant to this study:

- Career Transition. Having a full-time job in one field or discipline and leaving that position to enter another field or discipline, particularly when it involves a substantial change in role (Thomas, 1980).

- Early Career Teacher Science, Technology, Math, or Engineering Teacher. An individual with up to 5 years of teaching experience in the fields of science, technology, engineering or mathematics (Bowles & Arnup, 2016; Koonce et al., 2011).

- Early Second-Career Science, Technology, Math, or Engineering Teacher. An individual with up to 5 years of teaching experience (Bowles & Arnup, 2016) who has transitioned into teaching after having at least 2 years of experience in another science, technology, engineering, or mathematics-related field (Chambers, 2002).

- Emotional Support. The amount of understanding, empathy, and acceptance of emotional processing an individual experiences within an interpersonal relationship (Friborg et al., 2005).

- Family Cohesion. The amount of family support, productive conflict, stability, and loyalty present in an individual's family (Friborg et al., 2003).

- Internship Candidate. An individual pursuing a preliminary California public school teaching credential who completes a 120-hour preservice program and then teach full-time in their own classroom (State of California Commission on Teacher Credentialing, 2016).

- Novice Teacher. An individual with less than 2 years of his or her teaching career (Bowles & Arnup, 2016), regardless of the discipline taught (Bowles & Arnup, 2016). A novice teacher may also be referred to as an ECST.

- Personal Competency. An individual's self-esteem, liking one's self, living in reality, and hope (Friborg et al., 2003).

- Personal Structure. A set of routines, plans, and general organization for a specified time period (Friborg et al., 2003).

- Professional Support. Support provided by colleagues and mentors concerning the technical aspects of an individual's position as well as guidance in entering, navigating, and succeeding in a particular profession (Friborg et al., 2005).

- Public School. Educational institutions designed to provide primary instruction to residents aged 4-18 within a designated geographic region.

Public schools are controlled by the government and funded through tax

revenue (Hess, 2004).

- Resilience. An individual's method of, engagement in, or outcomes related

    to positive adaptation despite challenge or threat (Bottrell, 2009; Bowles &

    Arnup, 2016; Masten et al., 1990).

- Secondary School. Education for students enrolled in grades 6 through

    12, with students ranging in age from approximately 12 to 18 (UNESCO

    Institute for Statistics, 2012).

- Second-Career Teacher. An individual who has transitioned into teaching

    after having work experience in another career (Chambers, 2002; Resta et

    al., 2001), regardless of the number of years of experience they have in

    teaching.

- Social Competency. An individual's social adeptness, extraversion, ability

    to initiation social interactions, and good communication skills (Friborg et

    al., 2003).

- Social Resources. A person having external support from family and

    friends, intimacy, and able to provide support to others (Friborg et al.,

    2003).

- Science, Technology, Engineering, and Math Education. Instruction in

    science, technology, engineering, and mathematics (Koonce et al., 2011).

- Student Teacher Candidate. An individual pursuing a preliminary

    California public school teaching credential who receives a year of

    mentorship by working with an experienced teacher teach the single

subject area and engaging in unpaid teaching within a controlled setting

(Commission on Teacher Credentialing, 2020).

Theoretical Framework

This dissertation is oriented around the theory of resilience and, specifically,

resilient leadership. This study utilizes Resilient Leadership Theory (Allison, 2012) and

Richardson's (2002) *Metatheory of Resilience and Resiliency* as theoretical frameworks

to understand resilience in ESCSTs. Resilience is associated with the ability to persist

through adversity—notably, not only surviving, but thriving (Duggan & Theurer, 2017).

These attributes include a willingness to continue to learn, being mindful of one's words,

staying optimistic, reacting quickly to setbacks, build strong social networks, inviting and

listening to feedback, and making needed changes (Allison, 2012). Many of these same

attributes align with being happy (Titova & Sheldon, 2019). Additional research

suggests that resilience has genetic roots, as serotonin, a neurotransmitter that helps

regulate happiness and sleep, may help increase one's happiness (Matsunaga et al.

2017) and level of resilience (Broekman, 2011).

If resilience was only based on these intrinsic qualities, then there would be no

reason to do further research. However, resilience is like a muscle: Some people are

born with more muscles (e.g., increased serotonin levels) and barely need to work out

to build strength (i.e., just naturally happy all the time), while others need to work out

intensively to build strength (and resiliency).

Resilient Leadership is the practice of attributes that increase resilience while

filling a formal or informal leadership role (Allison, 2012). Resilient leaders, from

administrators and others, will shepherd ESCSTs and ECSTs through the credentialing

process and the first years of teaching. These resilient leaders support new teachers when navigating early career challenges to their morale, wellbeing, and success (Bezzina, 2006). Such challenges include (a) insufficient pre-service education and onboarding (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006), (b) excess idealism misaligned with the daily realities of classroom teaching (Abbott-Chapman, 2005; Day & Gu, 2010), and (c) inadequate personal and contextual factors to support success, resilience, and retention (Andrews et al., 2007; Kanpol, 2007; Quinn & Andrews, 2004). In light of these challenges, ESCSTs and ECSTs often experience excessive stress and burnout (Goddard & O'Brien, 2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007), with many ultimately leaving teaching (House of Representatives Standing Committee in Education and Vocational Training, 2007).

In addition, this study utilizes Richardson's (2002) Metatheory of Resilience and Resiliency. Richardson noted that research on resilience developed in three waves: (a) identifying resilient qualities (i.e., the characteristics of people who thrive during adverse conditions); (b) identifying the resilient processes people use that culminate in resilient characteristics; and (c) examining resilient motivation, the force that compels people to reintegrate and rebound following adversity. Richardson (2002) asserted that people respond in different ways to adversity, depending upon the nature and strength of their resilient motivation, process, and qualities. Richardson outlined four types of responses:

1. Resilient reintegration (the best outcome), where adversity spurs personal growth.

2. Reintegration back to homeostasis (a moderate outcome), where the person returns to their original state after adversity but does not achieve growth.

3. Reintegration with loss (a less satisfactory outcome), where the individual feels hopeless and demotivated in response to adversity.

4. Dysfunctional reintegration (an unsatisfactory outcome), where the individual responds in a destructive manner in response to adversity.

Researcher Background

I initially planned to study project management and business leadership within my Pepperdine doctoral program. However, my goals shifted when I recognized an opportunity to make a greater difference as a STEM advocate and educator. Over the past 3 years, I went through the process of earning a preliminary teaching credential in the state of California while doing an internship program at a university. I was fortunate to also have the support from an external organization, Second Act. Second Act's mission is to help transition people working in a STEM-related field into the K-12 classroom. I am teaching currently at a high school in Southern California and I hold preliminary credentials in biological sciences, chemistry, and English Language Learners. I should convert my preliminary credential to a clear credential this year. Based on my experience as an early second career, STEM teacher, I believe it is important that we understand how to assist other ESCSTs to navigate this transition. In fact, it is critical to grow the number of STEM teachers and, thus, grow the number of STEM educated students.

Limitations

Limitations are the inadvertent events and issues that occur during a study that affect the validity or reliability of the collected data (Creswell & Creswell, 2017). A primary limitation concerns the risks of researcher bias. A researcher naturally enters a study with certain beliefs and predispositions based upon his/her personal and professional experiences. As an ESCST, my experiences may predispose and/or influence my interpretation of the data. Being diligent to *bracket* my experiences was central to reducing this bias (Moustakas, 1994).

An additional issue that may affect the data's trustworthiness is the concept of social desirability. Social desirability has to do with the research study participants' motivation to offer answers or behave in a manner to make participants "look good" to the researcher or other participants (Bryman et al., 2008). Social desirability was intentionally minimized through the use on an anonymous survey and sound interview techniques such as building rapport with the participants to put them at ease and employing a non-judgmental stance. The researcher used a conversational style with participants to help them feel comfortable while telling their stories and minimize the risk of this limitation.

Delimitations

Delimitations are the methodological and design choices in the study that affect the study data and findings (Creswell & Creswell, 2017). The primary delimitation of the present study is drawing participants from a couple organizations. At best, the findings will permit the development of in-depth understanding of teachers within Second Act

and California Science Educators. Because the findings are limited to two California-based organizations, they may be transferable but not generalizable to other ESCSTs.

Another delimitation is the use of self-reported survey data and interviewing to collect data. Self-reported interview data limit the findings to what insights participants provide of themselves or in conversation with the researcher. It is possible that gathering data through other means might have generated other insights and conclusions as participants built upon each other's ideas. The study also relies on self-reported data with no direct observable information about the actual events and behaviors of the participants.

A third delimitation involves convenience sampling methods (Creswell & Creswell, 2017), which involves recruiting participants accessible to the researcher (e.g., within their existing personal or professional network). This strategy could be construed as problems with external validity, as opposed to random sampling methods typically used in quantitative studies. The population of research participants consisted of those individuals which the researcher has linguistically and logistically more convenient access. Issues of validity and reliability measures will be addressed in the methods chapter.

The final study delimitation was reliance on a small sample size. Research interview studies tends to utilize small sample sizes to assure that processes of data collection and management remain feasible (Brinkmann & Kvale, 2005); however, this limits the range of data and insights gathered, thus affecting the ability to transfer findings to other settings. However, the sample size in this study was acceptable for the research design and achieved data saturation (Creswell & Creswell, 2017).

Assumptions

This dissertation assumes that individuals transitioning into teaching as a second career have a natural desire to be a successful teacher and resiliency may play a factor in that professional success. Literature across fields expanded research efforts regarding resilience in teachers and students; however, research is currently lacking regarding second career teachers; especially ESCSTs. Accordingly, this dissertation is anticipated to fill a current gap in literature and practice. It is additionally assumed that enhancing ESCST resilience may be achieved by uncovering and leveraging factors known to enhance resilience.

Organization of the Study

This chapter provides an introduction to the study, including the problem background and study purpose and research questions. The setting for the study also was introduced and the significance of the study was outlined. Definitions for the terms central to the study were presented, along with the underlying theoretical framework for the study. The researcher's background also was described. Chapter 2 reviews extant research and literature related to this study, including what is currently known about STEM teachers public secondary schools; the challenges facing early career teachers; and a discussion of the career transition process and how STEM professionals transition into teaching roles in a public secondary schools. This chapter also describes resilience theory as a theoretical framework. Chapter 3 outlines the study methods, including the research paradigm, research design, participant selection, ethical considerations, and data collection and analysis procedures. Chapter 4 reports the results of the study. The quantitative survey results are reported first, followed by the

qualitative results. Chapter 5 provides a discussion of the results, beginning with a

summary of the study summary, followed by a presentation analysis of the findings,

implications for practice, and recommendations for additional research.

Chapter 2: Literature Review

The purpose of this mixed methods, phenomenological study was to examine and compare resilience in ESCSTs and ECSTs in public secondary school settings. In addition, it examined how ESCSTs and ECSTs perceive and foster resilience in their K-12 teaching experience. Three research questions were examined:

1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?

2. How do ESCSTs and ECSTs describe their resilience?

3. How do ESCSTs and ECSTs build resilience?

This chapter provides a review of literature relevant to the present study. First, what we know currently about STEM teachers is reviewed. Next, literature on public secondary teachers is reviewed, including a discussion of the public school setting and the process of becoming a public school teacher. The challenges facing early career teachers also are acknowledged, followed by an analysis of the career transition process and how STEM professionals transition into teaching roles in public secondary schools. Next, the chapter discusses resilience, including its definition and review of why resilience is important. Moreover, the personal, contextual, and procedural factors that enhance resilience are outlined. Instruments to measure resilience are then reviewed and a discussion of how resilience is sustained during career transition is presented. Finally, resilience in teachers, specifically, is analyzed before introducing resilient leadership, the theoretical framework on which this study was based. The chapter closes with a summary and identification of gaps in the literature.

What Do We Know About STEM Education and Teachers?

The launch of Sputnik on October 4, 1957, spawned the Space Race, a Cold War competition between America and Russia to lead space exploration. As part of the Space Race, STEM education was given more funds and became a focus in schools, starting with the 1958 National Defense Education Act, or NDEA (Hoff, 1999; Markus, 2021; Powell, 2007). Academics began revising physics, biology, chemistry, and mathematics courses with funding from the National Science Foundation. The campaign had entered the social sciences by the early 1960s. For example, hundreds of summer seminars taught by university professors demonstrated to teachers how to use the new STEM materials in the classroom. The NSF, a separate federal body, spent $500 million on curricula and teacher training in the 20 years following Sputnik. A few science resources were well-liked and often used, and copies of them can still be found in schools today. Others, however, such as the "New Math" of the 1960s and "Man: A Course of Study," a fifth-grade anthropology course, did not catch on, prompting Congress to cut back on NSF curricular programs in the late 1970s (Hoff, 1999).

Since 2011, California has updated its standards and frameworks across all subject areas (Markus, 2021). These updates brought targeted student outcomes and instructional approaches that were better aligned with the most recent learning research. For instance, the Common Core Mathematics Practices and the Science and Engineering Practices of the Next Generation Science Standards both assist students in developing essential abilities and ways of thinking.

STEM-related positions are those related to science, technology, engineering, and math, including computer and mathematical, architecture and engineering, and life

and physical science occupations, as well as managerial and postsecondary teaching occupations related to these functional areas (U.S. Bureau of Labor Statistics, 2020c). Sales occupations requiring scientific or technical knowledge at the postsecondary level also are considered STEM occupations. As of 2019, 6% of all jobs in the U.S. (9,955,100) were STEM-related. This number is projected to increase to 14% by 2029, totaling 10.8 million jobs (U.S. Bureau of Labor Statistics, 2020a). The median wage for a STEM occupation in 2019 ($86,980) was approximately 40% higher than that of secondary teachers ($61,660) —the population examined in the present study—and more than double the median wage for non-STEM occupations ($38,160; U.S. Bureau of Labor Statistics, 2020a, 2020b). These statistics indicate that the demand for STEM-trained professionals is growing and the compensation for pursuing a STEM-related career is highly lucrative.

Fulfilling the demand for STEM-trained professionals in the U.S. requires a strong K-12 and university pipeline to equip individuals to fill these roles (Morrell & Salomone, 2017). While the curriculum must be focused, rigorous, and coherent; an equally critical component is having qualified, committed STEM teachers. Specifically, instruction should be provided by educators who have deep content knowledge and the ability to teach that content in accessible ways to students.

However, teacher preparation programs struggle to produce teachers. Although more than 1,200 teacher education programs are offered at universities nationwide and 130 alternative routes to licensure are available, central oversight and curriculum standards are lacking to assure teaching quality (Shulman, 2005). Levine (2006) wrote an influential series of policy papers critical of teacher education programs, calling for

an overhaul of how teacher candidates are prepared and closure of failing teacher preparation programs. As a result, a system of teacher preparation that emerged tended to be disorganized and uncoordinated (Wilson, 2011).

There is an overrepresentation of foreign-born post-secondary STEM teachers in the United States (Furuya et al., 2019). While it is possible to recruit public secondary STEM teaching staff from countries with stronger STEM competencies, only 11% of the nation's estimated 8.1 million teachers are legal immigrants, and only 7% of K-12 teachers across all subjects are foreign-born. The overrepresentation of post-secondary foreign-born teachers is due to (a) the sizable and expanding number of international doctoral students studying in the U.S., (b) the numerical limits on visas imposed on U.S. employers, and (c) increasing barriers to legal immigration. For example, recent barriers to legal immigration include changes to student visas and cultural exchange visas, revisions to the H-1B visa program, bans on admissions on nationals from certain countries, termination of Deferred Action for Childhood Arrivals and work authorization for spouses of highly skilled workers (U.S. Citizenship & Immigration Services, 2022). Moreover, some states, such as Pennsylvania, require public school teachers to have U.S. citizenship, further reducing the population of eligible K-12 STEM teachers (Penn State College of Education, 2020). These declines in eligible K-12 STEM teachers also may be influenced, in part, by the federal restrictions on visas and by the school shutdowns associated with the COVID-19 pandemic.

The National Comprehensive Center for Teacher Quality (2007) noted six strategies for increasing the number of U.S.-born STEM teachers. These include (a) grow your own, (b) partner with universities and colleges, (c) offer incentives, (d) reduce

obstacles to hiring, (e) provide support for these teachers, and (f) improve retention. Another approach to increase the number of qualified STEM teachers is to attract, encourage, and support those individuals with deep STEM knowledge built through a career in industry to transition into teaching. Yet, finding willing candidates does not ensure they will successfully overcome the many hurdles that they will face in their journey to become a credentialed teacher (Johnson et al., 2014). Common challenges faced by ESCSTs include a rigorous, multi-year credentialing process (Commission on Teacher Credentialing, 2019); a range of challenges that threaten teacher candidates' morale, wellbeing, and success (Bezzina, 2006), such as insufficient pre-service education and onboarding (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006); excess idealism misaligned with the daily realities of classroom teaching (Abbott-Chapman, 2005; Day & Gu, 2010); and inadequate personal and contextual factors to support success, resilience, and retention (Andrews et al., 2007; Kanpol, 2007). When STEM professionals transition to the classroom, the result is often a "sink-or-swim" experience (Howe, 2006). Stress and burnout are common (Goddard & O'Brien, 2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007). The result often is untenable levels of attrition in early career teachers (House of Representatives Standing Committee in Education and Vocational Training, 2007).

The next section examines the unique population of public secondary teachers in more detail, including definition, the processes and qualifications for public school teaching, the challenges early career teachers experience, and how STEM professionals transition into teaching.

What Are Public Schools?

The history of public education starts with the founding of the United States. Thomas Jefferson believed that education was the best way to prevent tyranny and in 1867, the Department of Education was formed (Snyder, 1993). The following sections provide an overview of different types of public schools in the U.S.

Public Schools Educate Most Americans

Public schools are educational institutions designed to provide primary instruction to residents aged 4-18 within a designated geographic region (Hess, 2004). Parents do not pay tuition for public compulsory education; instead, educational costs are paid for primarily using tax revenue. Oversight and funding for public schools occur at the federal level by the U.S. Department of Education, at the state level by state-based departments of education, and at the local level by the county office and school districts. In 2021, the most recent data available at the time of the present study, approximately 49.5 million children (78%) of children were enrolled in 98,469 public schools within 13,551 public school districts across all 50 states, grades K-12 (National Center for Education Statistics, 2022). These public school districts and organizations employ 3.2 million K-12 teachers.

States and school districts share control over planning curricula. Each state directs the school districts located within it concerning educational standards and standardized testing, while each county office and school district sets the curricula, funding and employment for the schools within its boundaries. There are three main types of public schools: neighborhood schools, charter schools, and magnet schools (Hess, 2004). These are described in the following sections.

Neighborhood Schools. A neighborhood public school is the school assigned to those children who fall within the grade range served by the school and who live within the specified vicinity of the school (Sun et al., 2023). School districts organize individual school boundaries to achieve school sizes that, based on enrollment, are neither too small nor too large (e.g., two to four classes per grade according to Sun et al., 2023). Additionally, neighborhood schools reflect their local communities.

Public Charter Schools. Charter schools are similar to neighborhood schools in that they are both funded in the same way, but charter schools are allowed greater freedom over their teaching methods and are subject to less rigorous state standards. Charter schools were first created in 1992 in Minnesota based on the belief that public schools should be held accountable for student learning (Schroeder, 2004). For example, students attending Louisiana public charter schools have an additional 50 days of learning in reading and 65 days in math, compared to their peers attending traditional public schools. Typical strategies used by charter schools include forming strong partnerships among parents, teachers, and students; adjusting curricula based on teacher discretion and student needs; forming a unique school identity by focal area (e.g., performing arts, career readiness, college preparation, autistic students); and developing and utilizing innovative learning models (e.g., outdoor classrooms, online learning). As of the 2017-2018 school year, 3.1 million students across grades K-12 were enrolled in 7,193 charter schools in the U.S. (U.S. Department of Education, 2019d).

Consistent with other public schools, charter schools do not charge tuition and do not have any special admission requirements. Although they are open to all children,

many utilize a lottery system to select incoming students due to their popularity. Advocates of charter schools assert that these schools close the achievement gap and help raise expectations of what is possible in public education, as they boast higher graduation rates, college enrollment rates, and standardized test scores than traditional public schools. They also have less financial restrictions.

Public Magnet Schools. Public magnet schools are educational institutions operated by a school district or collection of districts (Wang & Herman, 2017). Each school defines a focused theme and aligns its curricula accordingly. Themes may range from science and engineering to the arts, to STEAM, to vocational training. Many offer self-paced curricula, although the teaching of the subject areas adheres to state, district, or Common Core standards. As of the 2017-2018 school year, 2.7 million children grades K-12 were enrolled in 3,421 magnet schools in the U.S. (U.S. Department of Education, 2019d).

Magnet schools exhibit similarities and differences to neighborhood and charter schools. First, magnet schools do not charge tuition. The sole admission requirement is that students have interests and talents that align with the school's focus (Wang & Herman, 2017). Gifted and Talented magnet schools sometimes require student assessment data and teacher or parent recommendations as part of the admissions process. Due to the popularity of magnet schools, most use a random computer-based lottery system to select students. Consequently, charter school, student demographics tend to be highly diverse.

Advocates of magnet schools boast higher student attendance and graduation rates, higher academic achievement, increased cultural competence of students,

reduced discipline problems, and increased parent engagement and satisfaction compared to traditional public options (Wang & Herman, 2017).

These data reveal that most U.S. public schools and their students (89%) are associated with neighborhood schools (see Table 1). Consequently, the focus of the present study was on neighborhood public school settings.

Table 1

Public School Enrollment by School Type

Public School Type	Number of Schools	Number of Students
Neighborhood	87,855 (89%)	44.9 million (89%)
Charter	7,193 (7%)	3.1 million (6%)
Magnet	3,421 (3%)	2.7 million (5%)
Total	98,469	50.7 million

Note: Data for 2017-2018 school year. Adapted from "Table 216.20. Number and enrollment of public elementary and secondary schools, by school level, type, and charter, magnet, and virtual status: Selected years, 1990-91 through 2017-18," by U.S. Department of Education, January 2019, Washington, DC: U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD; https://nces.ed.gov/programs/digest/d19/). In the public domain.

There Are Multiple Pathways to Become a Public School Teacher

As of the 2018-2019 school year, more than 307,000 credentialed teachers taught in the California teaching workforce (EdSource, 2020). Three types of credentials exist in California: multiple subject, single-subject, and education specialist. The multiple-subject credential includes 42.9% of credential earners in the 2017-2018 school year, largely for elementary teachers who must teach multiple subjects. Single-subject credential account for 37.8% of credential earners in the 2017-2018 school year, primarily for middle and high school teachers who deliver instruction in one subject.

Finally, education specialist credentials total 19.3% of credential earners in the 2017-2018 school year, typically for special education teachers.

The average age for teachers in California is 45 years old, with most teachers being 30–39 (15%), 40–49 (24%), and 50–59 (21%). In the 2018-2019 school year, 6.4% of California's teachers were in their first year of teaching and just over 5% were second-year teachers. Although statistics are available related to the STEM job market and student-related STEM indicators, specific statistics on the STEM teaching workforce were not found as part of this review.

The process of becoming a credentialed California public school teacher involves extensive training, documentation, and persistence over several years. To qualify to teach, initially, an individual needs a *Preliminary* or *Level I* Credential (Commission on Teacher Credentialing, 2019). Four requirements—basic knowledge, knowledge of the U.S. constitution, subject matter expertise, and teacher preparation and performance—need to be satisfied to attain a preliminary credential from the California Commission on Teacher Credentialing (see Figure 1).

Figure 1

Preliminary Credential Requirements for California Public Schools Teachers
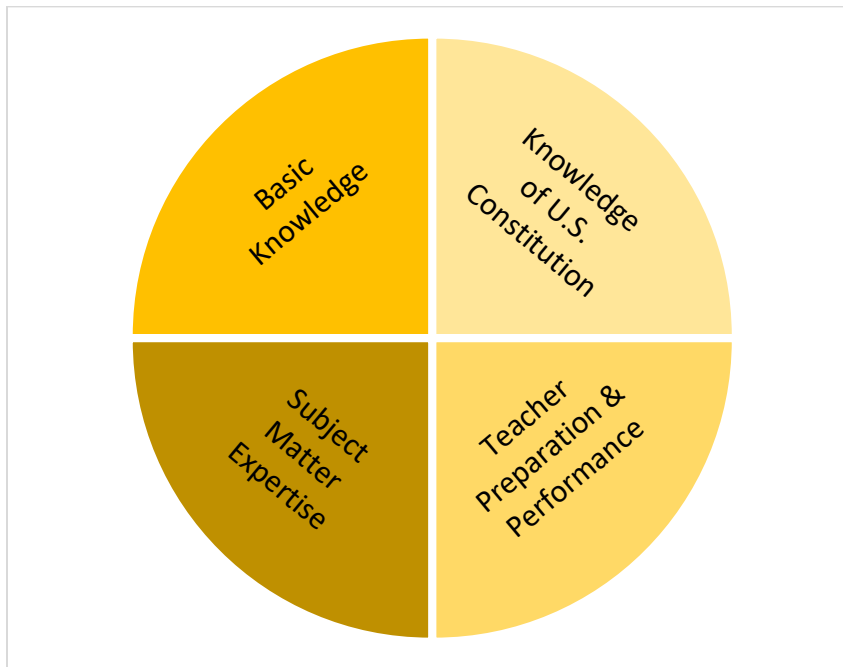
Note: Adapted from "Clear Your Credential," by Commission on Teacher Credentialing, 2019 (https://www.ctc.ca.gov/credentials/clear-credential). In the public domain.

Basic Knowledge. Basic knowledge involves demonstrating that the individual possesses the basic knowledge and skills needed to teach. This proof is provided by holding at least a bachelor's degree and completing one of the following requirements:

- Passing the California Basic Educational Skills Test (CBEST)

- Passing the California Subject Examinations for Teachers (CSET): Multiple Subjects plus writing skills examination

- Passing the California State University (CSU) Early Assessment Program (EAP; English and Mathematics sections) or the CSU Placement Examinations (English Placement Test [EPT] and Entry Level Mathematics [ELM])

- Attaining a qualifying score on the SAT or ACT

- Achieving a score of 3 or higher on the College Board AP English exam and AP Calculus or AP Statistics exam

- Passing a basic skills examination from another state (State of California Commission on Teacher Credentialing, 2020).

Knowledge of the U.S. Constitution. Individuals may prove they possess adequate knowledge of the U.S. Constitution by completing a 2-semester unit or 3 quarter unit course on the U.S. Constitution or by passing an examination administered by a regionally accredited college or university (State of California Commission on Teacher Credentialing, 2019).

Subject Matter Expertise. Subject matter expertise may be demonstrated by achieving passing score on the appropriate subject-matter examination. It also can be demonstrated by completing a Commission-approved subject-matter program or its equivalent, or taking and passing the appropriate subject matter examinations or completing approved subject-matter coursework (for specialized science subjects only).

Teacher Preparation and Performance. Individuals also must complete a Commission-approved teacher preparation program that includes developing English language skills (including reading), instruction in foundational and advanced computer technology (especially as applied to educational settings), and instruction in health education (i.e., nutrition, substance use, cardiopulmonary resuscitation; State of California Commission on Teacher Credentialing, 2019). Candidates also must receive a formal recommendation for the credential from the program sponsor. As of July 2008, candidates also must pass an assessment of their teaching performance through the educative Teacher Performance Assessment (edTPA), the California Teacher

Performance Assessment (CalTPA), or the Fresno Assessment of Student Teachers (Commission on Teacher Credentialing, 2020).

While holding a preliminary credential, individuals are required to complete additional requirements while teaching and to earn a Clear or Level II credential. To do so, individuals may complete a Commission-approved Teacher Induction Program and submit an application for the clear credential through the Induction program sponsor (State of California Commission on Teacher Credentialing, 2019). Alternately, teachers who received the California Preliminary Single Subject Teaching Credential and earned certification through the National Board of Professional Teaching Standards are issued a Clear Teaching Credential in their designated subject area. A third pathway to a clear credential for holders of a career technical education preliminary credential (for career technical, trade, or vocational courses) is to gain 2 years of verified successful teaching, completion of a commission-approved program of personalized preparation, education in the U.S. Constitution, health education, and education in computer-based technology (State of California Commission on Teacher Credentialing, 2016).

Although most California public school teachers need to satisfy the four requirements to earn a preliminary credential and go on to earn a clear credential, four pathways exist to complete this process (Suckhow & Lau, 2019; see Table 2):

1. Student teaching candidates receive a year of mentorship by watching an experience teacher teach the single subject area and engaging in teaching in a controlled setting. Student teachers are unpaid. Approximately 53% preliminary credential holders in the 2018-2019 school year were student teachers.

2. Internship candidates complete a 120-hour preservice program and then teach full-time in their own classroom. Internship candidates accounted for 22% of preliminary credential holders in 2018-2019.

3. Out-of-state or out-of-country teaching candidates gain teaching experience outside of California or the U.S.. For example, a candidate serving in the Peace Corps who teaches 50% of their time over 18 months could obtain the credential with a letter from a director in the Peace Corps (State of California Commission on Teacher Credentialing, 2019). Similar to the Internship candidates, Out of State or Out of Country candidates made up 22% of preliminary credential holders in 2018-2019.

4. Career Technical Education: Candidates teach engineering, architecture, health science, medical terminology, or information and communication technology. In order to get a 3-year preliminary credential, the holder must have worked 1000 hours per year part-time or full-time, paid or unpaid, in the industry sector to be named in the credential. They must possess a high school diploma or equivalent, live-scan (fingerprinting), verification and recommendation by the commission approved Career Technical Education program sponsor. Career Technical Education candidates made up 3% of preliminary credential holders in 2018-2019.

Table 2

Four Pathways Utilized to Obtain a California Teaching Credential California (2018-2019)

Pathway	Requirement	Percentage
Student teaching	Observed an experienced teacher teach the single subject area and teach in a controlled setting	53%
Internship credential	Completed a 120-hour preservice program and then teach full-time in their own classroom	22%
Out-of-state and out-of-country teaching	Gained teaching experience outside of California or the U.S.	22%
Career Technical Education Program	Worked 1000 hours per year part-time or full-time, paid or unpaid, in the industry sector to be named in the credential	3%

Note: Adapted from "Teacher Supply in California: A Report to the Legislature," by M. A. Suckhow and P. P. Lau, 2019, Annual Report, 2017-2018 Submitted Pursuant to AB 471 (Chap. 381, Stats. 1999). California Commission on Teacher Credentialing (https://www.ctc.ca.gov/docs/default-source/commission/reports/ts-2018-19-annualrpt.pdf?sfvrsn=bd1b2cb1_2). In the public domain.

Multiple Pathways Emerged in Response to the California Teacher Shortage

The multiple pathways to becoming a public-school teacher in California emerged as a result of a decades-long teacher shortage across the state's districts. In 2016, the Learning Policy Institute (LPI) and the California School Boards Association (CSBA) surveyed 211 of the state's 945 districts and found that 75% reported a shortage of qualified teachers for the 2016-17 school year and 7% reported shortages of principals and district-level administrators. The greatest needs for teachers were reported in large metropolitan areas and in schools that had large populations of English language learners, low-income students, minority students, and students needing special education (Podolsky & Sutcher, 2016). Relevant to the present study, among the districts with shortages, 58% reported a shortage of math teachers, while 57% reported a shortage of science teachers.

The teacher shortage result from various factors, including increased turnover, escalating numbers of retirements as *Baby Boomers* (born between 1946-1964) and *Generation Xers* (born between 1965-1980) reach retirement age, and even more troubling, a declining supply of teachers (Podolsky & Sutcher, 2016). An earlier report found that teacher education enrollments dropped 35% across the nation from 2009 to 2014, indicating that the teacher shortage will only continue (Sutcher et al., 2016).

The teacher shortages affected 80% of districts by 2019 (Learning Policy Institute, 2019). The shortages persisted across the state as of the 2022-2023 school year, based on a survey conducted by EdSource (Jones, 2022). The survey polled a representative sample of 16 California school districts representing urban, rural, coastal, valley, large, small, affluent, and low-income districts across the state. Of the respondents, 44% of districts reported significant shortages and 44% of the districts reported minor shortages (Jones, 2022). The shortages continued to occur within districts, primarily occurring in less wealthy, more urban, and more diverse (in terms of ethnicity, language, and learning differences) schools.

Districts use various strategies to cope with the teacher shortages. These strategies include bringing onboard teachers with emergency or temporary credentials (55%), hiring long-term substitutes (24%), leaving the teaching positions vacant (17%), increasing the sizes of their classes (9%), and canceling courses (8%). Other strategies included teacher preparation partnerships, such as establishing alliances with teacher colleges and expanding residency programs; fortifying the pathways to becoming a teacher in the district; and improving teacher compensation, hiring and management practices, and working conditions. In addition, several STEM-specific programs (e.g. the

Georgia Residency for Educating Amazing Teachers (GREAT), U-Teach, and The Michigan Institute for Teacher Excellence Program, EnCorps) emerged to help foster future STEM teachers. These are discussed in more depth below.

The COVID-19 Pandemic Exacerbated the California Teacher Shortage

The teacher shortages have only intensified amidst the COVID-19 pandemic and corresponding "Great Resignation". Moreover, these shortages disproportionately affected STEM and special education teachers, which were already significant before the pandemic (Jones, 2022; Learning Policy Institute, 2019; Podolsky & Sutcher, 2016). With the COVID-19 pandemic, increasing numbers of educators fell ill, were forced to quarantine, opted for early retirement, or simply left the field, while even fewer people applied for substitute teaching credentials.

These dramatic shifts further weakened an already shaky labor market of California teachers. For example, as of 2018, teacher turnover contributed to 88% of the demand for new teachers, as 8.5% of California educators leave the field each year and another 8% leave their schools to join the staff of another (Darling-Hammond, Goldhaber et al., 2018). The teacher supply impacts of COVID-19 left several school districts simply trying to stay open. In turn, school districts redoubled their efforts to fill the shortages through hiring underqualified educators, especially in areas such as special education and STEM. The staffing problems have only added to the associated problems of online learning and COVID-19, intensifying issues of low student engagement, high teacher-student ratios, poor educational standards, and substandard learning outcomes (Heinich et al., 2012; Hidayati et al., 2020; Hoang et al., 2020; Pressley, 2021).

Early Career Teachers Experience Multiple Challenges

Numerous studies have explored the challenges and obstacles early career teachers face (Abbott-Chapman, 2005; Algozzine et al., 2007; Andrews et al., 2007; Bezzina, 2006; Day & Gu, 2010; House of Representatives Standing Committee in Education and Vocational Training, 2007; Howe, 2006; Johnson et al., 2009; Kanpol, 2007; Peters & Le Cornu, 2007a, 2007b; Quinn & Andrews, 2004; Robertson, 2006; Ramsey, 2000; Roehrig & Luft, 2006). Bezzina (2006) used the grim metaphor of teachers' battles to survive in the trenches to characterize educators' experiences. Core issues identified in past research include:

- Insufficient pre-service education and onboarding, leaving teachers with knowledge and skill gaps that undermine their abilities to meet the demands of classroom teaching (Algozzine et al., 2007; House of Representatives Standing Committee in Education and Vocational Training, 2007; Ramsey, 2000; Roehrig & Luft, 2006). Particularly acute gaps tend to occur in the area of classroom management (Johnson et al., 2009; Robertson, 2006). Howe (2006) suggests that most teachers must resort to trial and error in their first year of teaching.

- Excess idealism misaligned with the daily realities of classroom teaching (Abbott-Chapman, 2005; Day & Gu, 2010).

- Insufficient personal factors, such as resilience (Peters & Le Cornu, 2007a, 2007b), enthusiasm, and creativity (Kanpol, 2007).

- Inadequate contextual factors (Peters & Le Cornu, 2007a, 2007b), such as lack of support from school leadership (Andrews et al., 2007; Quinn &

Andrews, 2004), unsupportive school cultures and policies, and

demoralization and disempowering tactics (Kanpol, 2007).

These challenges tend to escalate teachers' stress and burnout (Goddard & O'Brien, 2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007), leading to untenable levels of attrition in early career teachers (House of Representatives Standing Committee in Education and Vocational Training, 2007).

The problem of early career teacher attrition and failure has not been solved. Although interventions and solutions to the problems described in this section have been attempted, the solutions typically surround "fixing" early career teachers who lack the knowledge, skills, and coping ability. However, such solutions tend to fail due to their focus on pathologizing and correcting individuals without attention to teachers' agency or the role of the larger environment. These efforts often fail to address the structural and programmatic deficiencies of teacher preparation programs. Instead, it is necessary to understand the role of resilience in early career teachers and how it can be enhanced.

How Do STEM Professionals Transition to STEM Teaching Positions?

STEM professionals could help with the teacher shortage by making a career shift to K-12 public school teaching. Thomas (1980) defines a career change as one that requires more than a 90-degree turn, meaning that the change will require new training, credentials, or certifications. Plimmer and Schmidt (2007) later characterized career transition as making a shift from working being a function of *what one wants to do* to working being a function *who one wants to be*.

Traditional conceptions of career transition held that people changed jobs to increase their salaries (Thomas, 1980). However, Thomas (1980) found that only 11% of career changers were motivated to shift careers due to compensation, with other participants even taking a pay cut to make a career change. Based on his research, Thomas defined four categories of career changers, who varied based on internal pressure to change (e.g., dissatisfaction, unhappiness, desire for challenge, drive for achievement, desire to make a difference) and external pressures to change.

There are four types of career changers. *Drift-outs* are those under no particular pressure from themselves or their organizations or environments to change. *Opt-outs* similarly experience low environmental pressure to change but are highly motivated within themselves to make a change. In contrast, *Force-outs* do not particular want to change but must do so as a result of significant external pressure. *Bow-outs* are distinct in that they experience high pressure both internally and externally to change. Thomas (1980) found that these four types of career changers differed on a variety of variables, including formal education (with force-outs having and seeking the least and opt-outs having and seeking the most during a career change); timeframe for the career change (force-outs demonstrates the shortest timeframe, drift-outs the longest); and radicalness of the career change (force-outs demonstrating the most, bow-outs the least); and motivation for career change. It is anticipated that the resilience of career changers also would vary by career changer type. Although Thomas (1980) did not explicitly examine the links between career changer types and resilience, a body of literature has examined resilience during career transitions. This theory and research are discussed in the next section.

Multiple Programs Help Prepare STEM Professional as STEM Teachers

Several programs have emerged to help STEM undergraduate degree holders and STEM professionals transition to K-12 STEM teaching roles. Several examples include Encorps, the Georgia Residency for Educating Amazing Teachers (GREAT), U-Teach, and The Michigan Institute for Teacher Excellence Program.

EnCorps was founded in 2007 for the purpose of "attracting the best and brightest STEM professionals" to teaching, providing significant opportunities to influence students in low-income communities (EnCorps, 2022). This effort is intended to address the STEM teacher shortage. EnCorps is dedicated to providing all students with access to excellent STEM teachers, excellent STEM instruction, and the opportunities these can bring. EnCorps Fellows herald from various STEM-related sectors, but share a fundamental dedication to public service and teaching in schools with significant need. EnCorps fellows are lifelong learners who encourage a passion for STEM in others and think all pupils are capable of success. Fellows receive teaching certification and use their STEM industry experience in under-resourced areas' high-needs schools. EnCorps is a selective program that, over the past three years, has accepted only 18.7% of its applicants as Fellows. The following competencies are given priority in their research-based method of candidate screening and selection: leadership and influence, mission alignment, accomplishments in their STEM field, resilience and grit, personal responsibility, growth mindset, orientation for lifelong learning, and cultural awareness and sensitivity (EnCorps, 2022).

The Georgia Residency for Educating Amazing Teachers (GREAT) is designed to help STEM graduates and professionals become middle school STEM teachers

(Southern Regional Education Board, 2020). The GREAT program uses funds from a U.S. Department of Education Teacher Quality Partnership grant to coordinate efforts between Georgia's Southern Regional Education Board and Georgia College & State University to prepare individuals with STEM-related degrees or careers to become middle grades STEM teachers in rural Georgia (Southern Regional Education Board, 2020). Candidates must hold a bachelor's degree in math, science, or a STEM field or expect to graduate with a bachelor's degree in one of these fields within a year. Candidates also must demonstrate professional experience in a STEM career field and hold a bachelor's degree in any field with a preferred minimum of nine undergraduate credit hours in math and nine in science. In the program, resident teachers gain paid classroom teaching experience in Grades 6-8 in rural Georgia under the guidance of a mentor teacher while completing an online 36-credit Master of Arts in Teaching at Georgia College & State University. After successful completion of the teaching residency, program teachers will be hired by the district where they served, and must agree to teach in the district for 3 years.

UTeach, designed to recruit talented STEM college majors into secondary teaching, offers a 4-year (rather than the typical 5-year) path to degree completion and teaching certification (University of Texas at Austin, 2020). The program combines coursework in STEM and pedagogy; personalized coaching and supervision by master teachers; and teaching intensives in K–12 classrooms, which begin in their freshman year and culminate in assuming full teaching responsibilities in a secondary classroom approximately four hours per day for 12 weeks in their senior year. UTeach originally was launched at the University of Texas at Austin in 1997 and has spread to 46

universities across 22 other states since them. The National Research Council and U.S. Department of Education have recognized UTeach as an exemplar for STEM teacher preparation.

The Michigan Institute for Teacher Excellence Program (2012-2021) focuses on enhancing the subject matter and pedagogical expertise of middle school Earth science teachers who have limited training. Groups of 12–24 teachers drawn from three cities (Grand Rapids, Kalamazoo, Jackson) dedicate 3 years to summer fieldwork studying the unique geology of the state, professional development days, online courses to cultivate content knowledge, internship experiences at national parks, and district leadership opportunities wherein they offer professional development to peers or present their work at state science teacher meetings.

The programs described in this section demonstrate the efforts among STEM educators and those who support them to assure that STEM teaching talent is cultivated and strengthened to support national competitiveness. The next section discusses the process of how STEM professional transition to a public secondary STEM teaching position.

How Do People Qualify as Public Secondary STEM Teachers?

Public schools are educational institutions designed to provide primary instruction to residents aged 4-18 within a designated geographic region. The majority of U.S. students are enrolled in public school and, of these, the majority are enrolled in neighborhood schools (U.S. Department of Education, 2019a, 2019b, 2019c).

Attaining a public school teaching credential involves a rigorous, multi-year process that requires a range of knowledge and skills as well as persistence and

attention to detail (Commission on Teacher Credentialing, 2019; State of California Commission on Teacher Credentialing, 2016, 2018, 2019, 2020). In addition to the rigorous credentialing process, early career teachers face a range of challenges that threaten their morale, wellbeing, creating a sink-or-swim experience and high attrition in early career teachers (House of Representatives Standing Committee in Education and Vocational Training, 2007).

Based on a review of literature, the present study proposes that enhancing teacher resilience may best support them in navigating the challenges of becoming a public school teacher (Johnson et al., 2014; McGarry et al., 2013; Peters & Pearce, 2012; Richardson, 2002). Research literature indicates five such strategies for supporting early career teachers: (a) effective recruiting and onboarding policies and practices, (b) support and development opportunities (Johnson et al., 2014), (c) an inclusive school culture regarding teaching and learning to teach (Conway & Clark, 2003; Flores & Day, 2006; McCormack et al., 2006; Peters & Pearce, 2012; Wood, 2005), (d) strong in-school relationships and support networks (Allison, 2012; Castro et al., 2010; Flores & Day, 2006; Gu & Day, 2007; Johnson et al., 2014; Mansfield et al., 2014; Manuel, 2003; Peters & Le Cornu 2007a); and (e) self-care and self-understanding (Allison, 2012; Johnson et al., 2014; Mansfield et al., 2014).

STEM-related positions comprise a rather small but growing percentage of the overall jobs in the U.S., but command the largest salaries (U.S. Bureau of Labor Statistics, 2020a, 2020c). Key to fulfilling the demand for U.S.-based STEM-trained professionals is building a strong K-12 and university pipeline to equip individuals to fill these roles (Morrell & Salomone, 2017). Success in creating this pipeline relies on

qualified, committed STEM teachers who have deep content knowledge and the ability to teach that content in accessible ways to students. Attracting and support career changers from industry may be a promising tactic for creating a knowledgeable and passionate STEM teaching force. However, career transition is fraught with difficulty (Zukas & Kilminster, 2014), meaning that those who attempt such as transition—especially into the challenging profession of teaching (Gu, 2014; Mackenzie, 2012; Mansfield et al., 2014)—needs to be equipped with resilience and supported in continually strengthening their resilience if they are to achieve long-term success and satisfaction in their new profession (Carless & Bernath, 2007; Carson & Bedeian, 1994; Cascio, 2007; Chiaburu et al., 2006; Kidd & Green, 2006; London, 1983; Lyons et al., 2015; Wei & Taormina, 2014). More research is needed to examine the specific factors and processes involved in supporting and enhancing the resilience of ESCSTs.

What Is Resilience?

Resilience is defined in this study as an individual's process of, ability to engage in, or outcomes related to positive adaptation despite challenge or threat (Bottrell, 2009; Bowles & Arnup, 2016; Masten et al., 1990). Nonetheless, it is helpful to understand the history of the study of resilience, the various definitions of resilience that have emerged, and the purposes that resilience serves. The following sections discuss these topics.

History of the Study of Resilience

Career resilience became a focus in practitioner literature in the late 1980s and early 1990s as organizations increasingly relied on downsizing and restructuring to gain strategic advantage (Collard et al., 1996; Waterman, 1994). In these articles, career self-reliance, defined as the "ability to actively manage one's work life in a rapidly

changing environment" and "attitude of being self-employed" were distinguished from career reliance, which is the end result of being self-reliant in one's career (Collard et al., 1996, pp. 30-31).

Academic interest in career reliance has expanded since the 1990s. This rising interest occurred in concert with shifting career contexts (Baruch et al., 2015)—particularly within helping professions such as teaching (Gu, 2014; Mackenzie, 2012; Mansfield et al., 2014) and nursing (Coogle et al., 2007; Hodges et al., 2008; Ngoasong & Groves, 2016), wherein career resilience is considered key to employee retention. For example, Chiaburu et al. (2006) concluded that career resilience "is an important component in focusing proactive behaviors, because it brings together the necessary long-term commitment and persistence needed to engage in career self-management" (p. 623). Moreover, two studies have found that individuals who perceive themselves as career resilient are less likely to think about changing careers (Carless & Bernath, 2007; Kidd & Green, 2006). Particularly noteworthy for the present study, Kidd and Green (2006) found that career resilience was the strongest predictor of intention to leave the science profession. Mishra and McDonald (2017) reasoned that being persistent and capable of adapting to changing circumstances can help individuals continue in their chosen careers. Career resilience also has been associated with subjective perceptions of career success (Wei & Taormina, 2014) and career satisfaction (Lyons et al., 2015).

What Are the Definitions of Resilience?

Resilience is described as bouncing back after challenge, change, or adversity (Bowles & Arnup, 2016; Garcia-Dia et al., 2013; Luthans et al., 2006). Since its early conceptions, resilience has been alternately described as one's process of, ability to

engage in, or outcomes related to positive adaptation (successful modification) despite challenge or threat (Bottrell, 2009; Bowles & Arnup, 2016; Masten et al., 1990). Richardson (2002) noted that the emergence of the resiliency movement has expanded the definition of resilience to mean "growth or adaptation through disruption rather than to just recover or bounce back" (p. 313). Based on his examination of the research, Richardson (2002) identified three waves of evolution:

Wave 1. Wave 1 examined resilient characteristics. At this stage of inquiry, researchers sought to identify the characteristics of those who thrive despite risk factors or adversity versus those who enact destructive behaviors under adverse conditions. Accordingly, resilience was defined as qualities, assets, and protective (developmental) factors that help people grow through adversity.

Wave 2. Wave 2 examined resilient processes. During this era of resiliency inquiry, the focus was on uncovering the process of developing resilient qualities. In turn, resiliency became defined as how individuals deal with change, threat, or opportunity in ways that lead to identifying and strengthening their resilient qualities.

Wave 3. Wave 3 examined resilient motivation. According to this view, resilience is "the motivational force within everyone that drives them to pursue wisdom, self-actualization, and altruism and to be in harmony with a spiritual source of strength" (Richardson, 2002, p. 308). Thus, in the third evolution of resiliency theory, researchers concluded that individuals need motivational energy to engage in the resilient processes of reintegrating from disruptions in life.

In contrast to Richardson (2002), most traditional conceptualizations of resilience emerged from the medical and psychological sciences and have strongly influenced

research and theorizing about the construct over the past three decades (Johnson et al., 2014). Moreover, resilience has been studied through various contextual lenses, including family resilience (Bhana & Bachoo, 2011), psychological resilience (Fletcher & Sarkar, 2013), personal resilience (Jackson et al., 2007), and resilience in childhood (Luthar & Zigler, 1991; Zolkoski & Bullock, 2012). Yet, various vocal critiques of the current body of resilience research are evident. Johnson and Down (2013) summarized several criticisms of conventional constructions of resilience, arguing that current theorizations—focus too heavily on reductionist views of human coping and adaptation, leading to an over focus on identifying discrete risk and protective factors. Furthermore, current theorizations psychologize and pathologize the challenges and problems endemic to living and focus too heavily on individually based rather than socially situated solutions to these so-called problems. The authors assert that current theories propose narrow definitions of successful and non-successful life outcomes that ignore the idiosyncrasies of the individual and his or her social, cultural, and historic context. They suggest that resilience is an actual psychological construct demonstrated in human behavior, rather than a guiding metaphor for the dynamic, complex interplay of individual, relational, and contextual conditions that influence individual well-being.

In light of these critiques, social theories of resilience have emerged from disciplines including sociology (Bottrell, 2009; Boyden & Cooper, 2007), social psychology (Luthar et al., 2000), cultural studies (Ungar, 2005), and education (Day & Gu, 2010). Such theorizations situate the individual's challenges within their broader social, cultural, and political contexts, leading to more insights about both the

interactions and influences of these contexts as well as how the individual may be more effectively supported (Bottrell, 2009; Johnson et al., 2014).

Researchers have evolved their conceptualizations of resilience from that of an enduring personality trait (Block & Block, 2006) toward resilience as a product of personal and contextual factors (Garcia-Dia et al., 2013). For example, Block and Block (2006), who argued for resilience as a personality trait, conceptualized resilience in terms of psychoanalytic concepts of *ego-control,* the degree of inhibition or expression of impulses, and *ego-resilience*, the ability to modify the expression or inhibition of their impulses based on the situation. Block and Block (2006) posited that individuals with strong ego-resilience could adapt their level of ego-control situationally and thus avoid maladaptive coping. Although this perspective has strongly influenced resilience theory, it ignores the complexities and interdependencies of individual psychology. In contrast, Richardson's (2002) *Metatheory of Resilience and Resiliency* incorporates trait factors and contextual factors. Regardless of how resilience is conceptualized, researchers agree that resilience is associated with valuable personal and life outcomes. These outcomes and the general importance of resilience are discussed in the next section.

Resilience Serves Multiple Purposes

Resilience enables someone to rebound in the face of loss (Allison, 2012). The importance of resilience is reflected in Richardson's (2002) *Metatheory of Resilience and Resiliency* that posits four possible outcomes following challenge—whether those challenges stem from significant negative life-changing events or everyday "battles." The particular outcome an individual experiences depends upon the strength of his or her resilient motivation, process, and qualities. The outcomes, from best to worst, are:

1. Resilient reintegration, wherein the disruption triggers growth or strengthening of personal qualities.

2. Reintegration back to homeostasis, wherein the individual focuses on healing and getting past the challenging event, without focusing on or achieving growth.

3. Reintegration with loss, wherein the individual surrenders motivation, hope, or drive in response to the threat or disruption.

4. Dysfunctional reintegration, wherein the individual resorts to substances, destructive behaviors, or other deleterious means to deal with the challenge.

These varied outcomes lead to various personal and life trajectories, ranging from the destructive to the generative. Additionally, resilience has been associated with other indicators of psychological functioning, such as stress (McGarry et al., 2013), affect, and personality (Friborg et al., 2005; Lu et al., 2014). For example, McGarry et al. (2013) concluded based on their study of stress in health professionals that resilience acts as a protective factor against stress and post-traumatic stress in this population. Personality researchers further determined that resilience is negatively correlated with neuroticism (Lu et al., 2014) and positively correlated with emotional stability (Friborg et al., 2003). Lu et al. (2014) additionally discovered that negative affect is negatively correlated with resilience, while positive affect is positively correlated with the construct. Not only do these findings indicate the role resilience plays in psychological functioning; but some researchers additionally posit that resilience is key to uncovering how individuals perceive their capacity for dealing with and recovering from adversity.

For leaders, the importance of resilience is even more apparent. Allison (2012) found that resilient leaders bounce *forward* rather than simply back to homeostasis. Moreover, they do this both for themselves and their organizations. Thus, the actions they take allow them and their organizations to respond appropriately to continually emerging realities; even as they maintain the essential operations of the organizations they lead (Reeves & Allison, 2009, 2010).

What Supportive Conditions and Processes Enhance Resilience?

An extensive body of research has examined the personal qualities, contextual conditions, and processes for promoting and strengthening resilience (Caza & Milton, 2012; DeCastro et al., 2013; Penley & Tomaka, 2002).

Personal Factors Enhance Resilience

Several researchers investigated personal factors (e.g., personality traits, attitudes, skills, behaviors, and personal history) regarding their association and role in resilience (e.g., Penley & Tomaka, 2002). Bolger and Zuckerman (1995) created the Differential Coping-Choice Model to reflect how personality traits influence both an individual's reactivity to stressors and his or her preferred coping strategies, while Bowles and Arnup (2016) outlined personality profiles based on their Adaptive Change Questionnaire. Research on traits indicate that conscientiousness, the tendency to be purposeful, organized, diligent, determined, and ambitious (Costa & McCrae, 1992), is positively correlated with resilience (Arora & Rangnekar, 2016a; Carless & Bernath, 2007; Lyons et al., 2015; Wei & Taormina, 2014). Similarly, Grzeda and Prince (1997) found positive relationships between resilience and persistence and perseverance, while other researchers found relationships between resilience and proactive

personality, the tendency to take personal initiative and to persevere (Botha et al., 2015; Chiaburu et al., 2006). The exact nature and mechanisms of these relationships remain unclear. However, Mishra and McDonald (2017) proposed that conscientiousness may act as a general protective factor (Bartley & Roesch, 2011) against career-related stressors. Highly conscientiousness individuals may enact proactive behaviors that preclude threatening situations (Aspinwall & Taylor, 1997) or utilize more effective task-oriented coping rather than less effective emotion-oriented coping to deal with challenges (Campbell-Sills et al., 2006; Saklofske et al., 2007).

Neuroticism. Neuroticism, the personality trait associated with a tendency to experience psychological distress, anxiety, and depression (Costa & McCrae, 1992), has been found to be negatively associated with resilience (Arora & Rangnekar, 2015; Lyons et al., 2015). In related research, negative correlations were found between resilience and variables of trait anxiety (Lee et al., 2008) and risk aversion (Bowles & Arnup, 2016). Arora and Rangnekar's (2015) indicated that when faced with adversity, individuals high in emotional stability (the opposite of neuroticism per Costa and McCrae, 1992) sought psychosocial mentoring opportunities that, in turn, boosted their resilience. Although these relationships require further exploration, Mishra and McDonald (2017) speculated that individuals high in neuroticism may engage in emotion-oriented coping such as disengagement and avoidance.

Openness. The personality trait of openness also is correlated with resilience (Arora & Rangnekar, 2016b; Lyons et al., 2015). Openness is the trait of being curious, flexible, and imaginative (Costa & McCrae, 1992). Openness may correlate with resilience due to a greater tolerance for ambiguity, tendency to cognitively restructure

setbacks (Connor-Smith & Flachsbart, 2007), and willingness to adopt alternate goals and strategies (Mishra & McDonald, 2017).

Agreeableness. Arora and Rangnekar (2016a) also found that agreeableness, the tendency to be trusting, caring, and sympathetic (Costa & McCrae, 1992), was positively associated with resilience and that agreeableness moderated the relationship between conscientiousness and resilience. Mishra and McDonald (2017) speculated that agreeable individuals may have higher resilience because they also tend to have strong social networks and support (Bowling et al.,2005; Zhu et al., 2013), which in turn boost resilience.

Self-Evaluation. What people think about themselves influences their resilience. These thoughts are called core self-evaluations and include self-esteem and one's overall sense of worth (Gowan et al., 2000). Self-evaluation also includes generalized self-efficacy or the self-perception of being able to perform effectively in different situations (Clendon & Walker, 2016; Gowan et al., 2000; Hodges et al., 2008; Lyons et al., 2015). Other elements of self-evaluation include emotional stability (discussed earlier), and internal locus of control, the belief that one controls one's own life (Brotheridge & Power, 2008; Lee et al., 2008; Lyons et al., 2015). These relationships may exist because people with positive core self-evaluations may experience fewer setbacks. They also may retain their sense of worth throughout setbacks (Mishra & McDonald, 2017). Finally, people with positive core self-evaluations may utilize adaptive coping processes (Kammeyer-Mueller et al., 2009).

Optimistic Attitude. Past research additionally demonstrated strong positive relationships between resilience and attitudes of optimism, eagerness to learn, liking

challenges, and not taking things personally (DeCastro et al., 2013; Mansfield et al., 2012). These attitudes likely reduce the sense of helplessness and hopelessness during times of adversity, thus helping to sustain motivation and the tendency for adaptive coping skills.

Stress Management Skills. Skills of being able to calm oneself down, seek support from others, challenge counterproductive beliefs, and other context-specific skills also have been associated with resilience (Hodges et al., 2008; Mansfield et al., 2012; Mishra & McDonald, 2017; Reivich & Shatte, 2003). Importantly, these resilience skills can be built, as evidenced by Akkermans et al.'s (2015) 2-week controlled trial to cultivate six career competencies related to career resilience. Akkermans et al. (2015) concluded that the measured effect on resilience occurred through two mechanisms: (a) increasing participants' self-efficacy to tackle work- and career-related activities and (b) raising participants' awareness about potential stressors and setbacks, thus inoculating them against setbacks.

Self-Care. Behaviors such as participating in physical exercise, breathing exercises, and meditation; engaging in ongoing learning (Abu-Tineh, 2011); maintaining personal boundaries; and practicing periodic self-reflection (Clendon & Walker, 2016; Hodges et al., 2008; Hodges et al., 2010; Kolar et al., 2016; Mackenzie, 2012; Maher, 2013) also were associated with resilience. Additional research would be helpful for illuminating the nature and mediators of these relationships. For example, boundary setting might aid the individual in maintaining a sense of stability despite adversity, whereas exercise might aid in reducing the stress of disruption.

In summary, a wide range of personal factors have been shown to demonstrate strong positive associations with resilience. However, more research beyond the present study is needed to better understand the nuances of these associations, the moderators influencing the associations, and the mediators and mechanisms through which these influences operate.

Contextual Factors Enhance Resilience

Contextual factors—namely support from one's environment and those in one's life—also has been associated with one's level of resilience. Past studies of career resilience have focused on supportive workplaces (DeCastro et al., 2013; Gu, 2014; Gu & Day, 2013; Hodges et al., 2010; Johnson et al., 2014; Mackenzie, 2012; Mansfield et al., 2014; Papatraianou & Le Cornu, 2014), equitable treatment at work (Kidd & Green, 2006), and support from others (Arora & Rangnekar, 2014, 2015; Brotheridge & Power, 2008; Green et al., 2011; Kao et al., 2014; Mackenzie, 2012; Maher, 2013; Mishra & McDonald, 2017; Papatraianou & Le Cornu, 2014). Other contextual challenges can be found in the regulatory and legislative environment in which teachers operate (Cefai & Cavioni, 2014), which can impose dramatic requirements and restrictions on the content and manner of their teaching as well as in the goals for which they must aim in the classroom (Gu & Day, 2007). The remainder of this section elaborates on these contextual influences on resilience.

Teachers need contextual support to enhance their resilience. Support may be located within the immediate classroom—such as managing challenging student behavior (Demetriou et al., 2009), satisfying diverse student needs (Fantilli & McDougall, 2009), cultivating positive interactions and relationships with students (Le

Cornu, 2013), and dealing with limited resources and equipment or challenging teaching assignments (Stallions et al., 2012). Support and challenges also can be found in the school community, in terms of dealing with difficult parents (Goddard & Foster, 2001), heavy workloads, and lack of administrative support (Flores, 2006).

One notable type of support in the workplace cited in literature is equitable treatment at work (Kidd & Green, 2006). If early career teachers lack confidence, they are less likely to be heard, respected, and helped to overcome their challenges. In turn, the obstacles endemic to teaching may soon become overwhelming. In turn, the early career teachers' sense of self-efficacy, satisfaction, and continuance in their careers may diminish.

Support at work—whether from supervisors, mentors, peers, or subordinates— boost people's ability to cope with setbacks (Mishra & McDonald, 2017). For example, a principal's personal support and leadership in supporting early career teacher resilience can be pivotal for helping novice teachers negotiate challenges (Brotheridge & Power, 2008; Peters & Pearce, 2012). Le Cornu (2013) agreed that positive workplace relationships are critical to resilience building in new teachers. The importance of a caring professional community has been stressed in whole school approaches to support pupil and teacher well-being and resilience (Cefai & Cavioni, 2014). Caspersen and Raaen (2014) emphasized that assisting novice teachers is a collective responsibility.

A particularly helpful form of support may be psychosocial mentoring (Arora & Rangnekar, 2014, 2015; Kao et al., 2014). Such mentoring, whether from the principal, skilled teachers, or other supports can aid teachers in developing productive peer,

parent, and administrative relationships as well as in cultivating essential skills related to classroom management, student success, obtaining instructional resources, and managing workload. Corbell et al. (2010) noted these factors as key in enhancing—not only resilience—but also beginning teacher satisfaction, commitment, and retention.

Support from one's family and friends also boosts resilience (Green et al., 2011; Mackenzie, 2012; Maher, 2013; Papatraianou & Le Cornu, 2014). For example, Maher (2013) noted in his study that disruptions in family life tended to affect individual's work life and vice versa. Mackenzie (2012) found that teachers who had family obligations sought flexible work schedules—and those who received such reported higher resilience. In Papatraianou and Le Cornu's (2014) study, informal support offered by family and friends enhanced resilience. In Green et al.'s (2011) study, resilience was teachers' spouses blamed them for work-family conflicts.

Mishra and McDonald (2017) reasoned that positive affective experiences yield a sense of support that helps individuals stay buoyant through the twists, turns, and difficult times of their careers. Morgan et al. (2010) similarly found that lack of positive affective experiences at work (evident in unsupportive workplaces) was negatively correlated to resilience.

In summary, various interpersonal and environmental contextual factors enhance resilience. More research beyond the present study that more deeply investigates the nature and nuances of these associations are needed.

Procedural Factors Can Enhance Resilience

A growing body of evidence suggests that people can increase their level of resilience over time (Caza & Milton, 2012; Youssef & Luthans, 2007). For example,

interventions such as training and mentoring have been found to impact employees'

resiliency (Cornum et al., 2011; Kao et al., 2014; Luthans et al., 2010).

Richardson (2002) added that outlining the processes for navigating adversity

and opportunity in ways that build one's protective factors was the focus of the second

wave of resiliency research. Specifically, this body of research outlines the disruptive

and reintegrative processes of acquiring resilient qualities, culminating in models that

help people in choosing between the four outcomes of resilient reintegration.

reintegration to homeostasis, reintegration with loss, and dysfunctional reintegration.

Research indicated that resilient qualities are developed through a law of

disruption and reintegration (Flach, 1988, 1997). Richardson et al. (1990) proposed a

detailed process of accessing resilient qualities, whereby an individual experiencing

"biopsychospiritual" homeostasis eventually experiences a situation when one's life

events exceed the capacities and thresholds set by one's protective factors and resilient

qualities. This may occur when the individual has thoughts, feelings, and experiences

not experienced before (or experienced before but without growth), or when the specific

disruptor cannot be met with the needed resilient qualities. At this time, disruption

occurs in the form of a planned or unplanned change, threat, challenge, or opportunity.

Unplanned disruptions trigger immediate emotions such as hurt, loss, guilt, fear,

and confusion characteristic of a sense of "poor me" (Richardson, 2002). Planned

disruptions may spark self-doubt about one's choice or ability to rise to the challenge.

Over time and with some initial adaptation, individuals begin to question what they will

do, which is the start of reintegration. When the individual is ready to reintegrate after or

in concert with the disruption, he or she makes the choice (whether conscious or

unconscious) of reintegrating with growth (resilient reintegration); reintegrating to one's

comfort zone (reintegrating to homeostasis) reintegrating following surrender of

motivation, hope, or drive (reintegrating with loss); or resorting to deleterious coping

behaviors (dysfunctional reintegration).

Resilient qualities are cultivated through the pathway of choosing resilient

reintegration, which results in growth, knowledge, self-understanding, and physical,

mental, and spiritual adaptation to one's life situation (Richardson, 2002). In turn, life

events and experiences progressively become routine and less disruptive to the

individual. In contrast, when individuals forgo growth and the consequent development

of resilient qualities, they can suffer from chronic stress. In such cases, old disruptions

continue to produce distress and ongoing disruption when they recur.

This description was necessarily simplistic for the sake of clarifying the process;

however, in actuality, multiple disruptive and re-integrative opportunities may be

occurring simultaneously (Richardson, 2002). The resiliency process depicted can

last from seconds (for minor shifts or insights) to years (for traumatic or dramatically

life-changing events). Moreover, the processing of certain experiences and

challenges may be postponed or iterated multiple times, such as child abuse that

initially may be reintegrated with loss (e.g., anger, distrust) and, later, resiliently

reintegrated using productive coping skills.

A central premise underlying Richardson's (2002) model is that disruption is

required to develop resilience, because homeostasis places no pressure on the

individual for improvement or growth. At the same time, disruption alone is

insufficient for growth. As Richardson noted, "Life progression is a function of

repeated resilient reintegrations that result from planned and reactive disruptions" (p.

313). In contrast, stagnation occurs when individuals resort to homeostasis by

simply focusing on getting past difficult experiences, whereas life digression occurs

when individuals chronically resort to reintegration with loss after disruption. Therapy

and education can be helpful for individuals facing disruption to aid them in

recognizing their choices to grow, recover, or lose. For the purposes of this study of

early career and early second career STEM teachers, stagnation may not occur

because of the short duration of the careers thus far, but it might be that stagnation

led to STEM professionals wanting to make the transition.

Resilience is Measured in Multiple Ways

Despite growing interest in resilience among researchers and practitioners alike,

validated scales for measuring resilience are lacking (Friborg et al., 2005). However,

several validated scales such as the CD-RISC, RSA, State–Trait Assessment of

Resilience Scale (STARS) are accepted as validated scales to measure resilience.

The Conner-Davidson Resilience Scale. The Connor-Davidson resilience scale

(CD-RISC) is a widely used resilience scale that has been validated in clinical settings

(Connor & Davidson, 2003). The researchers generated the scale's initial item pool

based on three sources: (a) the personal characteristics of Sir Edward Shackleton

(leader of a 1912 expedition to the Antarctic); (b) Kobasa's (1979) work on hardiness;

and (c) Rutter's (1985) work on adaptive coping. The CD-RISC's final 25-item scale

(CD-RISC-25) contains five subscales: (a) personal competence, high standards and

tenacity; (b) trust in one's instincts, tolerance of negative affect, and strengthening

effects of stress; (c) positive acceptance of change and secure relationships; (d) control;

and (e) spiritual influences. Scores on each item range from 0 (not true at all) to 4 (nearly all the time), on items (e.g. "I am able to adapt when changes occur"), with greater total scores indicating greater levels of resilience. Connor and Davidson (2003) reported the scale had sufficient internal reliability (Cronbach α = 0.89) and strong test–retest reliability of 0.87.

However, studies have found mixed results when examining the factor structure of the scale with three, four, and five-factor solutions being reported (Green et al., 2014). Creation of a 10-item version (CD-RISC-10) has generally resolved this issue. The resulting single scale measures individuals' ability to bounce back from various life challenges, including change, personal problems, illness, pressure, failure, and painful feelings (Campbell-Sills & Stein, 2011). Critics of the scale argue that it lacks a consistent theoretical basis (Windle et al., 2011) and emphasizes resilience as a personality trait, in contrast to contemporary understandings of the construct (Windle et al., 2011).

Resilience Scale for Adults. Friborg et al. (2005) developed the RSA, a widely used measurement for resilience. Friborg et al. (2005) created the RSA and cross-validated and compared it with three measures of personality: (a) the Big Five (Costa & McCrae, 1995), (b) cognitive abilities of Advanced Matrices, Vocabulary, and Number Series (Raven, 1986), and (c) social intelligence using the Tromso Social Intelligence Scale (Silvera et al., 2001). All four measures were given to 482 military college applicants (47 females, 403 males; mean age = 24, *SD* = 3.0 females, 2.2 males). Confirmatory factor analyses confirmed the fit of the five-factor model, measuring personal strength, social competence, structured style, family cohesion, and social

resources. Using the Big Five to discriminate between well-adjusted and more vulnerable personality profiles, all resilience factors were positively correlated with the well-adjusted personality profile. RSA-personal strength was most associated with emotional stability, RSA-social competence with extroversion and agreeableness, as well as social skills, RSA-structured style with conscientiousness. Unexpectedly, but interestingly, measures of RSA-family cohesion and RSA-social resources were also related to personality. Furthermore, the RSA was unrelated to cognitive abilities. This study supported the convergent and discriminative validity of the scale, and thus the inference that individuals scoring high on this scale are psychologically healthier, better adjusted, and thus more resilient.

The RSA consists of three categories that are divided into the five scales (Friborg et al., 2005). The first category consists of three scales that are the personal competency, social competency, and personal structure. Personal competency includes self-esteem, liking one's self, living in reality, and hope. Social competency is social adeptness, extraversion, ability to initiation social interactions, and good communication skills. Personal structure includes having daily routines and the ability to plan and organize. The second category consists solely of family cohesion. Family cohesion is the amount of family support, conflict, stability and loyalty. The third and last category consists solely of social resources. Social resources are having external support from family and friends, intimacy, and able to provide support to others (Friborg et al., 2003).

State-Trait Assessment of Resilience Scale. In concert with recent conceptualizations of resilience, Lock et al. (2020) developed and validated the 13-item STARS. The STARS uses six items to measure how respondents feel at the present

time (State Resilience) and seven items to assess how they feel in general (Trait

Resilience). Items are answered using a four-point scale from Disagree to Strongly

Agree, with higher scores indicating higher levels of resilience. The scale was

psychometrically validated by administering it online along with cross-validation

measures (i.e., CD-RISC-25 [Connor & Davidson, 2003], Perceived Stress Scale-10

[Cohen & Williamson, 1988], Positive and Negative Affect Scale [Watson et al., 1988],

ten-item personality inventory [Gosling et al., 2003]) to a sample of 274 adults (34

males, 238 females, 2 genderfluid = 2; Age: M = 28.33, SD = 10.59). An item response

theory approach to examining the psychometric properties of the STARS supported the

measures, which suggested that the state and trait measures reliably estimated

respondents' resilience. The examination of convergent and concurrent validity with

other theoretically associated measures provided further support for the validity of the

STARS. The researchers concluded that the STARS may be useful for measuring,

tracking, and predicting an individual's resilience within professional contexts, such as

allied health, policing, or the military.

How is Resilience Sustained During Career Transitions?

Resilience is critical during career transitions. Zukas & Kilminster, (2014) argues

that significant career transitions—like those experienced by doctors, teachers, and

academics—require learning new tasks, assuming new responsibilities, and meeting

new accountability standards and expectations and result in unavoidable difficulty for

those who attempt these transitions. For example, a preponderance of literature is

available on the trials and travails of early career teachers as they navigate the tasks

and responsibilities of being a new teacher (Andrews et al., 2007; Kanpol, 2007; Peters & Le Cornu, 2007a, 2007b).

References to career resilience are found throughout literature (Cascio, 2007; London, 1983; Carson & Bedeian, 1994). Cascio (2007) asserted that "career resilience is an essential survival skill in the 21st century" (p. 552). For example. some of the earliest references to career resilience are found in London (1983), who grouped resilience with career identity and career insight as being central to career motivation. According to London (1983), career resilience is "a person's resistance to career disruption in a less than optimal environment," compared to career vulnerability, defined as "the extent of psychological fragility . . . when confronted by less-than-optimal career conditions" (p. 621). This framework proposes that career resilience consists of high self-efficacy, willingness to take risks, and low dependency needs (especially low need for approval). Later, Carson and Bedeian (1994) later associated resilience with career commitment.

As applied during career transition, resilience is reflected in individuals' abilities to recover from career-related setbacks (Abu-Tineh, 2011; Chiaburu et al., 2006). However, this definition suggests that career resilience is static rather than fluctuating and further ignores the various contextual factors that help people recover from career disruptions (Caza & Milton, 2012).

Caza and Milton (2012) asserted that sustaining resilience during career transition requires a process or developmental trajectory. Mansfield et al. (2012) called these resilience processes as "complex, dynamic and multi-dimensional phenomenon" and a "process of development occurring over time, through person-environment

interactions" (p. 365). Accordingly, various mechanisms influence how people sustain resilience and cope with career disruptions and changes. Mishra and McDonald (2017) added that sustaining resilience during career transition requires "a developmental process of persisting, adapting, and/ or flourishing in one's career despite challenges, changing events, and disruptions over time" (p. 216). These researchers stressed that rather than being a one-time event, career resilience evolves and unfolds over one's career. Moreover, they viewed career resilience as developmental, positive adaptation. Furthermore, they did not confine career resilience as pertaining to challenges occurring in one's career. Instead, they acknowledged that challenges and disruptions requiring career resilience can emerge from both their professional and personal lives.

How Can We Support Resilience in Early Career Teachers?

Various researchers have applied the concept of resilience in teachers to determine what serves to enhance or compromise their performance, wellbeing, and intentions to remain in education (Allison, 2012; Castro et al., 2010; Johnson et al.; 2014; Mansfield et al., 2014). Correlations have been found between career resilience and age and experience, indicating that early career individuals tend to have lower career resilience than more seasoned professionals (London, 1993; Noe et al., 1990). Based on in-depth interviews with 60 early career teachers, Johnson et al. (2014) proposed a framework of five strategies and 18 related conditions that support resilience specifically in early career teachers. The strategies they articulated were consistent with frameworks and studies by other practitioners and researchers (e.g., Allison, 2012; Castro et al., 2010; Mansfield et al., 2014).

The first strategy is designing effective recruiting and onboarding policies and practices. Johnson et al. (2014) explained that supportive schools have officially mandated statements, guidelines, values, and prescriptions concerning (a) the provision of relevant, rigorous, and responsive pre-service preparation for the profession; (b) innovative partnerships and initiatives that assist smooth transitions to the workforce; and (c) the implementation of transparent, fair, and responsive employment processes.

The second strategy is to provide support and development opportunities for early career teachers (Johnson et al., 2014). Specifically, the most supportive schools in Johnson et al.'s study: (a) acknowledge the complex, intense, and unpredictable nature of teachers' work; (b) develop teachers' curriculum and pedagogical knowledge and strategies; (c) provide support to create engaging learning environments; and (d) ensure access to appropriate ongoing support, resources, and learning opportunities. These opportunities include peer mentoring, opportunities for collaborative planning, school-wide policies for managing student behavior, extra release time, task-specific assistance.

The third strategy is to promote an inclusive school culture regarding teaching and learning to teach characterized by values, beliefs, norms, assumptions, behaviors, and relationships that: (a) promote a sense of belongingness and social competence, (b) develop educative, democratic, and empowering processes, (c) provide formal and informal transition and induction processes, and (d) develop a professional learning community. Mentors, professional learning communities, and principals play particularly salient roles in boosting early career teachers' resilience in the area of school culture

(Conway & Clark, 2003; Flores & Day, 2006; McCormack et al., 2006; Peters & Pearce, 2012; Wood, 2005).

Relationships constitute the fourth strategy outlined by Johnson et al. (2014). Other researchers also emphasized the importance of developing support networks, such as ensuring that one has mentors, friends, and confidants; knows the students' parents; and meets regularly with administration (Allison, 2012; Castro et al., 2010; Mansfield et al., 2014). Moreover, early career teachers need school-based social networks and human connections that (a) promote a sense of belonging, acceptance, and well-being; (b) emphasize the importance of the student–teacher relationship; (c) foster pedagogical and professional growth; and (d) promote collective ownership and responsibility for the well-being of beginning teachers (Flores & Day, 2006; Gu & Day, 2007; Manuel, 2003; Peters & Le Cornu 2007a).

Finally, it is critical for early career teachers to nurture their own self-care and self-understanding and receive environmental support. Particular topics teachers need to negotiate for themselves include: (a) understanding that personal and professional identities are linked and interconnected; (b) engaging in forms of self-reflection that situate personal experiences within broader social, historical, and political contexts; and (c) understanding the importance of their own ethical and moral purposes in guiding their teaching actions. In particular, Johnson et al.'s (2014) found that early career teachers who had a high level of personal awareness, viewed themselves as learners, were reflexive, and nurtured their own wellbeing exhibited stronger self-confidence and sense of personal agency. These characteristics culminated in strong emerging teacher identities and enhanced resilience. This might manifest as managing one's workload to

allow for adequate personal time and rejuvenation (Mansfield et al., 2014) as well as focusing one's attention and language on positivity and action-oriented behavior (Allison, 2012).

Resilience Theory Has Evolved Over Time

As shared throughout this chapter, resilience theory has evolved over time. Early theories conceptualized the construct as one's ability to bounce back from adversity (Bowles & Arnup, 2016; Masten et al., 1990) and largely due to one's personality traits to conceptualizing resilience as the personal traits, contextual factors, and processes that produce positive adaptation following disruption (Bottrell, 2009; Lock et al., 2020; Johnson et al., 2014; Richardson, 2002). Moreover, resilience has been associated with emotional stability, stress tolerance, overcoming challenges, growth, and wellbeing (Allison, 2012; Friborg et al., 2003; McGarry et al., 2013; Richardson, 2002).

A rather vast body of literature has associated resilience with personal factors including personality traits, attitudes, skills, behaviors, and personal history (e.g., Arora & Rangnekar, 2016a; Clendon & Walker, 2016; DeCastro et al., 2013; Kolar et al., 2016; Mishra & McDonald, 2017). Contextual factors, including support from one's environment and those in one's life, further helps to enhance resilience, based on correlational studies (e.g., Brotheridge & Power, 2008; DeCastro et al., 2013; Johnson et al., 2014; Morgan et al., 2010). More research is needed to better understand the nuances of these associations, the moderators influencing the associations, and the mediators and mechanisms through which these influences operate.

Evidence is growing to suggest that people can increase their level of resilience (Caza & Milton, 2012; Cornum et al., 2011; Youssef & Luthans, 2007). Richardson

(2002) outlined a detailed model to illustrate how people move from homeostasis to disruption to strengthening their resilience. These studies offer insights regarding how training, therapy, coaching, and education may be used to enhance individuals' resilience for improved performance and wellbeing. The body of resilience research is applicable across industries and professions. The next section of this chapter focuses on public secondary teachers, the population focused on in the present study.

Resilience Theory Related to STEM Teaching

Neighborhood public schools serve the educational needs of the majority of U.S. children aged 4-18 (U.S. Department of Education, 2019a, 2019b, 2019c). As noted earlier in this chapter, teachers within neighborhood public schools face a wide range of challenges in their effort to become credentialed and then to educate their students (Abbott-Chapman, 2005; Algozzine et al., 2007; Bezzina, 2006; Day & Gu, 2010; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006; State of California Commission on Teacher Credentialing, 2016, 2018, 2019, 2020). When teachers fail to navigate these challenges, the result can be stress, burnout, and attrition (Goddard & O'Brien, 2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007). Such outcomes can be particularly problematic among STEM teachers, given the growing demand for STEM professionals and the need for strong K-12 STEM pipelines from K-12 to undergraduate school and through teacher preparation programs.

Strong STEM pipelines rely on sound curricula and qualified and committed STEM teachers. However, this latter condition is problematic, given the nationwide shortage of teachers, particularly STEM teachers (President's Council of Advisors on Science and Technology, 2012). However, STEM professionals could help fill the gap

by joining the K-12 public school teaching force, even though the path toward success in teaching is fraught with difficulties and obstacles.

Enhancing teacher resilience will help ESCSTs attain professional success in the classroom and their careers (Johnson et al., 2014; McGarry et al., 2013; Peters & Pearce, 2012; Richardson, 2002). Although various personal and contextual factors, as well as mechanisms and processes have been examined related to resilience (e.g., Johnson et al., 2014; Mishra & McDonald, 2017), research is lacking on the population of ESCSTs who face the multiple challenges of navigating a career transition into a demanding teaching profession (Gu, 2014; Mackenzie, 2012; Mansfield et al., 2014; Zukas & Kilminster, 2014). Additionally, more research is needed to better understand the nuances and nature of these associations between the personal factors, contextual factors, and processes.

The present study aims to fill-in this gap in the research literature by focusing on three research questions: (a) to what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs; (b) how do ESCSTs and ECSTs describe their resilience; and (c) how do ESCSTs and ECSTs build resilience? Table 3 illustrates how the research questions emerged from the review of research literature.

Table 3

Comparison of Research Questions to Literature

Research Question	Supporting Literature
1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?	Career transition, especially to teaching, requires resilience (Friborg et al., 2005; Gu, 2014; Mackenzie, 2012; Mansfield et al., 2014; Zukas & Kilminster, 2014)
2. How do ESCSTs and ECSTs describe their resilience?	Enhancing resilience—the ability to bounce back and even grow from challenge (Allison, 2012)—is believed to best help teacher candidates in attaining success in the classroom and their careers (Johnson et al., 2014; McGarry et al., 2013; Peters & Pearce, 2012; Richardson, 2002).
3. How do ESCSTs and ECSTs build resilience?	Individuals transitioning to teaching need to continually strengthen their resilience if they are to achieve long-term success and satisfaction in their new profession (Carless & Bernath, 2007; Carson & Bedeian, 1994; Cascio, 2007; Chiaburu et al., 2006; Kidd & Green, 2006; London, 1983; Lyons et al., 2015; Richardson, 2002; Wei & Taormina, 2014)

ESCST = early second career science, technology, engineering and teachers; ECST = early career science, technology, engineering and teachers

Theoretical Framework

The underlying theoretical framework for this study is comprised of resilient leadership (Allison, 2012) and Richardson's (2002) Metatheory of Resilience. Allison's (2012) theory of resilient leadership is rooted in the difficult reality facing many school systems. Historically, this reality includes financial shortages, undermining their ability to hire a sufficient number of qualified teachers, acquire instructional tools, and secure needed resources. In the absence of adequate conditions, school leaders (whether administrators, staff, or teachers) need to cultivate their resilience. Allison (2012) derived her theory from her work coaching school leaders and determined that five

indicators show a need for more resilience. Those indicators include a lack of learning by school leadership, an overreliance on blaming lack of funds for poor performance, lack of attention to key performance indicators, an excessive number of initiatives, and failing to celebrate success. Most recently, the COVID pandemic exacerbated existing challenges (e.g. teacher shortage) and created new challenges such as escalating burnout, exhaustion, and disrespect.

According to the theory of resilient leadership, six approaches build resilience within school leaders and their systems: (a) practicing self-care that results in personal renewal, (b) communicating with respect in ways that inspire others, (c) maintaining optimism, (d) counteracting the adverse impacts of obstacles, (e) building support networks and resources even before they are needed, and (f) monitoring performance data to detect and act on opportunities for change. Although Allison (2012) originally created this theory to build resilience in school leaders and systems, this study expands on this framework to examine how these approaches might build resilience amongst ECSTs and ESCSTs.

School staff, district and school administrators, and the programs and professional organizations dedicated to teacher success also can act on these five areas to increase teacher resilience. For example, providing resources and contacts to guide teachers through pre-service education and onboarding tasks could help buffer obstacles and strengthen teachers' support networks (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006). Mentoring programs could combat the idealism that can be common among future and new teachers (Abbott-Chapman, 2005; Day & Gu, 2010). Offering self-care programs and supporting the creation of peer

self-care groups (e.g., running groups, yoga groups, and meditation groups) could help

teachers manage the stress and burnout common in teaching (Goddard & O'Brien,

2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007).

This study also utilizes Richardson's (2002) *Metatheory of Resilience and Resiliency* as a theoretical framework. Richardson (2002) emphasized the importance of resilient qualities, processes, and motivation in determining the outcomes people experience following adversity and disruption. According to Richardson (2002), there are four responses to adversity, listed in order from responses reflecting the most resilience to responses reflecting the least resilience:

1. Resilient reintegration: experiencing post-disruption growth.

2. Homeostatic reintegration: experiencing post-adversity healing back to the original state without growth.

3. Loss-based reintegration: experiencing hopeless and lack of motivation following disruption.

4. Dysfunctional reintegration: responding destructively to adversity.

A central premise underlying Richardson's (2002) model is that disruption is required to develop resilience, because homeostasis places no pressure on the individual for improvement or growth. Becoming a teacher was the disruption for the ESCSTs and ECSTs. At the same time, disruption alone is insufficient for growth. As Richardson noted, "Life progression is a function of repeated resilient reintegrations that result from planned and reactive disruptions" (p. 313). For the purposes of this study, the multiple disruptions and repeated "reintegrations" provide a framework to understand what led study participants to continue with their careers as teachers. Some

study participants may have multiple disruptions and followed by reintegration with loss

or dysfunctional reintegrations that led to them leaving their careers as teachers. Others

may have multiple disruptions followed by reintegration back to hemostasis or, better

yet, resilient reintegrations that led to them staying in their teaching careers. It is

important to identify and understand what factors help ECSTs and ESCSTs deal with

these multiple disruptions in a positive way that led to the resilient reintegrations.

Conclusion

Fulfilling the demand for STEM-trained professionals in the U.S. requires a

strong K-12 and university pipeline staffed by qualified STEM teachers (Morrell &

Salomone, 2017). However, there is a significant shortage of such teachers,

necessitating innovative approaches to fill the gaps, such as attracting STEM

professionals to teaching. Doing so requires these professionals to acquire a public

school teaching credential, which is a lengthy and arduous process (Commission on

Teacher Credentialing, 2019; State of California Commission on Teacher Credentialing,

2016, 2018, 2019, 2020). Once in a teaching role, these individuals are likely to

encourage various challenges to their success (Bezzina, 2006). Combating these

challenges requires resilience. This study examined the resilience of ESCSTs to gain

deeper insights about the level of their resilience and their experiences as novice

teachers to inform approaches and interventions to enhance their success.

The research design and execution of the present examination was influenced by

the study's underlying theoretical frameworks, which utilized theories of resilience and

resilient leadership. Resilient leadership is the exercise of resilience-associated

attributes while carrying out a formal or informal leadership role over themselves and/or

others (Allison, 2012). Resilient leadership is believed to support ESCSTs in negotiating the challenges of becoming a teacher and succeeding in the early years of their teaching careers. Allison (2012) asserted that teachers should practice personal renewal, stay optimistic, and cultivate networks before challenges hit to sustain and build their resilience as leaders. Richardson (2002) emphasized the importance of resilient qualities, processes, and motivation in determining the outcomes people experience following adversity and disruption. According to Richardson (2002), there are four responses to adversity, resilient reintegration (experiencing post-disruption growth), homeostatic reintegration (experiencing healing back to original state), loss-based reintegration (experiencing hopelessness), and dysfunctional reintegration (responding destructively). Both Allison (2012) and Richardson (2002) theoretical frameworks were utilized in this study.

The next chapter describes the methods used in this study. Specifically, the chapter outlines the research design and research site, participant and sampling procedures, steps of data collection and analysis, ethical considerations of the study, and the researcher's positionality.

Chapter 3: Research Methodology

The purpose of this study is to examine resilience in ESCSTs in public secondary school settings as compared to ECSTs. Twenty-seven participants completed an online survey and volunteered to undergo an interview, and 8 volunteers were randomly selected and underwent a 1-hour interview about their experiences. Survey data were analyzed using descriptive and inferential statistics, while the interview data were examined using Moustakas' (1994) phenomenological approach. Three research questions were examined:

1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?

2. How do ESCSTs and ECSTs describe their resilience?

3. How do ESCSTs and ECSTs build resilience?

The quantitative part of this mixed-methods research has a null hypothesis and a hypothesis. They are as follows.

H_o: There are no differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs.

H_1: It is hypothesized that differences exist in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs." Make sure to apply this globally throughout the document.

This chapter describes all aspects of the research methods, including the research design, site and participant and sampling procedures, procedures related to data collection and analysis, ethical considerations, and researcher positionality.

Research Design

This study employed a convergent mixed method design (Creswell, 2018). The quantitative portion of the study gathered data using an online self-report survey and applying descriptive statistics for a MANOVA. The sample size was limited, and the results describe how to do a quantitative analysis with sufficient significance (Erdfelder et al., 1996). In addition, a post hoc ANOVA was completed on each attribute. The qualitative portion of the study took form of a descriptive phenomenological inquiry (Moustakas, 1994), which revealed ESCSTs' lived experience of transitioning into teaching and their current teaching experiences. This approach was appropriate as a means for ascertaining participants' inner sense making, cognitions, and emotions related to their transition. The rationale for this study and the quantitative and qualitative research design are provided below in the data and analysis section.

Participant and Sampling Procedures

Recruitment Sources

Participants for this study were recruited from two settings: *Second Act* and *California Science Educators*. Second Act is a California-based nonprofit organization that delivers programs to support the transition of STEM professionals into teaching roles. Second Act coordinates teaching fellowships and hosts weekend and summer gatherings to prepare teacher candidates. For example, Second Act convenes members at conferences and conducts trainings to help aspiring teachers. In addition,

the conferences provide networking opportunities where members can make new friends and offer support to one another. The organization also sets up Google classrooms for teacher candidates to learn how to obtain their credentials and to access resources and support to help teacher candidates navigate the many procedures needed to earn a teaching credential. Since the organization's founding, it has helped more than 1,000 STEM professionals transition into K-12 teaching. At the time of the study, there were 185 teachers active in the organization who were within their first 5 years of teaching in Southern California.

California Science Educators is a non-profit association of science educators in California with over 11,000 members. These members include teachers as well as administrators and policy makers. The association sends out bi-monthly newsletters by email and are involved with science curriculum, planning, testing, and policy making. The next section describes how participants were recruited from these organizations.

Sample Size

The quantitative sample size consisted of 27 respondents. The minimal necessary sample size necessary to detect a moderate effect (an *F*-squared of 0.0625) in a MANOVA comprised of two groups (ESCSTs and ECSTs) and five predictor variables, with 80% power at a significance level of 0.05 is 206, assuming equal numbers of ESCST and ECST respondents (Erdfelder et al., 1996). Data were obtained only from 20 ESCSTs and seven ECSTs. Therefore, the quantitative analysis may reasonably be considered severely underpowered (Reinhart, 2015).

The qualitative sample size consisted of eight volunteers (four ESCSTs, four ECSTs). The procedures for selecting these participants are described in the Selection

Procedures section below. Brinkmann and Kvale (2005) noted that qualitative interviewing sample sizes range from 5 to 25, depending upon the nature of the interview. Merriam and Tisdell (2016) advised that the sample size should be determined based on reaching a saturation point.

Selection Criteria

Two samples were drawn for this study: ESCSTs and ECSTs. Selection criteria to qualify as an ESCST in this study were:

1. The respondent has at least 1 month, but less than 5 years, of full-time teaching in a public secondary setting.

2. The respondent has currently taught or served as a student teacher in a STEM subject within the past 12 months, although the individual presently may be out of work.

3. The respondent is pursuing a teaching credential or Career Technical Education or holds one of these credentials.

4. The respondent had at least 2 years of full-time STEM-related work experience.

Selection criteria to qualify as an ECST in this study were:

1. The respondent has at least 1 month, but less than 5 years, of full-time teaching in a public secondary setting.

2. The respondent has currently taught or served as a student teacher in a STEM subject within the past 12 months, although the individual presently may be out of work.

3. The respondent is pursuing a teaching credential or Career Technical

Education or holds one of these credentials.

These criteria were necessary to assure that the respondent was part of the focal

population being studied in this research.

Selection Procedures

All members of Second Act who teach in California received an email inviting

them to complete an online survey and a follow up email two weeks after the initial

email (see Appendix A). California Science Educators members received an invitation

through their bimonthly newsletter to participate in the study and to complete an online

survey, and a follow up invitation in the following bimonthly newsletter. California

Science Educators also posted the same invitation to their Facebook group.

Participation was voluntary, and online consent was given prior to taking the survey.

The first page of the online survey presented the consent information (see

Appendix B). To proceed to the survey, participants needed indicated their consent by

pressing "Agree." Next, respondents were required to answer qualifying questions to

determine whether they satisfied the selection criteria (see Appendix B). Participants

who answered all questions affirmatively proceeded to the survey. Participants that did

not answer all questions affirmatively were thanked for their time and notified that that

were not eligible to participate in the study.

To recruit the interview sample, all survey respondents were asked to volunteer

to undergo an interview. A total of 25 respondents volunteered. These volunteers were

separated into ECSTs (n = 7) and ESCSTs (n = 18) within their groups. These two

groups were separated into two separate Excel sheets. A column was added to each

Excel sheet and the random number generator function was used to generate a random number from zero to one. The participants were then sorted from high to low based on the random number generated. This was used as the selection criteria. Note that all 7 ECSTs were selected due to the limited number of respondents, and 8 out of the 18 were selected from the ESCSTs. The first four ECSTs and first four ESCSTs were contacted by email to schedule an interview. Two interviewees from each group did not respond; therefore, the next two were selected from each group and scheduled for an interview. Research participants were provided compensation for their participation in the quantitative and qualitative portions of the study. One participant from those who completed the quantitative survey was randomly selected using random number generator function in Excel to receive a $100 Amazon gift card. In addition, each participant who completed an interview received a $25 Amazon gift card.

Participant Profiles

Eight teachers—four ESCSTs and four ECSTs—were interviewed for the study. Pseudonyms were used to protect the confidentiality of the participants (see Table 4). It is important to note that all interviews were conducted in Fall 2021 as public schools in California reopened following school closures caused by the COVID-19 pandemic.

Table 4

Descriptions of Participants

Pseudonym	Age	Subject Matter[1]	Group[2]	*Gender*
Brook	20-29 years	MS Science	ESCST	Female
Carlos	30-39 years	MS Science	ESCST	Male
Cindy	20-29 years	HS Chemistry	ESCST	Female
Uma	40-49 years	MS Science	ESCST	Female
Lily	30-39 years	HS Biology	ECST	Female
Morgan	30-39 years	HS Chemistry	ECST	Nonbinary
John	30-39 years	HS Math	ECST	Male
David	20-29 years	MS Science	ECST	Male

[1]MS = Middle School, HS = High School; [2]ESCST = Early Second Career STEM Teacher, ECST = Early Career STEM Teacher

Data Collection and Analysis

Data was collected for this study using survey and interview procedures. Survey procedures involved an assessment of participants' resilience. Following the completion of the surveys, a descriptive phenomenological interview was conducted with eight volunteers selected from the survey respondents.

Quantitative Methods

The quantitative portion of this study utilized a survey design. The following sections describes the design of the assessment, how it was administered, and how the data was gathered and analyzed.

Measure

The quantitative portion of this study utilized a survey design based on the RSA developed by Friborg et al. (2005), as shown in Appendix C. It is important that the

survey instrument used to gather quantitative data must be relevant, creditable, valid, and reliable (Morra Imas & Rist, 2009). The RSA was used in its entirety, not modified, and maintains all the characteristics of a strong survey tool. The 33-item RSA consists of five scales: personal strength which includes personal strength/perception of self (6 items) and personal strength/perception of future (4 items), structured style (4 items), social competence (6 items), family cohesion (6 items), and social resources (7 items). Each item is comprised of a stem and a corresponding Likert-type scale from 1 to 5, where one end of the spectrum is associated with a behavior or attitude indicating high resilience (e.g., I always find a solution) and the other end is associated with a behavior or attitude indicating low resilience (e.g., I often feel bewildered). A high score on the scale indicates greater resilience. Sixteen of the 33 items are reverse scored. Scoring the RSA involves calculating descriptive statistics for each scale as well as the overall instrument (Friborg et al., 2005).

A preliminary version of the RSA was developed in an earlier study (Hjemdal et al., 2001). This version consisted of 45 items covering five dimensions: personal competence, social competence, family coherence, social support, and personal structure. The RSA, along with the Sense of Coherence scale (SOC) and the Hopkins Symptom Checklist (HSCL) were given to 59 psychiatric outpatients once, and to 276 normal controls twice, separated by four months. The factor structure was replicated.

The dimensions have Cronbach's alphas ranging from .67 to .90, and four-month test-retest correlations ranging from .69 to .84. Construct validity was supported by positive correlations with SOC and negative correlations with HSCL. The RSA differentiated between patients and healthy control subjects. Discriminant validity was

indicated by differential positive correlations between RSA subscales and SOC. The RSA scale may be used as a valid and reliable measurement in health and clinical psychology to assess the presence of protective factors important to regain and maintain mental health. The RSA has good discriminant and convergent validity in relation to personality and intelligence (Friborg et al. 2005). In a recent review of 15 resilience measures, Windle et al. (2011) rated the RSA as having among the best psychometric properties of any reviewed. For example, in Friborg et al.'s (2005) assessment of the scale on a sample of 59 patients and 276 normal controls, the factor structure was replicated and the respective RSA dimensions exhibited Cronbach's alphas of 0.90, 0.83, 0.87, 0.83 and 0.67, and four-month test-retest correlations of 0.79, 0.84, 0.77, 0.69 and 0.74. Construct validity was supported by positive correlations with the Sense of Coherence Scale and negative correlations with Hopkins Symptom Checklist. The RSA differentiated between patients and healthy control subjects. Discriminant validity was indicated by differential positive correlations between RSA subscales and Sense of Coherence Scale. These results indicated that the RSA instrument possesses sufficient validity.

Survey Administration

The Second Act participants received an email invitation that introduced the researcher and the study, assured participants of the voluntary and confidential nature of participation, and outlined the extent of participation needed for the study (see Appendix A). Participants also received a link to the online survey administered by the survey tool. The landing page for the survey presented the consent information. Participants clicked "Accept" to indicate consent, or "Cancel" to be redirected to a thank

you page. The survey remained open for 12 weeks between July and October 2021.

Members of California Science Educators were invited to participate via a monthly,

digital email newsletter that they received from the organization. Two separate

California Science Educators newsletters invited research participants and provided a

link to participate. This link directed potential research participants to the same link as

the Second Act participants.

Analysis

Descriptive and inferential statistics were calculated for each subscale for the

RSA, both overall and by each demographic grouping. To test the study hypotheses,

the data were evaluated to determine whether any statistical relationship exists between

ESCSTs' and ECSTs' resilience. A one-way MANOVA was conducted to assess if the

quantitative data was significant or not along with a post hoc ANOVA.

Qualitative Methods

Moustakas' (1994) phenomenological method was used in the qualitative portion

of this study to gather, analyze, and interpret data. The interview findings were used to

create a description of the common lived experience of transitioning from a professional

STEM career to a teaching role in STEM. This approach was appropriate because the

aim of the study was to understand participants' lived experiences of the transition and

how ESCST and ECST perceived their challenges and how they overcame these

challenges.

Design

Phenomenological approaches stress the importance of encouraging the

participants to share their experiences in as much detail and with as little interruption as

possible (Moustakas, 1994). Therefore, rather than a semi-structured interview script, the researcher posed the core question of the interview: "Please tell me, in as much detail as possible, about your experiences transitioning from your past job in a STEM-related field to becoming a STEM secondary teacher" (see Appendix D). The participants were encouraged to tell their detailed story rather guiding or interrupting them with a series of questions that would elicit short answers (Moustakas, 1994). Prompts and probes were used only as needed to encourage the participant to tell a rich story. For example, prompts included:

How did your perception of yourself change, if at all, through this experience?

How did your perception of the future change, if at all, through this experience?

In what ways, if at all, did your work approach or ability to structure your effort shift?

Prompts and probes can help the participant to add details to their own story and they were only utilized when needed during the interviews (see Appendix D for additional questions). Table 5 provides an overview of the study research questions, interview questions or prompts, variables measured in the quantitative survey, and the theoretical support.

Table 5

Connection Between Research Methods and Theoretical Frameworks

Research Question	Sample Interview Question	Theoretical Support
1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?	How did your perception of yourself change, if at all, through this experience? How did your perception of the future change, if at all, through this experience?	Arnup and Bowles (2016)
2. How do Early Career STEM Teachers and Early Second Career STEM teachers describe their resilience?	In what ways, if at all, did your level of comfort in social settings shift through this experience?	Allison (2012), Arnup and Bowles (2016), Richardson (2002)
3. How do Early Career STEM Teachers and Early Second Career STEM teachers build resilience?	Please tell me, in as much detail as possible, about your experiences becoming a STEM secondary teacher?	Allison (2012), Arnup and Bowles (2016), Richardson (2002)

Eight interview participants from the survey respondent were randomly selected; four from the ESCST grouping and four from the ECST grouping. Each randomly selected participants completed a 45-minute to 1-hour interview conducted via an online platform (Zoom) and shared his/her experience of career transition into a STEM teaching position. Each interview was recorded using the online conference software and will be stored on the researcher's personal, password-protected laptop for 3 years. The platform provided an initial transcription and the researcher then meticulously edited each interview transcription. Table 5 presents the connection between research methods and theoretical frameworks.

Interview Analysis

The interview data gathered for this study were subjected to steps of phenomenological analysis including horizontalization, thematizing, textural and

structural description, and intuitive integration as described by Moustakas (1994).

Horizontalization involved carefully reviewing the transcripts and isolating relevant

meaning units. Due to the intensive nature of this step, the amount of data collected,

and the potential for confidentiality breach if the raw transcripts and meaning units were

published, the details of horizontalization are not included in this document. The results

of the remaining steps are reported in Chapter 4.

Following horizontalization, the data were carefully examined, and themes

emerged from the data to reflect the essence of the participants' lived experiences as

early career teachers and early second career teachers, consistent with the

phenomenological method.

Following thematizing, the third step of phenomenological analysis was

composing textual and structural descriptions. This step involved creating a description

of "what" participants experienced (textural description) and "how" they experienced it

(structural description). Invoking imaginative variation, additional meanings for the

textural and structural descriptions were considered and sought from different

perspectives, roles, and functions (Moustakas, 1994).

In the final step of analysis, called intuitive integration, the textual and structural

descriptions of the experiences were synthesized into a composite description of the

phenomenon. This description constitutes the essential, invariant structure of ultimate

"essence" that captures the meaning ascribed to the participants' experience (Creswell,

2018; Moustakas, 1994; Wertz et al., 2011).

Throughout this process, the researcher bracketed his own experiences to avoid

contaminating and biasing the analysis (Van Manen, 2016). To do so, the researcher

deliberately put aside his preconceived beliefs and views about the phenomenon so as to capture the present experience as faithfully as possible (Husserl, 1913/1982, 1923/1970; Moustakas, 1994), including the psychological meanings and experiences associated with the data. Moreover, the researcher adopted the stance of a phenomenological researcher, meaning that the objects that presented themselves to the researcher were the phenomena. It is understood that it is through the lens of the consciousness of the researcher that this is done. This becomes the scholarly work that qualitative research is meant to uncover.

Ethical Considerations

The Pepperdine Institutional Review Board provided oversight of this research (see Appendix E). The researcher completed CITI ethics training to assure that he is knowledgeable of "human subjects" protections and complied accordingly. The study settings provided a letter of permission indicating their consent for to conduct with study with its members. Each participant also provided their consent to participate (see Appendix B).

Participants faced no more than minimal risk and did not experience more than low-level emotional risks--such as boredom and mild fatigue due to the duration of engagement—by taking part in this study. However, any time you are talking to interview participants, in this case, teachers, about perceptions of themselves, work, social settings, levels of comfort, support from family and friends, challenges, classroom management, and/or grading; that interview participants may become upset. While there is no more than a minimal risk, the potential exists to become emotionally upset.

Study candidates were advised that participation was voluntary, and they may decline or withdraw their involvement at any time. Participants were also advised that their survey data are confidential, and all data would be analyzed in aggregate.

Hard copies of the study data will be kept in a locked cabinet in the researcher's home office and the confidential electronic study will be stored on a password-protected file on the researcher's personal computer. After a period of 3 years, the data will be destroyed. Any names or other identifying information that participants provided were replaced with pseudonyms to protect the confidentiality of the participants.

Prospective participants were assured that participation in the study is voluntary and that they may be excused from the study at any time with no penalty. They were also assured they were under no compulsion to participate; they were free to decline any survey or interview question, and that they were entirely welcome to withdraw from the study before, during, or after the survey or interview. This information was included electronically on the consent form prior to participation in the quantitative survey and via email prior to the qualitative interview. The researcher verbally reiterated this information prior to the interview and at every contact with the participants. In addition, no participants withdrew and there was no need for counseling or any additional support as a result of the interviews.

Positionality

As mentioned in Chapter 1, I am a trained biologist who conducted academic and industrial research and design for 17 years before earning my California teaching credential and becoming a secondary-level, STEM science teacher. I earned a single subject science credential while working fulltime as a science teacher enrolled

concurrently in an internship program at a university. Fortunately, I received additional support from Second Act, an external organization designed to help transition people working in a STEM-related profession into the K-12 classroom. Through my journey, I recognized both support and resilience are critical to make the transition from as a STEM researcher into a fully-credentialed school teacher. I am currently an ESCST, and I recognize quality research is key to understanding how different factors of resilience impact the transition and retention of STEM teachers.

I became a program manager developing new biotechnology products for customers. We called our process "user centered research," but it really was qualitative and quantitative research, a mixed-methods approach. Using qualitative and quantitative methods enabled our products to be successful on the market. It allows for one to dig deeper into meaning. I hope that more repetitive social research is conducted that digs deeper into the previous quantitative research that lead to more successful policy implementation. I think that STEM education, and education in general, can benefit from this approach.

Summary

This chapter described the methods used to examine resilience among individuals that transitioned from a full-time professional STEM role to a STEM teaching role in a public secondary school setting. All 27 participants completed a brief online survey and eight individuals were selected randomly completed a 1-hour interview about their experiences. Survey data were analyzed using descriptive and inferential statistics, while the interview data were examined using Moustakas' (1994) phenomenological approach. Participants faced no more than a minimal risk and did not

experience more than low-level emotional risks. As a ESCST, this researcher

recognizes how important quality research is to understanding how different factors of

resilience impact the transition and retention of STEM teachers. Chapter 4 reports the

results of the study.

Chapter 4: Results

The purpose of this study was to examine resilience in ESCSTs in public secondary school settings as compared to ECSTs. Three research questions were examined:

1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?

2. How do ESCSTs and ECSTs describe their resilience?

3. How do ESCSTs and ECSTs build resilience?

The quantitative part of this mixed-methods research has a null hypothesis and a hypothesis. They are as follows.

H_o: There are no differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs.

H_1: It is hypothesized that differences exist in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs." Make sure to apply this globally throughout the document.

This chapter reports the results of the study. The quantitative survey results are reported first, followed by the qualitative results.

Quantitative Survey Results

The original intent of this research was to complete a mixed-method design that utilized inferential quantitative statistical analysis with qualitative phenomenological

analysis. The quantitative survey was given to two separate groups and over 11,000 people with the intent to get enough survey respondents to provide sufficient quantitative power. Only 27 participants responded, and the quantitative portion was severely underpowered. As such, the quantitative portion utilizes descriptive statistical analysis and describes what should be done for an inferential quantitative analysis.

The minimal necessary sample size necessary to detect a moderate effect (an *F*-squared of 0.0625) in a MANOVA comprised of two groups (ESCSTs and ECSTs) and five predictor variables, with 80% power at a significance level of 0.05 is 206, assuming equal numbers of ESCST and ECST respondents (Erdfelder et al., 1996). Data were obtained only from 20 ESCSTs and seven ECSTs. Therefore, the quantitative analysis may reasonably be considered severely underpowered (Reinhart, 2015). In addition, given that the population consisted of approximately 11,000 teachers and that data were obtained from only 27 respondents, selection bias may also be a reasonable explanation of the data (Fritz & Lim, 2018). Nevertheless, the following results, calculated are presented both in order to answer the associated quantitative research question as well as to provide a template for future studies that are sufficiently powered for an inferential analysis of this fashion.

Descriptive Statistics

Summary statistics were first calculated for each of the outcome variables concerning resilience – Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources – across all respondents. When the kurtosis is greater than or equal to 3, then the variable's distribution is markedly different than a normal distribution in its tendency to produce outliers (Westfall & Henning, 2013).

Such observations for Personal Strengths had an average of 3.85 (*SD* = 0.67,

Min = 2.00, Max = 4.60, Skewness = -1.23, Kurtosis = 1.11, *Mdn* = 4.00, Mode = 3.60).

The observations for Structured Style had an average of 3.58 (*SD* = 0.89, Min = 1.75,

Max = 5.00, Skewness = -0.26, Kurtosis = -0.43, *Mdn* = 3.50, Mode = 3.25). The

observations for Social Competency had an average of 3.51 (*SD* = 0.71, Min = 2.33,

Max = 5.00, Skewness = 0.04, Kurtosis = -0.90, *Mdn* = 3.50, Mode = 4.17). The

observations for Family Cohesion had an average of 3.80 (*SD* = 0.84, Min = 2.17, Max

= 4.83, Skewness = -0.51, Kurtosis = -0.97, *Mdn* = 4.00, Mode = 4.67). The

observations for Social Resources had an average of 4.20 (*SD* = 0.68, Min = 1.86, Max

= 5.00, Skewness = -1.45, Kurtosis = 3.13, *Mdn* = 4.29, Mode = 4.86). When the

skewness is greater than 2 in absolute value, the variable is considered to be

asymmetrical about its mean. These summary statistics can be found in Table 6.

Table 6

Summary Statistics Table for Interval and Ratio Variables

Variable	*M*	*SD*	*n*	Min	Max	Skewness	Kurtosis	*Mdn*	Mode
Personal Strengths	3.85	0.67	27	2.00	4.60	-1.23	1.11	4.00	3.60
Structured Style	3.58	0.89	27	1.75	5.00	-0.26	-0.43	3.50	3.25
Social Competency	3.51	0.71	27	2.33	5.00	0.04	-0.90	3.50	4.17
Family Cohesion	3.80	0.84	27	2.17	4.83	-0.51	-0.97	4.00	4.67
Social Resources	4.20	0.68	27	1.86	5.00	-1.45	3.13	4.29	4.86

Summary statistics were subsequently calculated for Personal Strengths,

Structured Style, Social Competency, Family Cohesion, and Social Resources among

only the ESCST respondents. Observations for Personal Strengths had an average of

3.81 (*SD* = 0.72, Min = 2.00, Max = 4.60, Skewness = -1.10, Kurtosis = 0.67, *Mdn* =

3.85, Mode = 3.60). The observations for Structured Style had an average of 3.61 (*SD* =

0.92, Min = 1.75, Max = 5.00, Skewness = -0.21, Kurtosis = -0.44, *Mdn* = 3.62, Mode =

3.25). The observations for Social Competency had an average of 3.34 (*SD* = 0.67, Min

= 2.33, Max = 4.50, Skewness = 0.05, Kurtosis = -1.32, *Mdn* = 3.33, Mode = 2.50). The

observations for Family Cohesion had an average of 3.64 (*SD* = 0.87, Min = 2.17, Max

= 4.83, Skewness = -0.30, Kurtosis = -1.24, *Mdn* = 4.00, Mode = 4.00). The

observations for Social Resources had an average of 4.09 (*SD* = 0.70, Min = 1.86, Max

= 4.86, Skewness = -1.51, Kurtosis = 3.25, *Mdn* = 4.14, Mode = 3.86). These summary

statistics can be found in Table 7.

Table 7

Summary Statistics Table for Interval and Ratio Variables

Variable	*M*	*SD*	*n*	Min	Max	Skewness	Kurtosis	*Mdn*	Mode
Personal Strengths	3.81	0.72	20	2.00	4.60	-1.10	0.67	3.85	3.60
Structured Style	3.61	0.92	20	1.75	5.00	-0.21	-0.44	3.62	3.25
Social Competency	3.34	0.67	20	2.33	4.50	0.05	-1.32	3.33	2.50
Family Cohesion	3.64	0.87	20	2.17	4.83	-0.30	-1.24	4.00	4.00
Social Resources	4.09	0.70	20	1.86	4.86	-1.51	3.25	4.14	3.86

Summary statistics were then calculated for Personal Strengths, Structured

Style, Social Competency, Family Cohesion, and Social Resources only the ECST

respondents. Observations for Personal Strengths had an average of 3.96 (*SD* = 0.50,

Min = 2.90, Max = 4.50, Skewness = -1.42, Kurtosis = 1.08, *Mdn* = 4.10, Mode = 4.10).

The observations for Structured Style had an average of 3.50 (*SD* = 0.85, Min = 2.00,

Max = 4.50, Skewness = -0.57, Kurtosis = -0.62, *Mdn* = 3.50, Mode = 4.25). The

observations for Social Competency had an average of 3.98 (*SD* = 0.63, Min = 3.17,

Max = 5.00, Skewness = 0.28, Kurtosis = -0.92, *Mdn* = 4.17, Mode = 4.17). The

observations for Family Cohesion had an average of 4.26 (*SD* = 0.59, Min = 3.33, Max

= 4.83, Skewness = -0.56, Kurtosis = -1.32, *Mdn* = 4.67, Mode = 4.67). The

observations for Social Resources had an average of 4.51 (*SD* = 0.56, Min = 3.43, Max

= 5.00, Skewness = -1.08, Kurtosis = -0.05, *Mdn* = 4.86, Mode = 4.86). These summary

statistics can be found in Table 8.

Table 8

Summary Statistics Table for Interval and Ratio Variables

Variable	*M*	*SD*	*n*	Min	Max	Skewness	Kurtosis	*Mdn*	Mode
Personal Strengths	3.96	0.50	7	2.90	4.50	-1.42	1.08	4.10	4.10
Structured Style	3.50	0.85	7	2.00	4.50	-0.57	-0.62	3.50	4.25
Social Competency	3.98	0.63	7	3.17	5.00	0.28	-0.92	4.17	4.17
Family Cohesion	4.26	0.59	7	3.33	4.83	-0.56	-1.32	4.67	4.67
Social Resources	4.51	0.56	7	3.43	5.00	-1.08	-0.05	4.86	4.86

Histograms of the distribution of average scores on each of the outcome

variables by response group (ESCST vs. ECST) appear in Figures 5 – 14.

Figure 2

Histogram of Personal Strengths Among ESCST Respondents
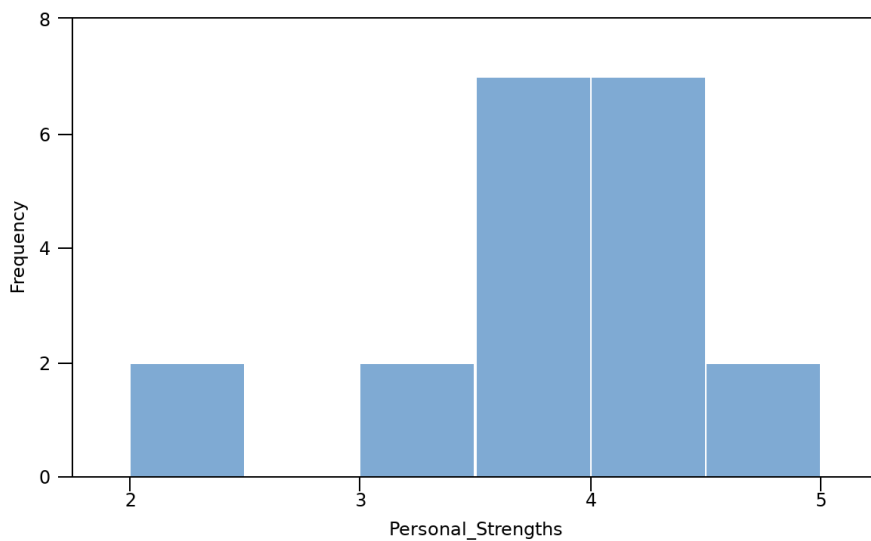
Figure 3

Histogram of Personal Strengths Among ECST Respondents
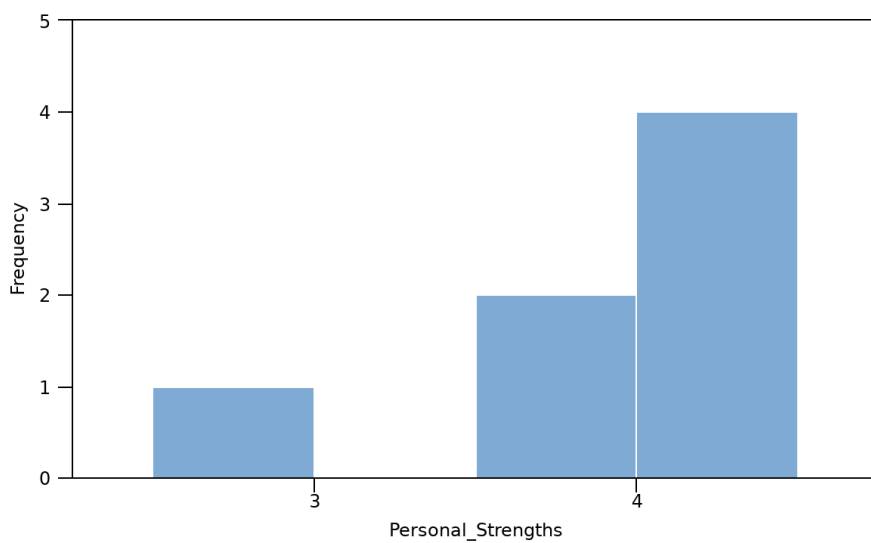
Figure 4

Histogram of Structured Style Among ESCST Respondents
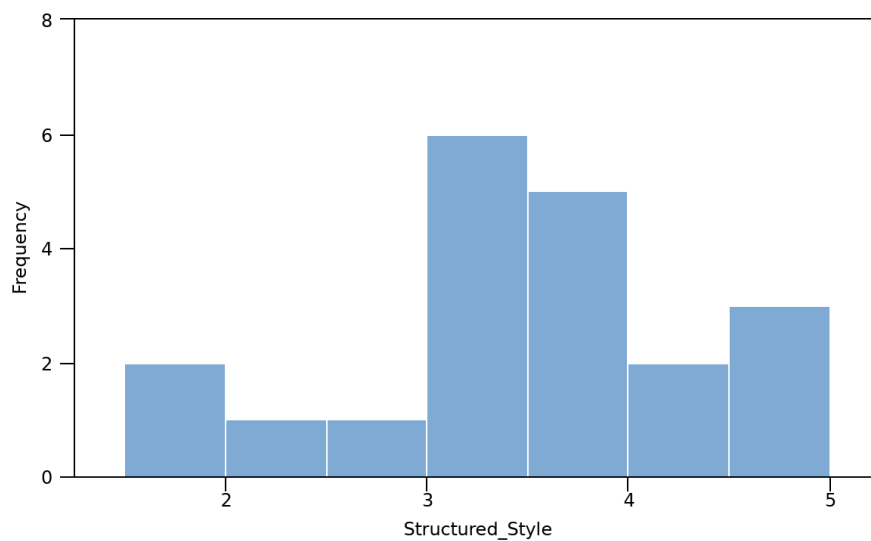
Figure 5

Histogram of Structured Style Among ECST Respondents
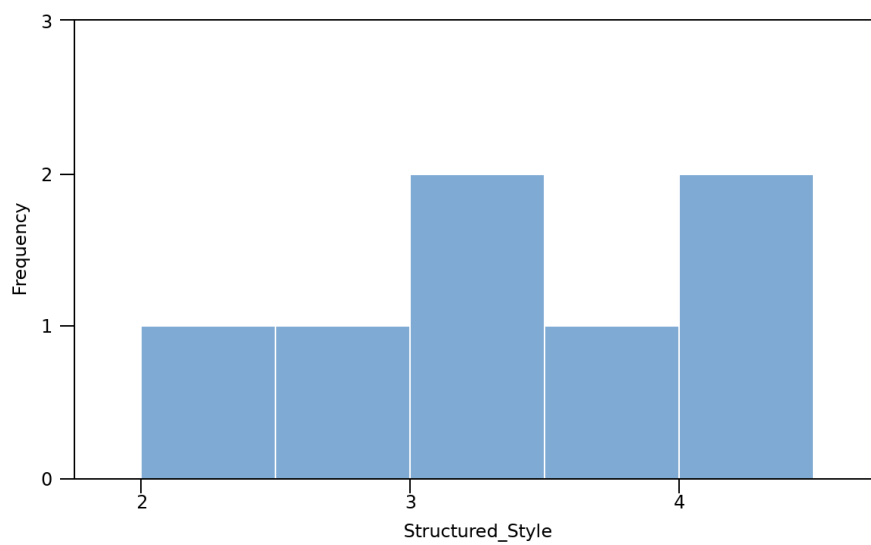
Figure 6

Histogram of Social Competency Among ESCST Respondents
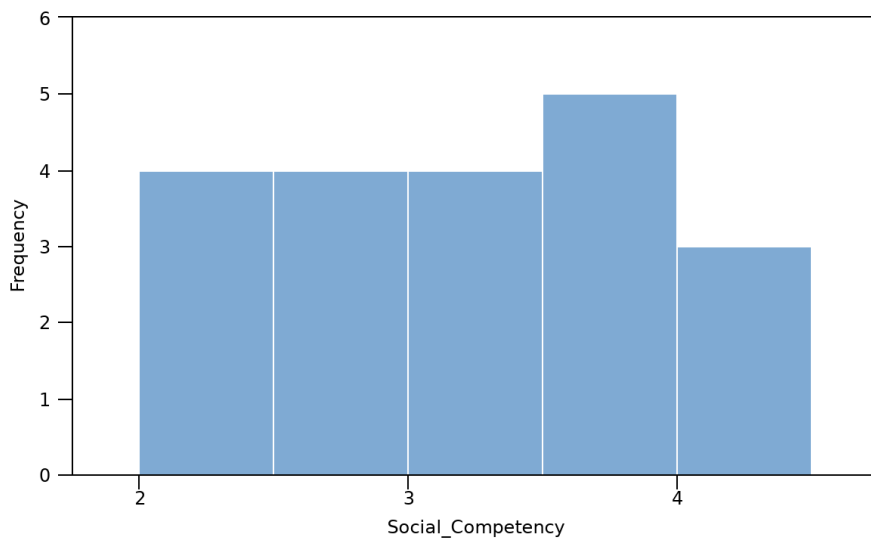
Figure 7

Histogram of Social Competency Among ECST Respondents
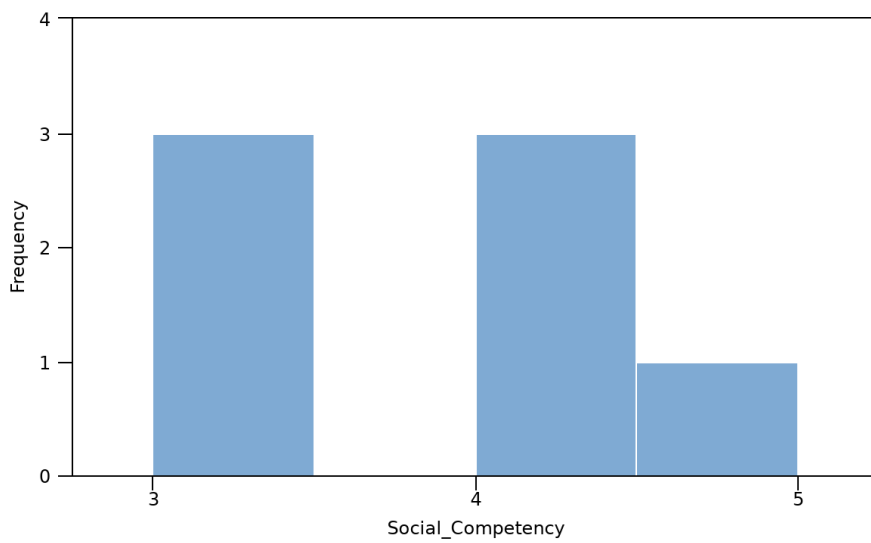
Figure 8

Histogram of Family Cohesion Among ESCST Respondents
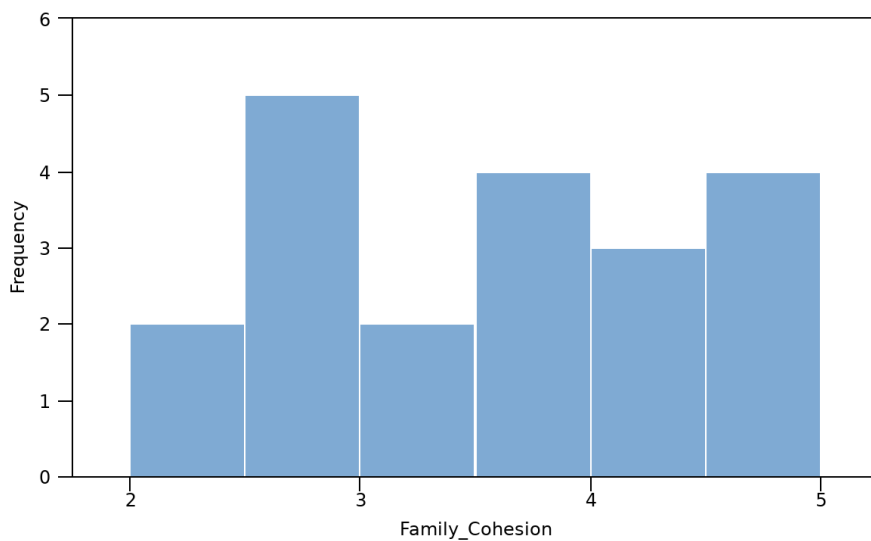
Figure 9

Histogram of Family Cohesion Among ECST Respondents
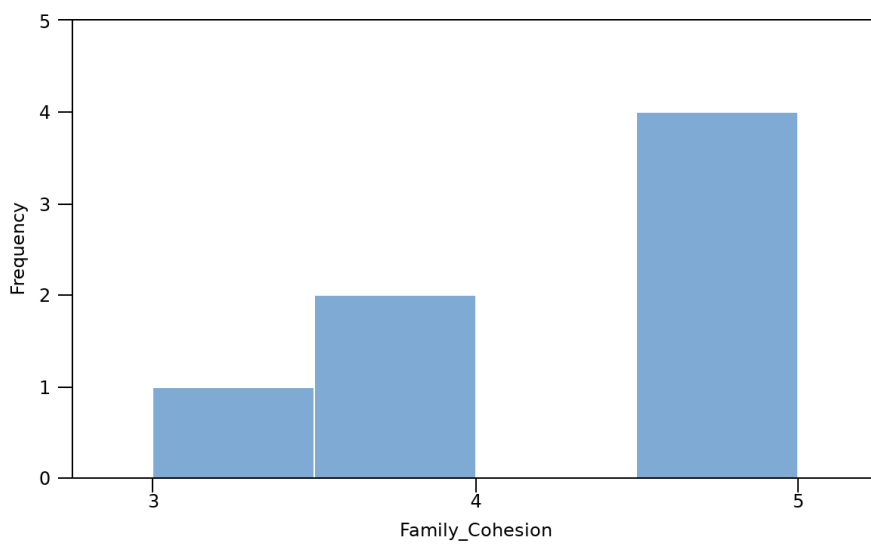
Figure 10

Histogram of Social Resources Among ESCST Respondents
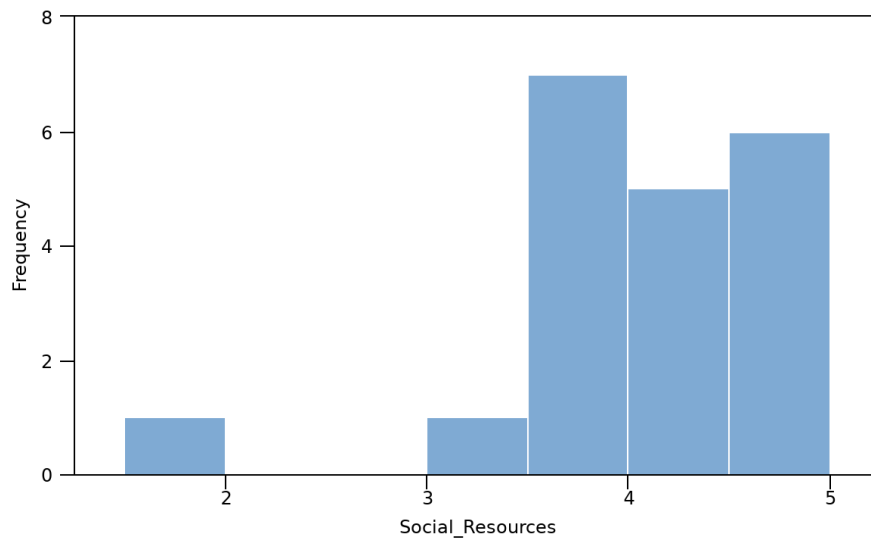
Figure 11

Histogram of Social Resources Among ECST Respondents
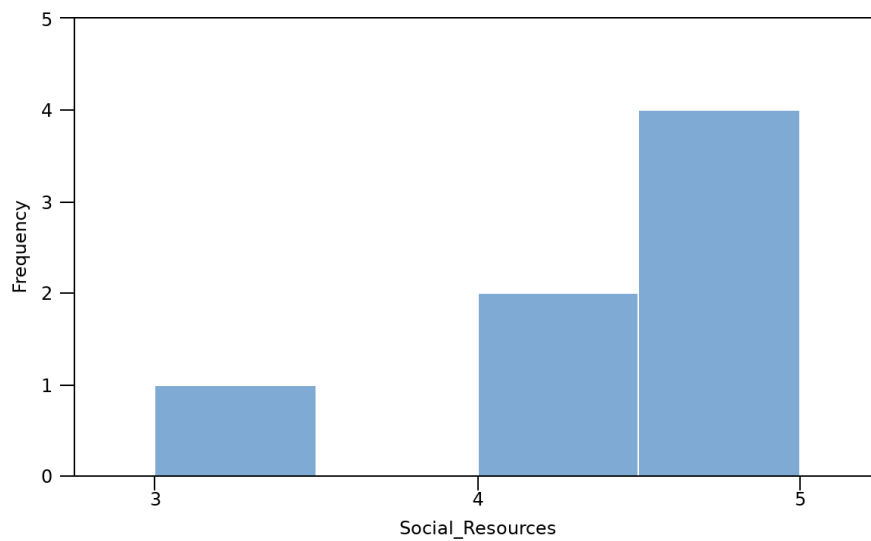
Boxplots of average scores on each of the outcome variables by response group (ESCST vs. ECST) appear in Figures 15 – 19.

Figure 12

Boxplot of Personal Strengths Between ESCST Vs. ECST Respondents
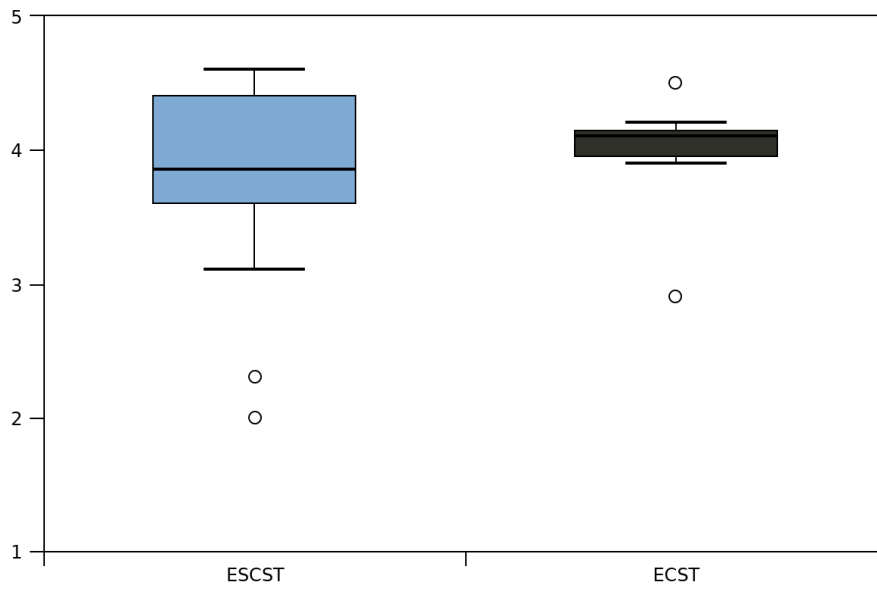
Figure 13

Boxplot of Structured Style Between ESCST Vs. ECST Respondents
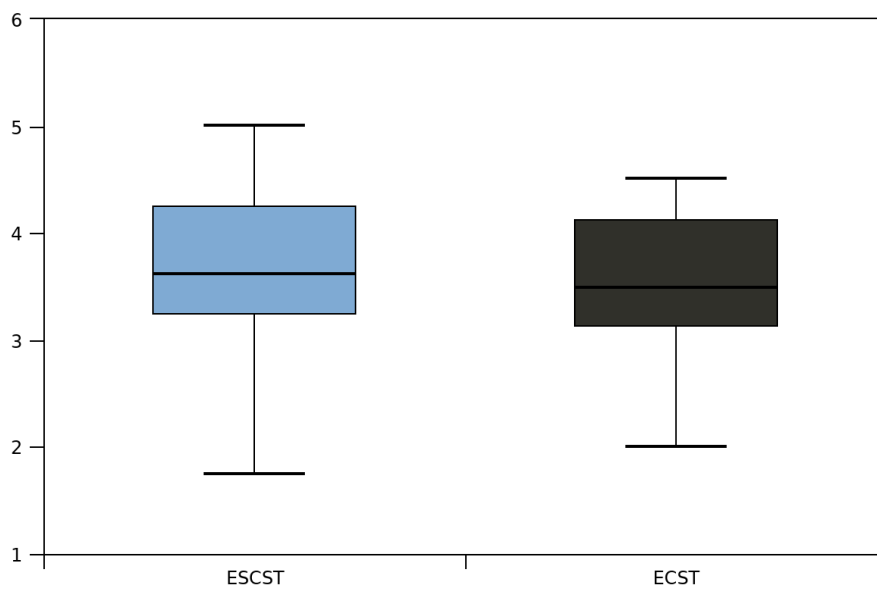
Figure 14

Boxplot of Social Competency Between ESCST Vs. ECST Respondents
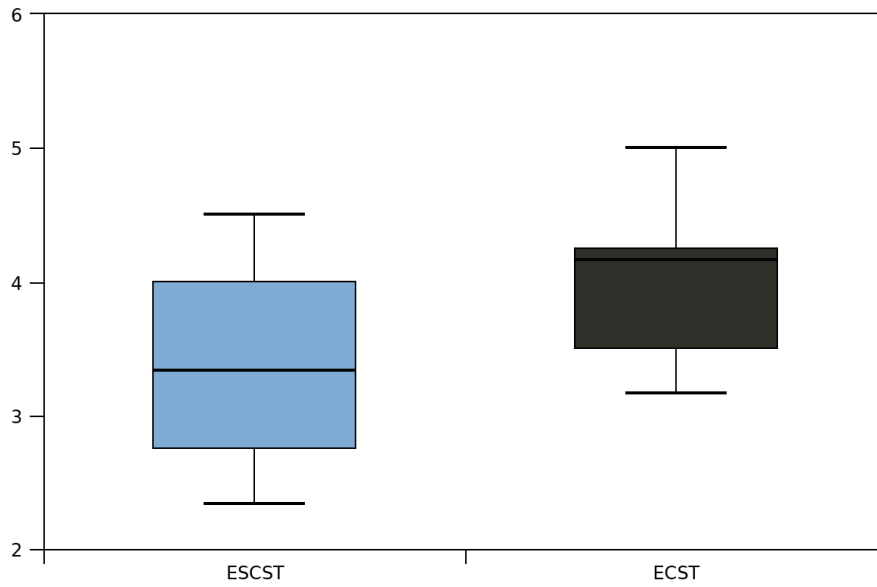
Figure 15

Boxplot of Family Cohesion Between ESCST Vs. ECST Respondents
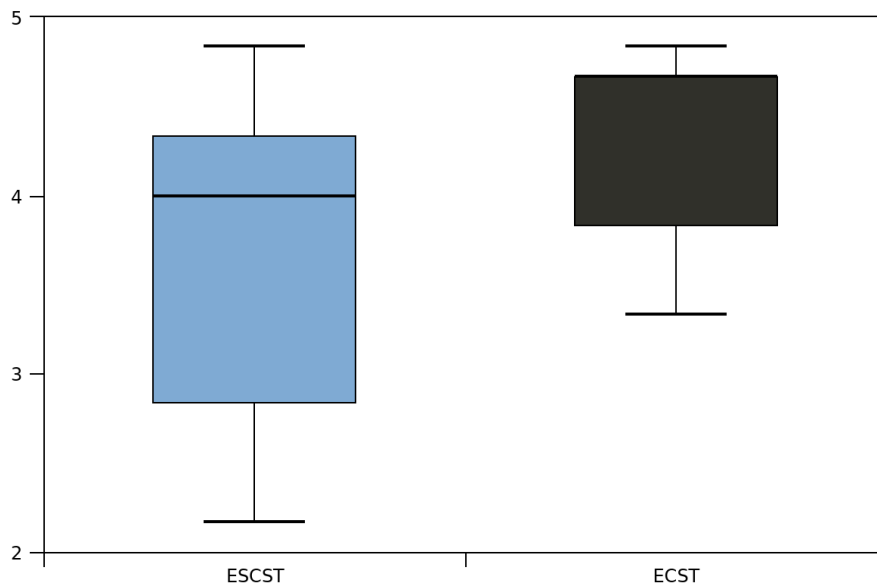
Figure 16

Boxplot of Social Resources Between ESCST Vs. ECST Respondents
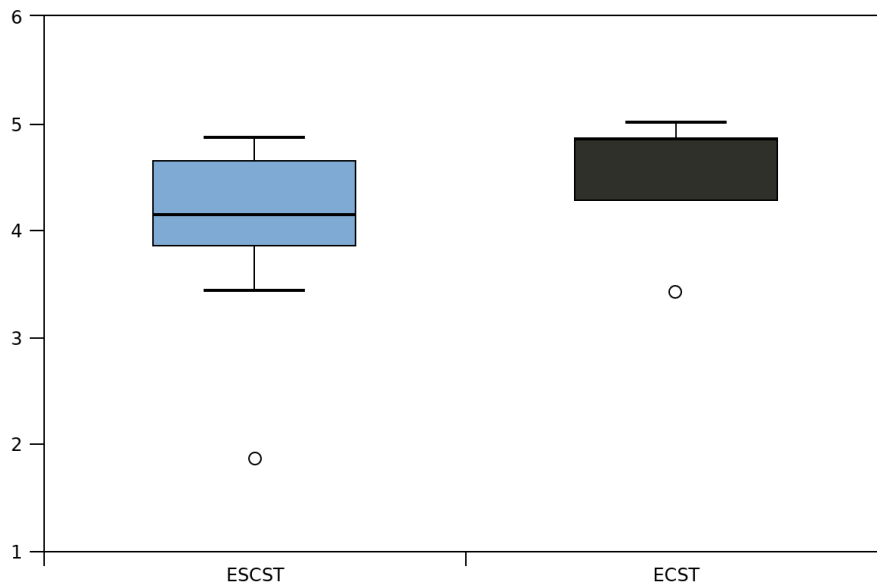
Assumption tests

Shapiro-Wilk tests were conducted in order to determine whether the distributions of each of the outcome variables – Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources – were significantly different from a normal distribution. The following variables had distributions which significantly differed from normality based on an alpha of 0.05: Personal Strengths ($W = 0.88$, $p = 0.005$), Family Cohesion ($W = 0.91$, $p = 0.019$), and Social Resources ($W = 0.85$, $p = 0.001$). Structured Style ($W = 0.95$, $p = 0.276$) and Social Competency ($W = 0.96$, $p = 0.0421$) did not significantly differ from normality based on an alpha of 0.05. The results are presented in Table 9.

Table 9

Shapiro-Wilk Test Results

Variable	*W*	*p*
Personal Strengths	0.88	.005
Structured Style	0.95	.276
Social Competency	0.96	.421
Family Cohesion	0.91	.019
Social Resources	0.85	.001

Univariate outliers were examined for the outcome variables, Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources. An outlier was defined as any value which falls outside the range of +/- 3.29 standard deviations from the mean (Tabachnick & Fidell, 2019). Under this criterion, there were no outliers present in any of the outcome variables.

Levene's test was conducted for Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources by ESCST vs. ECST respondents. Levene's test for equality of variance is normally used to assess whether the homogeneity of variance assumption was met (Levene, 1960). The homogeneity of variance assumption requires the variance of the outcome variable be approximately equal in each group. Median centering was used for the calculations. An alpha of 0.05 was used for the interpretation.

The result of Levene's test for Personal Strengths was not significant, $F(1, 25) = 1.72$, $p = 0.202$, indicating that the assumption of homogeneity of variance was met for Personal Strengths. The result of Levene's test for Structured Style was not significant, $F(1, 25) = 0.09$, $p = 0.773$, indicating that the assumption of homogeneity of variance was met for Structured Style. The result of Levene's test for Social Competency was not

significant, $F(1, 25) = 0.41$, $p = 0.525$, indicating that the assumption of homogeneity of variance was met for Social Competency. The result of Levene's test for Family Cohesion was not significant, $F(1, 25) = 1.16$, $p = 0.291$, indicating that the assumption of homogeneity of variance was met for Family Cohesion. The result of Levene's test for Social Resources was not significant, $F(1, 25) = 0.23$, $p = 0.633$, indicating that the assumption of homogeneity of variance was met for Social Resources.

Cronbach's Alpha Reliabilities

A Cronbach alpha coefficient was calculated for each subscale of the RSA. The Cronbach's alpha coefficient was evaluated using the guidelines suggested by George and Mallery (2018) where > 0.9 excellent, > 0.8 good, > 0.7 acceptable, > 0.6 questionable, > 0.5 poor, and ≤ 0.5 unacceptable. The items for Personal Strength – Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, and Q22 – had a Cronbach's alpha coefficient of 0.85, indicating good reliability. The lower and upper bounds of Cronbach's α were calculated using a 95% confidence interval. Table 10 presents the results of the reliability analysis.

Table 10

Reliability Table for Personal Strength

Scale	No. of Items	α	Lower Bound	Upper Bound
Personal Strength	10	.85	.79	.91

A Cronbach alpha coefficient was calculated for the Structured Style scale, consisting of Q23, Q24, Q25, and Q26. The items for Structured Style had a Cronbach's alpha coefficient of 0.77, indicating acceptable reliability. Table 11 presents the results of the reliability analysis.

Table 11

Reliability Table for Structured Style

Scale	No. of Items	α	Lower Bound	Upper Bound
Structured Style	4	.77	.64	.89

A Cronbach alpha coefficient was calculated for the Social Competency scale, consisting of Q27, Q28, Q29, Q30, Q31, and Q32. The items for Social Competency had a Cronbach's alpha coefficient of 0.77, indicating acceptable reliability. Table 12 presents the results of the reliability analysis.

Table 12

Reliability Table for Social Competency

Scale	No. of Items	α	Lower Bound	Upper Bound
Social Competency	6	.77	.66	.88

A Cronbach alpha coefficient was calculated for the Family Cohesion scale, consisting of Q33, Q34, Q35, Q36, Q37, and Q38. The items for Family Cohesion had a Cronbach's alpha coefficient of 0.86, indicating good reliability. Table 13 presents the results of the reliability analysis.

Table 13

Reliability Table for Family Cohesion

Scale	No. of Items	α	Lower Bound	Upper Bound
Family Cohesion	6	.86	.80	.93

A Cronbach alpha coefficient was calculated for the Social Resources scale, consisting of Q39, Q40, Q41, Q42, Q43, Q44, and Q45. The items for Social Resources had a Cronbach's alpha coefficient of 0.86, indicating good reliability. Table 14 presents the results of the reliability analysis.

Table 14

Reliability Table for Social Resources

Scale	No. of Items	α	Lower Bound	Upper Bound
Social Resources	7	.86	.79	.93

Inferential Analysis Via MANOVA

A MANOVA was conducted to assess if there were statistically significant differences in the linear combination of Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCST vs. ECST respondents.

Assumptions

Multivariate Normality. To assess the assumption of multivariate normality, the squared Mahalanobis distances were calculated for the model residuals and plotted against the quantiles of a Chi-square distribution (DeCarlo, 1997; Field, 2017). The scatterplot for normality is presented in Figure 20. In the scatterplot, the solid line represents the theoretical quantiles of a normal distribution. Multivariate normality can be assumed if the points form a relatively straight line. Strong deviations could indicate that the parameter estimates are unreliable and multivariate normality cannot be assumed.

Figure 17

Chi-Square Q-Q Plot for Squared Mahalanobis Distances of Model Residuals to Test Multivariate Normality
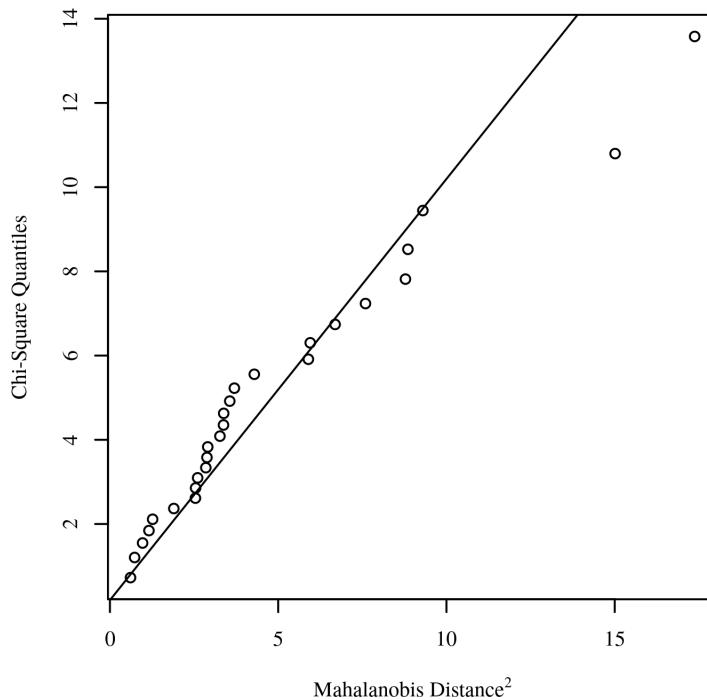
      A Mardia's test was conducted on the model residuals to determine if the residuals could have been produced by a multivariate normal distribution. The results of Mardia's test was significant based on an alpha value of 0.05, pskew < 0.001, pkurt = 0.141, suggesting that it is unlikely for the model residuals to have been produced by a multivariate normal distribution. This indicates that the multivariate normality assumption is violated.

      Homogeneity Of Covariance Matrices. To examine the assumption of homogeneity of covariance matrices, Box's *M* test was conducted. The results were not significant based on an alpha value of 0.05, $\chi2(15) = 14.37$, *p* = 0.498, indicating that

the covariance matrices for each group of respondents were similar to one another and that the assumption was met.

Multivariate Outliers. To identify influential points in the model residuals, Mahalanobis distances were calculated and compared to a χ2 distribution (Newton & Rudestam, 2012). An outlier was defined as any Mahalanobis distance that exceeds 20.52, the 0.999 quantile of a χ2 distribution with 5 degrees of freedom (Kline, 2015). There were no such outliers detected in the model.

Absence Of Multicollinearity. A correlation matrix was calculated to examine multicollinearity between the outcome variable s. All variable combinations had correlations less than 0.9 in absolute value, indicating the results are unlikely to be significantly influenced by multicollinearity. The correlation matrix is presented in Table 15.

Table 15

Correlations Between Outcome Variables

Variable	1 (PS)	2 (SS)	3 (SC)	4 (FC)	5 (SR)
1. Personal Strengths (PS)	-				
2. Structured Style (SS)	0.52	-			
3. Social Competency (SC)	0.34	0.09	-		
4. Family Cohesion (FC)	0.32	0.29	0.39	-	
5. Social Resources (SR)	0.17	0.26	0.29	0.80	-

Results of the MANOVA

The main effect for respondent (ESCST vs. ECST) was not significant, $F(5, 21) =$ 1.18, $p = 0.352$, η2p = 0.22, suggesting the linear combination of Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources was similar for each level of respondents. The MANOVA results are presented in Table 16.

Table 16

MANOVA Results for Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources by ESCST Vs. ECST Respondents

Variable	Pillai	*F*	*df*	Residual df	*p*	η_p^2
respondent (ESCST vs. ECST)	0.22	1.18	5	21	0.352	0.22

Posthocs. To further examine the effects of respondents (ESCST vs. ECST) on Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources, an ANOVA was conducted for each of these outcome variables.

ANOVA Of Differences In Personal Strengths. An ANOVA was conducted to determine whether there were significant differences in Personal Strengths between ESCST vs. ECST respondents. The ANOVA was examined based on an alpha value of 0.05, as was the case for all subsequent analyses. The results of the ANOVA were not significant, $F(1, 25) = 0.23$, $p = 0.636$, indicating the differences in Personal Strengths among the two respondent attributes studied (ESCST vs. ECST) were all similar (Table 17). The main effect of respondent was not significant, $F(1, 25) = 0.23$, $p = 0.636$, indicating there were no significant differences of Personal Strengths by this respondent attribute. The means and standard deviations are presented in Table 18.

Table 17

Analysis of Variance Table for Personal Strengths by Respondent

Term	SS	df	F	p	η_p^2
respondent	0.10	1	0.23	0.636	0.01
Residuals	11.42	25			

Table 18

Mean, Standard Deviation, and Sample Size for Personal Strengths by Respondent

Combination	M	SD	n
ESCST	3.81	0.72	20
ECST	3.96	0.50	7

ANOVA Of Differences In Structured Style

An ANOVA was conducted to determine whether there were significant differences in Structured Style between ESCST vs. ECST respondents. The results of the ANOVA were not significant, $F(1, 25) = 0.08$, $p = 0.779$, indicating the differences in Structured Style among the two respondent attributes studied were all similar (Table 19). The main effect respondent was not significant, $F(1, 25) = 0.08$, $p = 0.779$, indicating there were no significant differences of Structured Style by this respondent attribute. The means and standard deviations are presented in Table 20.

Table 19

Analysis of Variance Table for Structured Style by Respondent

Term	SS	df	F	p	η_p^2
respondent	0.07	1	0.08	0.779	0.00
Residuals	20.43	25			

Table 20

Mean, Standard Deviation, and Sample Size for Structured Style by Respondent

Combination	M	SD	n
ESCST	3.61	0.92	20
ECST	3.50	0.85	7

ANOVA Of Differences In Social Competency

An ANOVA was conducted to determine whether there were significant differences in Social Competency between ESCST vs. ECST respondents. The results of the ANOVA were significant, $F(1, 25) = 4.75$, $p = 0.039$, indicating there were significant differences in Social Competency among the two respondent attributes studied (Table 21). The eta squared ($\eta p2$) was 0.16, indicating that this respondent attribute explains approximately 16% of the variance in Social Competency. The means and standard deviations are presented in Table 22.

Table 21

Analysis of Variance Table for Social Competency by Respondent

Term	SS	df	F	p	η_p^2
respondent	2.09	1	4.75	0.039	0.16
Residuals	10.99	25			

Table 22

Mean, Standard Deviation, and Sample Size for Social Competency by Respondent

Combination	M	SD	n
ESCST	3.34	0.67	20
ECST	3.98	0.63	7

ANOVA of Differences in Family Cohesion

An ANOVA was conducted to determine whether there were significant

differences in Family Cohesion between ESCST vs. ECST respondents. The results of

the ANOVA were not significant, $F(1, 25) = 3.02$, $p = 0.094$, indicating the differences in

Family Cohesion among the two respondent attributes studied were all similar (Table

23). The main effect of respondent was not significant, $F(1, 25) = 3.02$, $p = 0.094$,

indicating there were no significant differences of Family Cohesion by this respondent

attribute. The means and standard deviations are presented in Table 24.

Table 23

Analysis of Variance Table for Family Cohesion by Respondent

Term	SS	df	F	p	η_p^2
respondent	1.99	1	3.02	0.094	0.11
Residuals	16.51	25			

Table 24

Mean, Standard Deviation, and Sample Size for Family Cohesion by Respondent

Combination	M	SD	n
ESCST	3.64	0.87	20
ECST	4.26	0.59	7

ANOVA of Differences in Social Resources

An ANOVA was conducted to determine whether there were significant

differences in Social Resources between ESCST vs. ECST respondents. The results of

the ANOVA were not significant, $F(1, 25) = 2.03$, $p = 0.167$, indicating the differences in

Social Resources among the two respondent attributes studied were all similar (Table

25). The main effect of respondent was not significant, $F(1, 25) = 2.03$, $p = 0.167$,

indicating there were no significant differences of Social Resources by this respondent attribute. The means and standard deviations are presented in Table 26.

Table 25

Analysis of Variance Table for Social Resources by Respondent

Term	SS	df	F	p	η_p^2
respondent	0.90	1	2.03	0.167	0.07
Residuals	11.15	25			

Table 26

Mean, Standard Deviation, and Sample Size for Social Resources by Respondent

Combination	M	SD	n
ESCST	4.09	0.70	20
ECST	4.51	0.56	7

The quantitative results show how to do the inferential and descriptive statistical analysis. This inferential statistical analysis was severely underpowered; therefore, research question 1 cannot be addressed adequately.

Qualitative Interview Results

The interview data gathered for this study were subjected to steps of phenomenological analysis, including horizontalization, thematizing, textural and structural description, and intuitive integration (Moustakas, 1994). Horizontalization involved carefully reviewing the transcripts and isolating relevant meaning units. Due to the intensive nature of this step, the amount of data collected, and the potential for a confidentiality breach if the raw transcripts and meaning units were published; the details of horizontalization are not included in this document. The results of the remaining steps are reported in the following sections.

Eight teachers—four ESCSTs and four ECSTs—were interviewed for the study.

Pseudonyms were used to protect the confidentiality of the participants (see Table 27).

It is important to note that all interviews were conducted in fall 2021 as public schools in

California reopened because of the COVID-19 pandemic.

Table 27

Descriptions of Participants

Pseudonym	Age	Subject Matter[1]	Group[2]	*Gender*
Brook	20-29 years	MS Science	ESCST	Female
Carlos	30-39 years	MS Science	ESCST	Male
Cindy	20-29 years	HS Chemistry	ESCST	Female
Uma	40-49 years	MS Science	ESCST	Female
Lily	30-39 years	HS Biology	ECST	Female
Morgan	30-39 years	HS Chemistry	ECST	Nonbinary
John	30-39 years	HS Math	ECST	Male
David	20-29 years	MS Science	ECST	Male

[1]MS = Middle School, HS = High School; [2]ESC = Early Second Career STEM Teacher, ECST = Early Career STEM Teacher

Thematizing

Following horizontalization, the data were carefully thematized. Themes were

drawn from the data to reflect the essence of the participants' lived experiences as

ESCSTs and ECSTs, consistent with the phenomenological method. Consistent with the

phenomenological method, six themes were drawn from the data to reflect the essence

of the participants' lived experiences as ESCSTs and ECSTs.

Theme 1: New Teachers Felt Unprepared to Manage Classroom Behaviors

The first theme shows that new teachers thought that they were unprepared to manage classroom student behaviors. Classroom behaviors are often referred to as classroom management, meaning the ability to manage students' behavior while delivering a lesson. Equal numbers of ESCSTs and ECSTs expressed that they were not prepared for classroom management. The COVID-19 pandemic and the shift to online education seemed to prevent novice teachers from gaining the needed experience with in-person, classroom management. *Lily* is an early career biology teacher in LAUSD. Lily stated, "I really feel like I got a taste of almost everything, but not so much in the classroom management aspect." Similarly, *Brook*, a first year, ESCST working in a small middle school outside of the Los Angeles area, added, "I think they [credential program] did a pretty good job of switching things to online with our classes, but I missed out on a lot of learnings, like classroom management." Brook, who also worked outdoors previously as an environmental researcher, thought that her credential program, during the pandemic, did not prepare her for "real-life". She added a colorful example:

> I guess classroom management is really hard for me, because I think that's something that I just didn't get to learn from my student teaching experience. I'm getting a lot of good tips from other teachers that I work with. I've started using different techniques that are working to some extent, but then, we have kids who just do these bizarre random things in the middle of class. Like, "Don't take your pants down in class"-I didn't think that was a behavioral expectation I had to say, but you know, just things like that come out of the blue.

As an ESCST, Brook is learning classroom management techniques on-the-job as the pandemic prevented her from experiencing physical classrooms and teaching in-person during her credential program. Since the reopening of schools in fall 2021, teachers

continue to witness behaviors that were not captured in online classrooms during the teacher preparation program; teachers are now learning how to handle those behaviors.

Some participants interviewed in this study had their first full year of teaching occur online during the pandemic. As an early career biology teacher in the Los Angeles area, Lily did not have to worry as much about classroom management during her first year of teaching. She reflected:

> I would say, in terms of classroom management, it didn't really come into play virtually because of blank screens [because students would have their cameras off.] There wasn't any behavior to manage really. When I first started [teaching] this past August, it was a shock. I don't feel like I was prepared in terms of classroom management, because there's just things coming up that you had no idea could ever come up.

Lily had some anxiety coming into the classroom for the first time after 1 year of teaching online; and, like Brooke, she did not feel prepared to handle "real-life" classroom management issues.

The first theme showed an equal number of ESCSTs and ECSTs were not well prepared for classroom management, which led to increased teacher anxiety and frustration. Furthermore, the pandemic exacerbated the lack of preparation felt by both sets of teachers.

Theme 2: Teachers Are Disillusioned When Students Are Not Held Accountable

The second theme drawn from the data involves a lack of students being held accountable for bad work or behavior. There was an equal number of ESCSTs and ECSTs who commented that schools continue to advance unprepared students through various grade levels, they deliberately do not discipline students who commit infractions, and seldom reward good behavior. These actions, or lack thereof, led to unmotivated and unprepared students. In turn, this led to disillusioned teachers feeling sad for the

future. *Carlos* teaches middle school science to mostly Hispanic students in the Los

Angeles area and is an ESCST. Carlos observed, "All these kids are not passing their

classes, but they are just getting pushed along anyway." Carlos expressed further how

his students will not be prepared for college, "If you're just pushing kids along it makes

sense that they show up to college and don't know these things [in basic biology]."

Similarly, *Morgan*, a third-year high school chemistry teacher in the Los Angeles area

and an ECST witnessed detrimental school policies. Morgan commented that "pushing

along" students, "made me really sad for the future. I don't know if [the school district] is

[even] trying to get students to graduate or actually prepared for college." Morgan

elaborated:

> One of our Deans literally came into the classroom to the ninth graders and said, "You know if you make a mistake, I'm not going to punish you. I'm going to punish your parents, because they're going to have to come and pick you up." I sat there and said [to myself], "Good job, I wonder how that's going to help you [the Dean] in the future."

This ECST recognized that the Dean's punishment was not directed at the students,

and that these students were not learning consequences—being held accountable—for

what is right and what is wrong. Morgan continued on:

> We learned when we went to high school that if we do something wrong, there will be negative consequences. If we do something right, we might get a prize. They're not learning that—they're not going to be ready for that in the workforce [or] for other things in their life, because these are the little things that help build a person's work ethic.

> The lack of accountability seemed to be as bad or worse for online schools.

John, an ECST, taught at a popular online school in California the previous year. He

could tell that his students were cheating on schoolwork by looking at the test scores.

John stated:

> Our test results were really bad. Our students were clearly cheating through everything, and there wasn't really much [we could do]. They [administration] didn't really seem to care, and they would say stuff like, "Okay, have you tried doing a better classroom culture?"

John felt like there was not much he could do to prevent his students from cheating while teaching at an online school, and his administration was out of touch on how to handle it.

An equal proportion of ESCSTs and ECSTs expressed frustration with a lack of accountability for theme two. This theme indicates that students are not being held accountable for bad work and behavior and that school leadership is not supporting the teachers' efforts and concerns.

Theme 3: Teachers Experience Difficulty Balancing Work with Life

Based on study participants' responses, teachers found difficulty balancing work with life. The ability to balance work with life refers to teachers that are able to do their jobs well while also making time for themselves and their personal lives. An equal number of ESCSTs and ECSTs expressed difficulty trying to balance work with life while teaching. Those who have difficulty complained about feelings of exhaustion and being drained and both ESCST and ECSTs described the work of teaching as "never ending". Furthermore, teachers struggle to create boundaries—physical and emotional—as they struggle with having a work/life balance.

Work as Never-Ending. Uma teaches middle school honors science in the San Francisco area and is an ESCST. Uma shared, "I feel like I work a lot harder now than I did when I was working in biotech." Surprisingly, Uma's workload as a STEM teacher is heavier than that of a STEM professional. Brook, also an ESCST, added, "I think of myself as a pretty hard worker, but oh my gosh. Teaching is 12-hour days, 60-plus hour

weeks." Like Uma, Brook finds work harder as a teacher than she did as a STEM

professional. Participants consistently voiced the sentiment that work seemed "never-

ending"; there are "too many things to do"; and that work was "always there". Morgan,

an ECST, voiced:

> I can't leave work. I can't leave work at all. It's always constant, and there's always 100 things to do. A lot of different things, be it lesson planning, grading. I have a mile high [list] of things [to do].

> Morgan, like Uma and Brook, expressed that teachers often have this feeling that

they cannot leave work.

Work Without Physical Boundaries. Multiple respondents described difficulties

establishing clear work with life boundaries. As an ESCST, Brook previously worked

outdoors doing biological research. Brook had no way to bring work home as she,

literally, had to be outdoors to do her job. Unlike a K-12 teaching position, Brook's

previous biological research position created a clear physical boundary. Brook

commented:

> I need to set a boundary and just stop working so much because I'm burning out. That wasn't a concern with my other jobs. It would be like I was either working outside doing research, and when I got home, I physically couldn't do it [outdoor research].

As a new teacher, Brook is already realizing that she is "burning out", and that she

needs to set boundaries. Brook added:

> I realized that I hadn't known this stuff about myself before, but I need to have boundaries between my work life and my personal life. I realize that I'm not good at setting those yet, and I need personal time when I'm not working. At my other job, they have been the kind of thing, where you can't bring work home. So, this has been like pretty overwhelming for me as a first-year teacher.

Cindy, a high school chemistry teacher in the San Diego area and an ESCST, also had a physical boundary while working in a laboratory setting with chemicals and equipment. Cindy shared:

> You know I used to go to work and it would be all right once I got there. I started thinking, I need to do this, this, and this. My day ends at this time, so I need to organize myself so that I accomplished all these things. At the end of the day, I was like, "All right, it's over I get to go home, and I don't really think about work now.

These two ESCSTs show that physical boundaries in their previous STEM occupations prevented them from bringing work home. They acknowledge the need to set boundaries between doing work and living life, and one of them realizes that they are already burning out.

Work Without Emotional Boundaries. In addition to their teaching, participants expressed that they needed to set emotional boundaries and that this can be difficult. John teaches high school math in the San Diego area and is interested in digital audio. John is an ECST and he thought of himself as an emotional parent to his students. He described dealing regularly with his students' emotional well-being:

> You realize, I'm the [emotional] parent for a bunch of kids even though it's only half an hour a day [when there is time for interaction with students]. They have a bunch of parents [i.e. teachers] for the day, but they go home, and they don't get that from their home. You were a lot for them. You have to deal with a thousand little emotional breakdowns a day. It is draining, it's very draining.

John realized that his students are also receiving considerable emotional support from him and their other teachers and that these students need their teachers for emotional support. However, this support is emotionally draining for teachers.

Work with Life Balance. Not all participants had a hard time balancing work with life. In fact, David teaches middle school science in the San Diego area and is an ECST. David chose teaching due to the great work-life balance:

> I'm not fully defined by my job. Teaching is great because I do have time to explore other stuff on top of it. I know a lot of people who define themselves by what they do. They work, work, work, work, and I just don't feel that way at all. I don't think that's the way I really want to live my life. Teaching, I think one of the biggest bonuses of teaching is that, like it gives you all this opportunity to spend time with your family, spend time with your friends, pursue other things that you enjoy doing. You don't necessarily have to work those big, huge hours.

This teacher likes teaching because it gives him the opportunity to have time outside of work. He is not defined by what he does as a job, but is defined by who he is as a person.

Theme 3 indicated that several participants struggled with setting work and emotional boundaries. Nonetheless, these teachers expressed feelings of exhaustion, being overwhelmed, emotionally drained, and burnout. It is important to note that one ECST described how he was able to set clear boundaries and enjoyed teaching due to the great work with life balance.

Theme 4: Support from Colleagues and Loved Ones Helps Teachers

The fourth theme suggests that support from loved ones and those in the profession helps teachers. Support comes in two areas, professional support and emotional support. Professional support for teachers includes learning classroom management and how to lesson plan, along with other areas of teaching. Emotional support means having someone there to understand what you are going through and help you deal emotionally with those situations (Friborg et al., 2005). All participants indicated that they received emotional support from loved ones. However, while all four ESCSTs shared this, only two ECSTs emphasized that mentors helped them along their path of becoming a teaching.

Professional Support. Professional support involves mentorship and mentorship can start early in the career and help people to break into the teaching

profession. For example, Second Act is an external nonprofit organization that supports individuals leaving STEM professions and becoming K-12 STEM teachers. Cindy stated, "I joined Second Act, a fellowship that helps you along the way with all the steps. They helped me with my CBEST and getting all these requirements out of the way, the certificate of clearance." Second Act assisted ESCSTs like Cindy and helps STEM professionals figure out the initial steps and exams needed to enter the teaching profession in California. Mentorship does not end there.

Mentorship continues as one gets into the profession and formal and informal mentorship occurs during the first few years of teaching. Brook, an ESCST, captured the positive feedback from a mentor well by stating:

> She has given me great advice, someone to talk to and come to with problems or questions. I feel like I'm not being judged. I can just say things to her and she'll listen without making me feel like I'm incompetent for having this happen in my class. All the supplies got stolen during the lab, and I can tell her about it. She's not judging me, like that's your fault. [Instead, she says] What you could do to prevent it?

The mentor's advice to this ESCST allowed Brook to have different strategies to deal with challenging situations.

Another area where mentorship helps is with classroom procedures and lessons. Several participants explained that as they proceed through their careers, they learn what they need in order to do their jobs and will often model mentors. Uma, an ESCST elaborated:

> I definitely copy from other teachers. The whole bell ringing, putting my hands up, the lunch detention, that's something that I got from another teacher. Sometimes, if they have like a really cool hands-on activity or a really cool lab that they did, I will copy that. There's a gummy bear lab we do to measure density, so I got to do that in person this year. That was really fun. The students enjoyed it, and they learned what I needed them to learn from it. I think everything, we pretty much copy from each other. I don't think there's anything that we really make up.

This quote shows how teachers "copy," and learn, from their mentors. Activities like bell ringing activities, having a lunch detention, and a fun hands-on lab were all ideas teachers learned from colleagues. Clearly, teachers will adopt classroom procedures and lessons from their mentors.

Emotional Support. Support also came from family and loved ones. David's parents helped him on his path to becoming a teacher and he explained, "My mom's been a teacher for a long time, and I come from a family of teachers. Teaching, in my family, is something that everybody really strongly supported." As an ECST, David did not realize in college what career that he wanted to pursue, yet his parents' thought that he would be a teacher before he realized it. David's parents told him, "We always thought you're going to be a teacher. We just didn't want to tell you that, because then you wouldn't know." His parents were very supportive.

Support from Significant Others Also Helps Teachers. Carlos reflected: "My wife is [supporting me] every week. If I have a bad day or something, or if I just need to just talk about it, she's there." As an ESCST Teacher, Carlos talks to his wife about "having a bad day at work", and this helps him deal with his job. He described the difference between support provided by significant others and support from those in the profession. He explained support from mentors and fellow teachers involved job related critiques and support. He shared:

> I also have some people at school that I met, other teachers. There're some things that my wife won't understand because she's not a teacher. It's nice to bounce it off them, to talk to them, about the problems that we're having since they're also experiencing it at the same school. I don't know. I definitely rely on others, just to maintain my sanity. You can't just deal with all that on your own. You've got to talk to people.

This shows that emotional support comes in different forms, and can come from loved ones (e.g., parents, spouse) or colleagues.

Emotional Deterrence. Not all participants had support from their loved ones. Cindy's mom told her, "Oh, why would you want to work at a school. Students are not very nice and with school shootings. Why would you put yourself in that position?" Cindy's mom was concerned about students' behavior, the threat of violence, and her daughter's safety. As an ESCST, Cindy received emotional deterrence from her mother. John, an ECST, also added, "I just feel like there isn't anything that any loved ones can really do to support you. All the stuff that's tough about school is just [on] you." John felt that his loved ones did not have the ability to support him as they could not understand the demands of teaching.

This fourth theme shows how emotional and professional support helps teachers. Professional support from mentors and emotional support from loved ones helps ESCSTs and ECSTs. Professional support in the form of job-related procedures and lessons from mentors helps teachers figure out how to do their job. Emotional support in the form of listening and encouragement from loved ones helps teachers deal emotionally with the challenges of the profession. More ESCSTs than ECSTs that mentioned the importance of mentorship. Lastly, not all support was positive as Cindy's mom deterred her from becoming a teacher, held negative perceptions of students and school safety; while John felt his loved ones did not understand the demands of teaching.

Theme 5: Talking to Students Increases Communication Skills

The fifth theme involves improving one's communication skills by talking to students. An equal number of ESCSTs and ECSTs referenced this theme. Ultimately, the STEM teachers found their voice—that they have knowledge and experience worthy of sharing—and they learned techniques to change the tone of their voice to engage students. Lily, an ECST, found her voice by teaching and commented:

> Even coming from strength and conditioning, this is very different in terms of my confidence and social settings, and speaking in groups or in front of groups, because I have my own classroom now and do it every day. The more you do it, the more comfortable you are with it.

Lily summarized how talking every day in her classroom allows her to become more comfortable talking to groups of students. She recognized that STEM teachers have valuable experience and can share their knowledge with their students. Cindy, an ESCST, realized that her perception of herself had changed through her engagement with students. She felt the students are interested in what she had to say. Cindy shared:

> If a student asks me a question, I have a lot more to say. There's more like of a breakdown. I realized how much I know through being an educator. Oh, I know a lot, and I think it's interesting how students are very interested in hearing how much I know. I guess my perception is changed. I think I'm a little more interesting now just because my students think I'm interesting. I'm like "Oh, I guess I do have something to share."

Cindy found that her work experience is interesting to her students. In addition, Cindy noted that she literally changed the inflection of her find her voice to sustain her students' attention:

> I also didn't realize how I change my voice depending on the conversation. It's either very formal or maybe it's a little more playful, and I didn't realize I had this [ability]. I was able to change how I talked to keep my students engaged. I think that kind of changed about me, so I'm not I'm not as quiet as I thought I was.

Cindy realized that her voice matters, both the content and the physical volume and tone of her voice influence how she engages her students.

Theme 5 shows that both ESCSTs and ESCSTs stated that engaging with students improved their confidence and communication skills. These teachers' build confidence over time by repeated teaching opportunities and developing their communication skills. They realized their experiences are worthy of sharing with students, and, at times, actually change their volume and tone to keep students engaged. Building communication skills will be discussed further in Chapter 5.

Theme 6: Teachers with a Sense of Purpose Find Fulfillment

Teachers talked about having a sense of purpose while doing their job and this sense of purpose leads to fulfillment. Theme 6 showed a difference between ESCSTs and ECSTs, and there were more ECSTs (n = 3) than ESCSTs (n = 1) that shared a sense of purpose. Uma, an ESCST, summed up this theme well, "I just feel like I have some purpose in life, and that I fulfill that purpose." Uma related this sense of purpose to being happy as a teacher and continued on by stating, "All in all, I'm very happy with my career decision and I love it. I love every minute of it." Uma shows how purpose relates to being fulfilled in your profession. Lily, an ECST, added, "I think the excitement of teaching and being a teacher has never left, even though there are some very hard and challenging times". Lily shared further:

> [Teaching is] inspiring us to be different, to be ourselves, and to really find our "why" and connect with our students and support them on so many different levels. That's what I want to continue doing, is just supporting students, helping them, and inspiring them to challenge themselves.

Lily found her "why" and this makes her want to continue teaching. David, another ECST, felt rewarded and fulfilled by teaching, and commented:

> I think my approach to work changed through this process because it is
> something that I guess I knew I would feel good about. I know what I'm doing.
> So, when you're putting that effort in, it feels good to be rewarded for it and
> fulfilled by it.

Feelings of excitement and fulfillment are born from a sense of purpose these teachers get from teaching and helping students.

This theme shows that the STEM teachers expressed a sense of purpose that builds happiness and enjoyment with their career. There are more ECSTs than ESCSTs that expressed a sense of purpose and the related happiness and enjoyment with their teaching career. Nonetheless, none of the participants interviewed expressed a desire to leave teaching at the time of the study or an ultimate disillusionment with their decision to become a teacher.

Textual and Structural Description

Following thematizing, the third step of phenomenological analysis was composing textual and structural descriptions. This step involved creating a description of "what" participants experienced (textural description) and "how" they experienced it (structural description). Invoking imaginative variation, additional meanings for the textural and structural descriptions were considered and sought from different perspectives, roles, and functions (Moustakas, 1994).

With respect to what the participants experienced while becoming secondary STEM teachers, participants explained that their preparatory experiences (e.g. teacher preparation and internship programs) as well as school policies and conditions set a context for their teaching experience that influenced their resilience. In addition, the support received from friends, family, and mentors further enhanced the conditions for more effective teaching. The experience of teaching improved communication and

served to enhance their resilience, while viewing their workload as excessive threatened their resilience. Moreover, the sense of purpose in teaching appeared to play a particularly more salient role for ECST compared to ESCSTs.

In terms of a structural description, which describes the context in which participants experienced these supports and obstacles, participants cited both support and discouragement from the school environment as well as from family, friends, peers, and mentors. Family members, in particular, play a primary support role for the participants, as they provided various forms of emotional, practical, and career-related help. Fellow teachers and mentors, meanwhile, tended to play a supplementary support role for the participants.

Intuitive Integration. In the final step of analysis, called intuitive integration, the textual and structural descriptions of the experiences were synthesized into a composite description of the phenomenon. This description constitutes the essential, invariant structure of ultimate "essence" that captures the meaning ascribed to the participants' experience (Creswell, 2018; Moustakas, 1994; Wertz et al., 2011).

Based upon the participants' accounts, ESCSTs and ECSTs' experiences of resilience in their teaching careers involve receiving developmental and early experiences as novice teachers as well as support from families, friends, peers, and mentors. These various influences shape their perceptions of themselves, their students, their careers, and their future as teachers which; in turn, influenced their resilience in their careers. A more thorough overview of the intuitive integration and essence of the phenomenon will be discussed in Chapter 5.

Conclusion

The mixed-method study found both quantitative and qualitative results. However, there were not enough participants to do inferential quantitative analysis and descriptive analysis was shown. The descriptive statistics illustrate how to conduct an inferential quantitative study. Inferential quantitative analysis was severely underpowered and was not able to address research question 1. The post hoc ANOVA indicated that the ECST respondents in this study reported significantly higher social competency than did ESCST respondents. Although the current low response rate prevented reliable inferential statistical data, the appropriate statistical methods were provided. Collecting survey data from a sizable sample of ECST and ESCST participants with sufficient power would allow for quantitative analysis to assess any significant quantitative differences between these two groups.

The interview data and subsequent phenomenological analysis indicated that the participants in this study received several forms of support (e.g. friends, family members, mentors, colleagues, and school environments) during their novice teaching experiences. These forms of support helped produce favorable perceptions of their careers and the students, thus enhancing the teachers' resilience. They experienced multiple disruptions followed by resilient reintegrations that led to them staying in their teaching careers (Richardson, 2002). Chapter 5 provides a discussion of these resilient reintegration results.

Chapter 5: Discussion

Introduction

Chapter 4 reported the quantitative and qualitative results for this study. Chapter 5 offers (a) the study summary, including its research question and hypotheses, methodology, and participants; (b) discussion of the findings (c) the intuitive analysis of the data, (d) implications for practice, and (e) recommendations for additional research. The contribution of the present study is examined in these sections and comparing the study findings to the extant literature and appropriate theoretical frameworks.

Summary of the Study

This study examined resilience in ESCSTs in public secondary school settings as compared to ECSTs, and how, if at all, resilience assisted teacher candidates in maintaining their intention to persist as STEM teachers (Allison, 2012; McGarry et al., 2013; Peters & Pearce, 2012). A gap existed in the extant literature related to the resilience of ECST and ESCSTs and the present study offered important insights to help fill this void. Consequently, the purpose of this mixed methods study was to examine resilience in ESCSTs in public secondary school settings as compared to ECSTs. The findings from this study have identified individual and programmatic factors that may increase ESCSTs' resilience, and how these findings might inform teacher preparation and support programs and approaches to help strengthen the K-12 STEM teaching workforce. Furthermore, conducting the present study within the COVID-19 pandemic era represented another area for unique contribution. Study participants transitioned to online teaching during the preservice experience and/or first year of

teaching and this shift posed both challenges and benefits that affected ECST and ESCSTs' experiences and, in turn, their resilience.

The research design, execution, and analysis were influenced by the study's underlying theoretical frameworks of resilience and resilient leadership. Resilient leadership is the exercise of resilience-associated attributes while carrying out a formal or informal leadership role over themselves and/or others (Allison, 2012). Resilient leadership is believed to support ESCSTs in negotiating the challenges of becoming a teacher and succeeding in the early years of their teaching careers. Allison (2012) asserted that teachers should practice personal renewal, stay optimistic, and cultivate networks before challenges hit to sustain and build their resilience as leaders. Richardson (2002) emphasized the importance of resilient qualities, processes, and motivation in determining the outcomes people experience following adversity and disruption. According to Richardson (2002), there are four responses to adversity, resilient reintegration (experiencing post-disruption growth), homeostatic reintegration (experiencing healing back to original state), loss-based reintegration (experiencing hopelessness), and dysfunctional reintegration (responding destructively). Both Allison (2012) and Richardson (2002) theoretical frameworks were utilized to analyze the data.

Research Question and Hypothesis

This study aimed to examine resilience in ESCSTs in public secondary school settings as compared to ECSTs. An ESCST is an individual with at least 2 years of STEM-related work experience who transitioned into public secondary STEM educator role and who is within the first 5 years of teaching. An ECST is a public secondary

STEM educator who is within the first 5 years of teaching. Three research questions were examined:

1. To what extent, if at all, are there differences in resilience related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources between ESCSTs and ECSTs?

2. How do ESCSTs and ECSTs describe their resilience?

3. How do ESCSTs and ECSTs build resilience?

The quantitative part of this mixed-methods research has a null hypothesis and a hypothesis. They are as follows:

H_o: No statistical relationship exists between ESCSTs' personal strength, social competency, and family cohesion resilience and ECSTs' personal strength, social competency, and family cohesion resilience.

H_1: A statistical relationship exists between ESCSTs' personal strength, social competency, and family cohesion resilience and ECSTs' personal strength, social competency, and family cohesion resilience.

Discussion of the Findings

The purpose of this study was to examine resilience in ESCSTs in public secondary school settings as compared to ECSTs. Friborg et al.'s (2005) RSA was used to gauge respondents' resilience using five subscales: *personal strength*, *structured style*, *social competency*, *family cohesion*, and *social resources*. Respondents were organized into two samples: ESCSTs and ECSTs. Qualitative data for this study was gathered using interviews with four ESCST and four ECSTs. The following sections discuss the results by research question. First, the quantitative data

analysis is reviewed to evaluate if there are quantitative differences in resilience between ESCST and ECSTs. Next qualitative data results are reviewed to indicate how ESCST and ECSTs describe resilience and how they build resilience in their profession. The results also are compared to extant literature and the theoretical frameworks are utilized to help make sense of the participants' lived experience. Data indicates that ESCST and ECSTs experience difficult challenges and find growth, confidence, and fulfilment in their teaching.

Research Question 1: To What Extent, if at all, Are There Differences in Resilience Related to Personal Strengths, Structured Style, Social Competency, Family Cohesion, and Social Resources Between ESCSTs and ECSTs?

The RSA was used to gather data about participants' levels of resilience. The RSA consisted of the scales of personal strength (6 items), personal strength/perception of future (4 items), structured style (4 items), social competence (6 items), family cohesion (6 items), and social resources (7 items). Descriptive statistics were calculated for each subscale by each demographic grouping and for the overall sample. As discussed in the Chapter 4, the results showed that there are not enough study participants (needed 206 or more participants) to make a quantitative MANOVA comparison comprised of two groups (ESCSTs and ECSTs) and five predictor variables with 80% power at a significance level of 0.05 (Erdfelder et al.,1996). Research question 1 was not addressed adequately by the results of this study. Nevertheless, descriptive quantitative statistics were completed. The post hoc ANOVA indicates a significant difference between ECSTs and ESCSTs for social competency, with ECSTs having a mean of 3.98 and ECSTs having a mean of 3.34; however, it is not appropriate

to analyze a single dependent variable when the tool is designed to test five variables and the MANOVA is severely underpowered. Future research should examine social competency between ECSTs and ESCSTs to determine if there truly is a significant difference between these two groups.

Research Question 2: How do Early Second Career STEM Teachers and Early Career STEM Teachers Describe Their Resilience?

Three themes emerged from this data regarding how ECST and ESCSTs described resilience. First, participants described how they felt unprepared to manage classroom behaviors. Second, ESCST and ECSTs had difficulty achieving work-life balance as their work spanned their physical and emotional boundaries and their work seemed endless. Third, participants described having a sense of purpose.

Unprepared to Manage Classroom Behaviors. Related to the first theme, the COVID-19 pandemic and the shift to online education prevented teachers from gaining much-needed classroom management experience. As noted in Chapter 4, Lily (an ECST) explained, "I really feel like I got a taste of almost everything, but not so much in the classroom management aspect." Brook, a first-year ESCST, similarly stated, "I think they [credential program] did a pretty good job of switching things to online with our classes, but I missed out on a lot of learnings, like classroom management." The study findings indicated that classroom management is difficult, and teaching during the COVID-19 pandemic made it even more challenging. As teachers moved from face-to-face to online instruction between 2020 and 2021, many ECST and ESCSTs missed critical developmental and early career professional experiences related to classroom management. Earlier studies, which occurred prior to intensifying effect of the COVID-

19 pandemic, observed similarly that particularly acute competency gaps often occur in the area of early teachers' classroom management proficiency (Johnson et al., 2009; Robertson, 2006).

Challenges with classroom management reflect Allison's (2012) theory of resilient leadership. Alison (2012) suggested that factors such as insufficient pre-service education and onboarding (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006); idealism misaligned with the daily realities of classroom teaching (Abbott-Chapman, 2005; Day & Gu, 2010); and inadequate personal and contextual factors to support success (Andrews et al., 2007; Kanpol, 2007; Quinn & Andrews, 2004) tend to undermine teachers' resilience. Notably, participants did not cite any individual measures (e.g. building strong social networks or maintaining optimism) or school-based efforts (e.g., professional development or mentoring programs) to fill their competency gap. Allison (2012) identified all of these as resilience-building strategies.

Accordingly, participants' acknowledged that they lacked classroom management proficiency, and they failed to discuss any efforts or strategies to overcome this competency gap. Richardson (2002) describes disruptions followed by loss-based reintegration when participants experience some lack of hope and motivation in response to the challenges they faced. Both Lily and Brook learned classroom management on-the-job. Brook's statement "Don't take your pants down in class" was something she never thought she would have to say. They did not expect to deal with such extreme classroom management issues and, consequently, they expressed a lack of hope and motivation.

Difficulty Managing Work-Life Balance. A second finding related to how teachers describe their resilience, or lack thereof, concerns teachers' difficulty managing their workloads and finding a work-life balance. For example, in Chapter 4, Uma (an ESCST) reflected, "I feel like I work a lot harder now than I did when I was working in biotech." Participants consistently described teaching as "never-ending" with "too many things to do." The notable exception to this theme involved David, an ECST whose parent also was a teacher. In contrast to other participants, David deliberately chose teaching due to what he viewed as exceptional work-life balance and the ability to spend time with family and friends. He expressed that he has time to pursue hobbies and other interests, and he does not define himself or his life's purpose as teaching. In the extant resilience literature, work-life balance related to supportive workplaces has been associated with resilience (DeCastro et al., 2013; Gu, 2014; Mackenzie, 2012). Having untenable workloads could relate to lack of support from the environment and, thus, may be related to the present study's findings.

The resilient leadership framework informs the challenge of work-life balance as overloading staff with initiatives that lowered resilience; however, building support networks and resources correlate with higher resilience (Allison, 2012). The participants' discussion of their untenable workload further indicates several factors Allison (2012) noted as undermining teacher motivation. For example, these factors include excess idealism misaligned with the daily realities of classroom teaching (Abbott-Chapman, 2005; Day & Gu, 2010); inadequate personal and contextual factors to support success, resilience, and retention (Andrews et al., 2007; Kanpol, 2007; Quinn & Andrews, 2004); excessive stress and burnout (Goddard & O'Brien, 2004; Howard & Johnson, 2004;

Noble & Macfarlane, 2007). Moreover, regarding their workload, the teachers did not mention any strategies that they adopted to address their workloads. These strategies include practicing self-care leading to personal renewal, building strong social networks and resources, maintaining optimism, or counteracting the adverse impacts of workload (Allison, 2012).

In turn, this finding reflects Richardson's (2002) classification of loss-based reintegration and dysfunctional reintegration. This suggests that participants may be lacking critical resilient qualities that would enable them to address their excessive workload in ways that enable them to thrive. Several participants, both ECSTs and ESCSTs, voiced that work seemed "never-ending" and that there are "too many things to do" and "work was always there." Loss-based reintegration results in a sense of hopelessness and these experiences may lead to dysfunctional reintegration resulting in STEM teacher attrition.

Teaching Leads to a Sense of Purpose and Fulfillment. Some of the ESCST and ECSTs emphasized that finding a sense of purpose and fulfillment in teaching produced a sense of happiness in their careers. Teachers described having a "sense of purpose" while teaching students and this sense of purpose leads to fulfillment. Interestingly, more ECSTs (n = 3) than ESCSTs (n = 1) shared a sense of purpose in their teaching. As shared in Chapter 4, Uma (an ESCST) summed up this theme well, "I just feel like I have some purpose in life, and that I fulfill that purpose." Uma related this sense of purpose to being happy as a teacher and in her decision to become a teacher. In fact, she exclaimed, "I love it". This finding regarding the fulfillment participants found in teaching reflect notion of career changers who leave the field do so from a strong

motivation to find purpose, confirming the finding that the ESCSTs interviewed in the present study were opt-outs driven by self-determination (Thomas, 1980).

According to Thomas' (1980) taxonomy of career changers, all four ESCSTs interviewed fit the classification of *opt-outs*. Opt-outs are defined as career changers where their transition was self-determined; they experienced high internal pressure to change but little pressure from their organizations or external environments to make the change. For example, Uma reflected on her entry into teaching: "I really didn't know where to start, you know. I was in biotech for almost 20 years before I decided to become a teacher, and I love every minute of it." Brook shared how she worked previously in "environmental research and conservation for a few years" before realizing that she wanted to change careers. These two teachers exemplify how the ESCSTs fit the classification of opt-outs.

In both groups, only one ESCST and one ECST expressed a different sense of purpose compared to their participant groups. One ESCST, Uma, expressed having a sense of purpose in teaching as a career. While all four ESCSTs expressed an internal desire to change careers (i.e. opt-outs), only Uma expressed having a sense of purpose being a teacher. In contrast, one ECST, David, did not express a sense of purpose as motivation for teaching while maintaining a healthy work/life balance. This data suggests that ECSTs have higher self-esteem and personal resilience (Friborg et al., 2005), and may be better at practicing self-care while inspiring others (Allison, 2012).

Resilient Leadership theory indicates a sense of purpose and fulfillment in teaching is associated with resilience. Having a *sense of purpose* is related to optimism and is key to resilient leadership. Moreover, it is possible that the happiness and

optimism the STEM teachers feel teaching may provide motivational force to practice the self-care that could create personal renewal and increase self-esteem. This would counteract the adverse impacts of obstacles and setbacks, strategies that Allison (2012) cites as instrumental in bolstering resilience.

Due to the sense of purpose and happiness participants described, they reflect some degree of the resilient qualities, processes, and motivation described by Richardson (2002). These qualities indicate the potential for resilient reintegration; the most resilient type of response wherein individuals experience growth following challenge and disruption. For example, an ECST, Lily, found her "why" (i.e., sense of purpose) by becoming a teacher and connecting with her students. This improved her self-esteem and fed her self-care. Furthermore, earlier researchers noted that being purposeful is positively correlated with resilience (Arora & Rangnekar, 2016a; Lyons et al., 2015; Wei & Taormina, 2014).

Research Question 3: How do Early Career STEM teachers and Early Second Career STEM Teachers Build Resilience?

Three themes emerged from the present study data regarding how ECST and ESCSTs build resilience. These themes involved ESCST and ECSTs experiencing: (a) disillusionment when they witnessed leadership not holding students accountable; (b) professional and emotional support of colleagues and loved ones; and (c) finding their voice and developing their communication skills through student engagement. Participants also noted that their resilience was enhanced by their preparation to enter teaching, their present school environment, support from others, and development of their communication skills. In contrast, negative perceptions of their workloads

diminished their resilience. Participants noted that the school environment, family, friends, colleagues, and mentors could become sources of support or discouragement, with family members playing a particularly powerful role. ESCSTs and ECSTs gained resilience in their early teaching careers by receiving support from families, friends, peers, and mentors. These various influences shape their perceptions of themselves, their students, their careers, and their future as teachers which; in turn, influenced their resilience in their careers.

A Lack of Accountability Leads to Disillusionment. Teachers experience disillusionment when they witnessed leadership not holding students accountable. The study findings illustrate that districts and schools appear to be "pushing" students through grade levels while failing to provide proper disciplinary action. Pushing students through refers to automatic academic promotion from one grade level to another, regardless of whether students have attained a minimum level of knowledge and competency (Neild, 2009). In addition, districts and schools neglected their own behavior policies and practices frequently rather than provide appropriate assessment and/or disciplinary action. For example, Carlos observed, "All these kids are not passing their classes, but they are just getting pushed along anyway." According to Neild (2009), the problem actually begins earlier when students are "pushed through" middle school with failing grades and a lack of basic competencies they need to perform well in high school. He posits that although these students may not go on to college, they drain resources from those students that do go on to college. In turn, college-bound high school graduates often find themselves unprepared for college once they enter.

In the present study, some STEM teachers explained that witnessing these dynamics led to a sense of disillusionment. Morgan, a third-year high school chemistry teacher in the Los Angeles area and an ECST, witnessed detrimental school policies "pushing along" students that led to feelings of sadness "for the future" and she questioned whether her school was actually preparing students to for post-secondary education. Similarly, past studies indicated that contextual factors, such as unsupportive school leadership (Andrews et al., 2007; Quinn & Andrews, 2004) and school environments that demoralize and undermine teachers' efficacy can undermine their resilience (Kanpol, 2007; Peters & Le Cornu, 2007a, 2007b). In contrast, strong and supportive leadership—in this case, the personal support and leadership from the school principal—is necessary to support early career teacher resilience (Brotheridge & Power, 2008; Peters & Pearce, 2012). Such leadership and support can be pivotal for helping novice teachers (i.e., ESCST and ECSTs) negotiate the inevitable challenges of beginning a teaching career, and this can build resilience and enable teaching longevity.

It is important to note that many school districts throughout California adopted multiple policies and practices to accommodate the perceived and real challenges that K-12 students and families faced during the COVID-19 pandemic. For example, students were often not required to turn on their cameras during synchronous online classes and many districts adopted a "no fail" policy. In fact, even institutions of higher education like the UC and CSUs postponed long standing practices like the use of the SAT II exam for university admission because they did not believe that all K-12 students received an inequitable or substantive education during COVID. Since this study

occurred as schools reopened in fall 2021, perhaps some of these legacy practices were influencing the leadership's inability to hold students accountable.

An equal number of ECSTs and ESCSTs participants appeared to have low resilience. Participants' sense of disillusionment reflected several aspects of Allison's (2012) theory of resilient leadership. The realities of limited support experienced from administration for student accountability reflect insufficient pre-service education and onboarding (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006); excess idealism misaligned with the daily realities of classroom teaching (Abbott-Chapman, 2005; Day & Gu, 2010); and inadequate personal and contextual factors to support success (Andrews et al., 2007; Kanpol, 2007; Quinn & Andrews, 2004). Allison (2012) noted that these factors tend to undermine teacher resilience. Furthermore, participants did not cite practices that would build resilience according to Allison (2012). Such practices could include engaging in learning about how to better motivate students to be accountable, self-care that produces personal renewal, building strong social networks and resources that could result in mentoring or productive action culminating in better student accountability, maintaining optimism, or counteracting the adverse impacts of these obstacles and reacting quickly to setbacks.

Moreover, with regarding to their disillusionment, the participants' responses indicated having less than optimal resilient qualities, processes, and motivation. For example, John, an ECST Math teacher, felt like there was not much he could do to prevent his students from cheating while teaching at an online school, and that his administration was "out of touch" on how to handle it. The participants' responses

indicated the state of loss-based reintegration; they experienced a lack of hope and motivation in response to the challenges of student accountability (Richardson, 2002).

Professional and Emotional Support Builds Resiliency. Research indicates that having sufficient professional and emotional support has multiple benefits. For example, professional and emotional support can improve new teachers' onboarding experience (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006); help new teachers develop realistic expectations of the classroom experience (Abbott-Chapman, 2005; Day & Gu, 2010); increase their personal and contextual resources to support success (Andrews et al., 2007; Kanpol, 2007; Quinn & Andrews, 2004); and counteract burnout (Allison, 2012). Professional and emotional support of colleagues and loved ones builds resiliency. As the participants described, professional support could take the form of mentorship, adopting others' classroom management practices or replicating others' in-class activities. Cindy, an ESCST that previously worked in a professional lab setting, joined Second Act, a nonprofit organization that provides mentorship and fellowship that helps people transition from their previous careers to become a teacher. Support from mentors and friends is critical as they provide moral support and can serve as a role model. For example, ECST David's parents helped him on his path to becoming a teacher. He explained, "My mom's been a teacher for a long time, and I come from a family of teachers. Teaching, in my family, is something that everybody really strongly supported." Support from parents as well as other family members and loved ones also was critical, in terms of moral support to become a teacher and serving as a role model.

Professional and emotional support within the STEM teacher participants reflected Allison's (2012) theory of resilient leadership that asserts building strong social networks enhances teachers' resilience. Specifically, these social networks can foster teachers' learning and help them buffer the effects of challenges they encounter (Allison, 2012).

Professional and emotional support also can help new teachers enhance their resilient qualities, processes, and motivation. This support may lead to homeostatic reintegration (i.e., healing and restoration to their original state following challenge) or resilient reintegration reflecting growth through adversity and challenge (Richardson, 2002). For example, ESCST Brook mentor's advice gave her ways to deal with unwanted classroom behavior and continue to grow as a novice teacher. Richardson's (2002) *Metatheory of Resilience and Resiliency* similarly noted that the disruption of change (in this case, beginning a new career as a teacher) can trigger growth and/or the strengthening of personal qualities.

Finding Voice Through Student Engagement. New teachers who find their voice and communicate effectively with others also are better equipped to respond productively and proactively to the events that erode resilience, such as insufficient pre-service education and onboarding (Algozzine et al., 2007; Johnson et al., 2009; Robertson, 2006; Roehrig & Luft, 2006). In such cases, new teachers could express the challenges they are having and request support for those challenges from peers, mentors, and administration. Through effective communication, new teachers also could test and adjust overly idealistic expectations about the classroom teaching experience (Abbott-Chapman, 2005; Day & Gu, 2010) and secure the resources and support they

need to enhance their success, resilience, and retention (Andrews et al., 2007; Kanpol, 2007; Quinn & Andrews, 2004).

Concepts of voice and communication skills also reflect the Resilient Leadership Theory (Allison, 2012). Early second career and early career STEM teachers build resilience as they find their voice and develop their communication skills through student engagement. Several participants emphasized how teaching helped them build confidence, find relevance in their knowledge and lived experience, and enhanced their ability to communicate effectively with others. Lily, an ECST, found her voice by teaching and commented, "The more you do it, the more comfortable you are with it." ESCST Cindy found that students showed interest in her scientific background and her experiences; this interest increased her confidence. Similarly, Friborg et al. (2003, 2005) cited communication ability as being central to resilience. Communication skills also are critical for interacting effectively with students and parents, colleagues, and administration (Flores, 2006; Goddard & Foster, 2001). Allison (2012) stressed the importance of using one's words carefully to create a positive emotional climate in which hope prevails and individuals feel inspired to create a better future, and referred to this as a practice central to resilient leadership. Effective communication and self-expression also can contribute to building strong social networks (Allison, 2012).

Participants' report that they found their voice and developed more effective communication skills through teaching further reflects Richardson's (2002) stage of resilient reintegration, where they experienced personal growth and grew their competencies as a result of and through the experience of the disruption—in this case, transitioning from a STEM career to the teaching profession. As such, this finding

indicates that participants possessed resilient qualities and motivation and further engaged in resilient processes.

Implications for Practice

This section describes three implications for practice to support and build resilience amongst ESCST and ECSTs. Based on findings in this study, the development of social networks, the cultivation of family support, and development of work-life balance strategies are critical to building resilience amongst all novice STEM teachers; in particular, for ESCSTs transitioning from a STEM profession into the K-12 teaching force.

Develop Social Networks. According to theories of resilience, social networks are central to fostering resilience (Allison, 2012; Duggan & Theurer, 2017; Friborg et al., 2005) and persisting in one's teaching career (Arnup & Bowles, 2016). Both the ECST and ESCST samples in this study reported moderate to high social support. Moreover, the ECSTs reported significantly higher social support than ESCSTs. It follows that ESCSTs may benefit from deliberate structure, support, or guidance in building their social networks.

A multi-pronged approach by STEM teachers, Institutes of Higher Education (IHE) (e.g. teacher prep, internship programs), K-12 school districts, and the STEM transition support programs (e.g. Encorps, GREAT) are critical to foster maximum opportunities to develop social networks is critical.

Given the importance of social support and networks for teacher resilience, ECST and ESCSTs would benefit from spending time to cultivating their support networks before the difficulties of teaching occur (Allison, 2012). Allison (2012) advised

that the essence of resilient leadership is to diligently build buy-in from those supporters and would-be supporters. This is important because these supporters believe in and are inspired by what the teacher and their school or school system is achieving and who, in turn, would happily offer resources and other forms of support. Such supporters may include teaching colleagues, leaders in the community, and influential families within the school system.

School districts and district leadership can implement multiple policies and practices to encourage teacher support systems, mentorship, and better assess levels of resiliency amongst teacher applicants and early career STEM teachers. Because of the strong relationship between social competency and resilience; administrators and school officials may be advised to evaluate teacher candidates' social networks and social competency as part of the hiring process. Given that ECSTs may tend to have stronger social networks and social competency than ESCSTs, when individuals are hired as second-career teachers; care might be taken to encourage and support these individuals in cultivating their social networks. Such support maybe implemented through formal mentoring programs, affinity groups, and the parent-teacher association.

Districts and induction programs also can aid new teachers in building their social networks and social competency by providing frameworks for building supportive relationships with colleagues, hosting networking events, and encouraging the creation of professional learning communities. These various activities create a forum and structure for relationship building among teachers that could prove instrumental in their forming supportive social networks and mentors. For example, Brook's mentor helped her when lab supplies were stolen from her classroom by suggesting ways to prevent it

from happening again. In alignment with Richardson's (2002) Metatheory of Resilience, mentors helped in numerous ways by listening and suggesting ways to prevent situations from happening again. Brook was open to the mentorship and feedback, indicating a state of resilient reintegration, wherein the disruption triggers growth or strengthening of personal qualities (Richardson, 2002). Teacher preparation programs working to train and support ECST and ESCSTs can create mentoring programs between early career teachers and veteran teachers and include awareness building and deliberate training related to fostering social/support networks so that new teachers establish and grow their networks during and after their preservice experience. Degree programs that train educators also should also raise candidates' awareness about the importance of cultivating and maintaining healthy social networks.

Policy makers at the school, district, county, state, and federal level should consider mandating education in resilience training, importance of academic support groups, as well as mandating in-service days dedicated to strengthening teachers' social networks. Collaboration across subject matter experts is key. Researchers studying STEM teacher resiliency also should investigate the importance of social networks and evaluate approaches ECST and ESCSTs can use to build their support networks.

Cultivate Family Support. Arnup and Bowles (2016) found that individuals with family cohesion (i.e., strong family support) reported low intention to leave their fields or professions. Little research exists that examines the importance and mechanisms of family support for supporting teacher resilience and persistence in their fields. However, this study offers initial indications that family support is critical within this population.

Participants emphasized that family, friends, and other loved ones could become supportive or discouraging. In particular, family members can become a source of guidance and motivation or, conversely, one of doubt and pessimism.

Furthermore, in the present study, ECST respondents reported significantly higher family cohesion than did ESCST respondents. It is unclear why this finding occurred and should be the focus of additional research beyond the present study. Moreover, given the role of family cohesion in resilience, teacher preparation programs that train educators should include explicit modules that elevate candidates' understanding of the role of family support in their careers. These programs also should provide frameworks for students to reflect about the family support they need and then discussing these needs with their families. Similarly, induction programs should consider how this element of resilience may be cultivated for all STEM teachers. For example, teacher preparation and induction programs could provide dialogue guides with questions and talking points for teacher candidates to use when discussing their career plans with their family members. This process could enhance the sense of cohesion and support.

Within K-12 school settings, in-service programs and professional development efforts can similarly facilitate peer dialogues to bring awareness to the ways (a) their families offer support, (b) their families could increase their support, or (c) the teachers themselves could initiate conversations to increase their family members' support.

Policy makers at the school, district, county, state, and federal level may consider mandating education and in-services related to helping teachers learn how to bolster family support. Researchers studying STEM teacher resiliency also should investigate

and evaluate approaches ECST and ESCSTs use to increase family members' support. David's parents supported him tremendously. This helped him to find teaching as his passion and allowed him to be optimistic while setting good boundaries. David now has a healthy relationship with teaching and a fulfilled career. Allison (2012) states that teachers should stay optimistic and cultivate networks before challenges hit to sustain and build their resilience as leaders.

Develop Work-Life Balance Approaches. Within district and school settings, organizations should introduce teachers to specific self-care approaches and provide self-care strategies in workshops, networking events and in-service days. Such approaches might include physical practices such as mindfulness, exercise, breathing, and meditation; intellectual practices such as ongoing learning; interpersonal activities such as maintaining personal boundaries; and intrapersonal practices such as periodic self-reflection. Past studies demonstrated that these practices enhance resilience; therefore, not only would these efforts improve teachers' work-balance, they also would enhance the teachers' resilience in the process (Clendon & Walker, 2016; Hodges et al., 2010; Maher, 2013).

Districts and policy makers at the school, district, county, state, and federal level should consider mandating certain limits on new teacher workloads to protect work-life balance. Teacher preparation programs and degree programs could aid by bringing candidates' awareness of work-life balance issues and provide frameworks and tools for self-care. Researchers could further advance this area of practice by further investigating the issue of work-life balance in ECST and ESCSTs and examining the efficacy of various approaches to enhancing work-life balance.

Although one ECST chose his profession expressly due to the opportunity for exceptional work-life balance, the remaining participants expressed significant difficulty managing their workloads. To aid teachers and teacher candidates in improving their wellbeing and work-life balance, induction programs and schools should make the conversation about self-care and work-life balance explicit. The Theory of Resilient Leadership calls for engaging in personal renewal as a first line of defense to balance work and life. Allison (2012) explained personal renewal requires physical, emotional, spiritual, and intellectual revitalization. Such revitalization is an essential practice for resilient leaders because the resulting personal renewal generates the energy leaders need to show up for demanding work. This is especially important considering the challenges teachers faced managing the COVID-19 pandemic between spring 2020 and the reopening of schools in fall 2021.

Recommendations for Further Research

The present study offered valuable insights about the level of resilience in novice STEM teachers and how resilience levels may vary when comparing ECST to ESCSTs. Nonetheless, the delimitations of a small sample drawn from only two sites affected the quantitative aspects of the study design. Three suggestions for further research are identified based on the present study: (a) the role of family support for ECSTs and ESCSTs, (b) the ways that social competency enhances teacher resilience, and (c) sense of purpose and motivation to pursue teaching among ESCSTs. These recommendations are described in the following sections. In addition, this dissertation can serve as a template for a mixed-method design for future dissertations, or as a

template to complete a comprehensive quantitative study with similar groups of early career and early second career STEM teachers.

   Examine Role of Family Support for Early Career and Early Second Career Teachers. In assessing the findings, it is noteworthy that family cohesion has not been examined thoroughly as a factor in promoting teacher success. While a comparatively large body of literature emphasizes the importance of family support in student resilience, persistence, and successful academic outcomes (e.g., Lawton-Sticklor, 2018; Roksa & Kinsley, 2019), little empirical data exists about the family's role in teacher resilience. This appears to be an oversight, as the path to becoming a teacher is lengthy and requires further education and training; several steps of credentialing; and often challenging early professional experiences. Moreover, in the present study findings, ECST participants reported high family cohesion, and this appeared to be a central factor in enhancing their resilience. It follows that the role of family support for ECSTs should be further examined and elaborated to better understand and identify intervention approaches for leveraging the family in boosting teacher success.

   Moreover, the ECSTs reported significantly higher family cohesion than did the ESCST respondents. This could suggest that (a) family cohesion was not as important to the ESCSTs or (b) family cohesion and support was lacking for these teachers transitioning from possibly high-paying and prestigious professional careers to lower-paying, secondary teaching positions. More research is needed to examine the role, nature, and mechanisms of family cohesion as variable to support ESCSTs. More deeply understanding these factors related to the unique population of ESCSTs will

inform more tailored and effective supportive mechanisms for these transitioning professionals.

Examine the Mechanisms Through Which Social Competency Enhances Teacher Resilience. Social competency and social networks enhance resilience among early teachers (Hannan et al., 2015; Navy et al., 2020; Pogodzinski, 2012; Turley et al., 2006). However, more research is needed to understand how social competency and social networks enhance resilience. Moreover, the post hoc ANOVA indicated that the ECST respondents in this study reported significantly higher social competency than did ESCST respondents. The quantitative analysis was severely under powered, however, redoing this quantitative analysis with sufficient power might prove that there is a significant quantitative difference between these two groups. Identifying the reasons and if this there is a true quantitative difference for these two groups requires additional research. For example, several researchers indicate that agreeable individuals may have higher resilience because these individuals tend to have broad, deep, and supportive social networks (Bowling et al., 2005; Mishra & McDonald, 2017; Zhu et al., 2013). Understanding these differences and how social competency bolsters teachers' resilience would inform programmatic, developmental, and personal interventions that could ultimately serve to increase these teachers' long-term success and resilience.

Examine a Sense of Purpose and Motivations to Pursue Teaching Among Second Career Teachers. The STEM teachers in this study discussed having "a sense of purpose" related to teaching K-12 students and that their sense of purpose also promoted a sense of fulfillment, happiness, and enjoyment in their career. Past research

suggests that being purposeful is positively correlated with resilience (Arora & Rangnekar, 2016a; Carless & Bernath, 2007; Costa & McCrae, 1992; Lyons et al., 2015; Wei & Taormina, 2014). Notably, more ECSTs than ESCSTs expressed having this sense of purpose and associated happiness and enjoyment in teaching. Connecting the present findings with extant literature suggests that these participants' sense of purpose had an enhancing effect on their resilience.

Given the role of purpose in resilience, further investigation is necessary to understand why so few ESCSTs (one of four interviewed) compared to ECSTs (three of four interviewed) reported a sense of purpose. Thus, additional research is suggested to more deeply examine the reasons ESCSTs decide to transition to teaching and how they make sense of this change and the purpose of their new careers. More deeply understanding purpose and motivation for ESCSTs may lead to more effective interventions and support for these professionals, which may in turn improve their chances for professional success and teacher retention.

A final recommendation for further research is to conduct the same study using a larger sample of teachers drawn from across the U.S., thus, making it a national study. This study can also be replicated in other countries like Australia (Arnup & Bowles, 2016). The expanded findings could provide critically needed insights regarding how to address the nationwide shortage of STEM teachers, and help other countries facing similar issues like Australia (Arnup and Bowles, 2016).

Conclusion

This convergent mixed methods, phenomenological study examined the level of resilience and the factors that build resilience within a sample of early career and early

second career STEM teachers. The study was performed within two research sites: Second Act, which helps STEM professionals transition into teaching, and California Science Educators, a nonprofit professional membership organization of science educators and policymakers. Friborg et al.'s (2005) RSA was used to measure respondents' resilience, although the minimal necessary sample size necessary to detect a moderate by MANOVA was considered severely underpowered (Reinhart, 2015). Additionally, four ESCST survey respondents and four ECST survey respondents underwent a descriptive phenomenological interview to ascertain the participants' experience and sense-making of being a novice STEM teacher.

Research literature indicates that a nationwide weakness in K-12 STEM education is at the root of the STEM teacher shortage (Morrell & Salomone, 2017). Such weaknesses means that fewer and fewer individuals are prepared for college-level STEM courses and, in turn, STEM careers. This is reinforcing the downward spiral of homegrown STEM competency (President's Council of Advisors on Science and Technology, 2012). One solution involves transitioning existing STEM professionals to K-12 STEM teachers; however, doing so requires significant commitment, a lengthy runway for completing the credentialing process, and multiple steps to complete along the way (Bezzina, 2006; Commission on Teacher Credentialing, 2019; Johnson et al., 2014). Overall, the teacher credentialing process is marred by high stress and burnout (Goddard & O'Brien, 2004; Howard & Johnson, 2004; Noble & Macfarlane, 2007), and many candidates abandon the process before completing it (House of Representatives Standing Committee in Education and Vocational Training, 2007).

The need for K-12 STEM teachers in the United States continues to rise; however, the population of native-born STEM professionals is shrinking (President's Council of Advisors on Science and Technology, 2012; U.S. Bureau of Labor Statistics, 2020a). The native-born labor shortage threatens the nation's economic competitiveness and stability, leading to growing concern among researchers, educators, and policymakers about how the gap can be closed and what corrective action needs to be taken.

This study found that new STEM teachers (a) felt unprepared to manage classroom behaviors; (b) experienced disillusionment when they witnessed students not being held accountable; (c) had difficulty achieving work-life balance, as the constant work spanned their physical and emotional boundaries; (d) benefited from the professional and emotional support of colleagues and loved ones; and (e) developed their communication skills by talking to students. Additionally, the teachers described feeling a sense of purpose and fulfillment related to teaching.

Based on these findings, ECSTs and ESCSTs and their allies should support the development of social networks, cultivating family support, and developing work-life balance approaches (see Figure 21). Teachers can work on increasing their own resilience by developing social networks, cultivating family support, and having a work-life balance. Districts can support teachers by developing a social network for teachers. This can be done by providing mentors and social events with other new teachers through induction programs. Districts should also stress the importance of family support through education and trainings. Lastly, districts should limit the workload on

new teachers by limiting the number of different class topics (e.g., chemistry and biology classes) and the total number of classes and students taught.

Figure 18

Building Resilience in Teachers
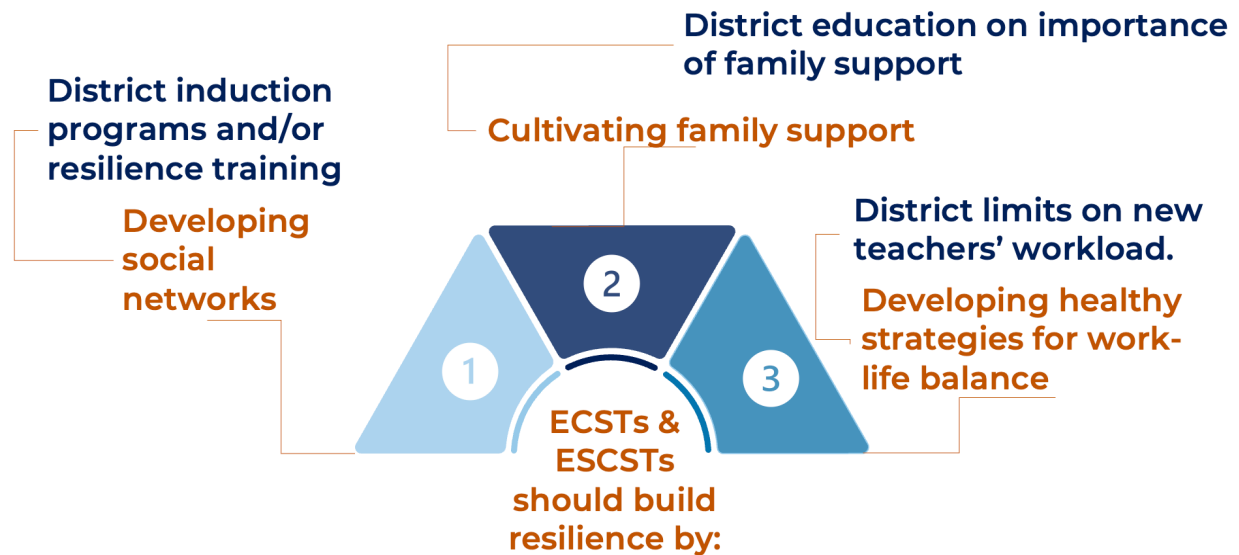
Through the lens of resilient leadership theory (Allison, 2012), these findings emphasize that ECSTS and ESCSTs recognize the demotivation brought on by poor classroom behaviors; witnessing students not being held accountable; and not being able to achieve a healthy work-life balance. Instead, ECSTs and ESCSTs should be encouraged to allow time for personal renewal while staying optimistic and cultivate their support networks before challenges arrive (Allison, 2012). Recommendations for future research include examining the role of family support for ECST and ESCSTs, examining the mechanisms through which social competency enhance teacher resilience, and investigating sense of purpose and motivation to pursue teaching among ESCSTs. Although the problem of a shrinking native-born STEM labor force is daunting,

the present study revealed important insights about the role of resilience and how to

enhance resilience among ECST and ESCSTs.

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APPENDIX A

Survey Invitation and Social Media Post

Dear XXXXX,

As part of my doctoral degree in global leadership and international change at Pepperdine University, I am conducting dissertation research to examine resilience in public secondary teachers who have transitioned from a full-time STEM position into teaching. I am requesting your help by completing an online survey and a possible interview about your experiences. You will be entered in to win a $100 gift certificate to Amazon by participating in this survey. You will also get a $25 gift certificate to Amazon if selected for and by participating in the interviews.

The survey is anticipated to take 10-15 minutes to complete. If you volunteer to undergo an interview and if you are selected, the conversation is anticipated to take 45 min to 1 hour to complete. The total duration of participation may last 10 to 75 minutes.

Please be assured that participation in this study is voluntary and confidential. You are free to decline any question asked of you or to withdraw at any time from the study.

If you are willing to participate, please complete the survey at: [link]

Please contact me with any questions at donald.selway@pepperdine.edu.

I sincerely thank you for your help!

Don Selway, Ph.D. Candidate
Pepperdine University's Graduate School of Education and Psychology

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Seeking teachers in their first five years of STEM teaching to participate in a survey and interview for a study conducted by Don Selway, Ph.D. Candidate, Pepperdine University's Graduate School of Education and Psychology.

Time Required: 5-15 minutes for the survey, up to 1 hour for the interview
Insert Payment: $50 Amazon gift card for one randomized winner
Contact Information:
For more information please contact:
donald.selway@pepperdine.edu

Principal Investigator: Don Selway
donald.selway@pepperdine.edu

APPENDIX B

Consent Form

IRB #:

Participant Study Title: Teacher Resilience

Formal Study Title: Resilience in Early Second Career Stem Teachers Employed in Public Secondary Schools

Authorized Study Personnel

Principal Investigator: Don Selway, Ph.D. Candidate
Faculty Advisor: Anthony Collatos, Ph.D.

Key Information:

If you agree to volunteer and participate in this study, you will be asked to take part in one 5- to 15-minute online survey and, for some, a 45 min to 1-hour interview regarding your experiences transitioning into a teaching role. You will be provided a copy of this consent form.

Invitation

You are invited to participate in a research study conducted by Don Selway, Ph.D. candidate, and Anthony Collatos, Ph.D., at Pepperdine Universit, because you transitioned into teaching STEM at a public secondary school after having worked full-time in a STEM role. Your participation is voluntary. You should read the information below and ask questions about anything that you do not understand, before deciding whether to participate. Please take as much time as you need to read the consent form. You may also decide to discuss participation with your family or friends.

Why are you being asked to be in this research study?

You are being asked to be in this study because you are a member of Encorps or CASE and teach STEM in a public secondary school.

What is the reason for doing this research study?

This research project is designed to provide insights about how and why individuals achieve success through this career change.

What will be done during this research study

If you volunteer to participate in this study, you will be asked to complete one 5- to 15-minute online survey and may be invited to complete a 45 minute to 1-hour interview, for a total of 5 to 75 minutes of participation. During the survey and interview, you will be asked to reflect on and share your experiences transitioning into teaching.

How will my data be used?

The researcher will record your answers in a password-protected document and a unique identifier (such as "Participant 1") will be assigned to your information. Any information you share that could uniquely identify you (such names, places, or events unique to you) will be given a fake name (i.e. pseudonym) and anonymized during the interview process.

What are the possible risks of being in this research study?

Participants will face no more than minimal risk and may experience low-level emotional risks by taking part in this study.

What are the possible benefits to you?

You are not expected to get any benefit from being in this study.

What are the possible benefits to other people?

Benefits to society include guiding future research or creating services to help individuals transition into teaching.

What are the alternatives to being in this research study?

The alternative to participation in the study is not participating or only completing the items for which you feel comfortable.

What will being in this research study cost you?

There is no cost to you to be in this research study.

Will you be compensated for being in this research study?

You will receive no compensation for your participation in this study. However, one participant will be selected randomly to receive a $100 gift card for participation in the survey and each participate will be selected to receive a $25 gift card for participation in the interview.

What should you do if you have a problem during this research study?

Your welfare is the major concern of every member of the research team. If you have a problem as a direct result of being in this study, you should immediately contact one of the people listed at the beginning of this consent form.

How will information about you be protected?

Reasonable steps will be taken to protect your privacy and the confidentiality of your study data. The data will be stored electronically through a secure server and will only be seen by the research team during the study and for 3 years after the study is complete.

The only persons who will have access to your research records are the study personnel, the Institutional Review Board (IRB), and any other person, agency, or sponsor as required by law. The information from this study may be published in scientific journals or presented at scientific meetings but the data will be reported as group or summarized data and/or with the use of a fake name. Your identity will be kept strictly confidential.

What are your rights as a research subject?

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study.

For study related questions, please contact the investigator(s) listed at the beginning of this form

For questions concerning your rights or complaints about the research contact the Institutional Review Board (IRB):

Phone: 1(402)472-6965
Email: gpsirb@pepperdine.edu

What will happen if you decide not to be in this research study or decide to stop participating once you start?

You can decide not to be in this research study, or you can stop being in this research study ("withdraw') at any time before, during, or after the research begins for any reason. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator or with Pepperdine University.

You will not lose any benefits to which you are entitled.

Documentation of informed consent

You are voluntarily making a decision whether or not to be in this research study. Signing this form means that (1) you have read and understood this consent form, (2) you have had the consent form explained to you, (3) you have had your questions answered and (4) you have decided to be in the research study. You will be given a copy of this consent form to keep.

Participant Name:

_____

(Name of Participant: Please print)
   By checking this box you consent to participate.

APPENDIX C

Resilience Survey

1. Are you currently employed as a STEM teacher or are looking for work as a STEM teacher?
   o Yes
   o No

2. How many years of total full-time professional experience working in a STEM-related field did you have before starting to pursue your teaching credential?
   o Less than 1 year
   o 1-2.99 years
   o 3-5 years
   o More than 5 years

3. What pathway are you taking or did you take to pursue your teaching credential?
   o Internship teaching
   o Student teaching
   o CTE

4. What is your credential status?
   o Preliminary credential
   o Clear credential

5. How many years of total full-time teaching experience do you have?
   o Up to 1.99 years
   o 2 years-4.99 year
   o More than 5 years

6. In what type of school do you teach?
   o Charter
   o Magnet
   o Neighborhood
   o Private
   o Other

7. What subjects do you teach?
   o Science
   o Technology
   o Engineering
   o Math

8. What is your age bracket?
   o 20-29 years
   o 30-39 years

- o 40-49 years
- o 50-59 years
- o 60-69 years
- o 70 years or older

9. What is your gender?
   - o Male
   - o Female
   - o Other

10. I think about quitting the teaching profession		1	2	3	4	5	1 not at all, and 5 very likely
11. I intend to quit the teaching profession		1	2	3	4	5	1 not at all, and 5 very likely
12. I intend to move into another profession/occupation		1	2	3	4	5	1 not at all, and 5 very likely
13. When something unforeseen happens:	I find a solution	1	2	3	4	5	I often feel bewildered
14. My personal problems:	Are unsolvable	1	2	3	4	5	I know how to solve
15. My abilities	I strongly believe in	1	2	3	4	5	I am uncertain about
16. My judgments and decisions	I often doubt	1	2	3	4	5	I trust completely
17. In difficult periods I have a tendency to	View everything gloomy	1	2	3	4	5	Find something good that helps me thrive
18. Events in my life that I cannot influence	I manage to come to terms with	1	2	3	4	5	are a constant source of worry and concern
19. My plans for the future are	Difficult to accomplish	1	2	3	4	5	possible to accomplish
20. My future goals	I know how to accomplish	1	2	3	4	5	I am unsure how to accomplish
21. I feel that my future looks	Very promising	1	2	3	4	5	Uncertain
22. My goals for the future are	Unclear	1	2	3	4	5	Well thought through
23. I am at my best when I	Have a clear goal to strive for	1	2	3	4	5	Can take one day at a time
24. When I start on new things/projects	I rarely plan ahead, just get on with it	1	2	3	4	5	I prefer to have a thorough plan
25. I am good at	Organizing my time	1	2	3	4	5	Wasting my time
26. Rules and regular routines	Are absent in my everyday life	1	2	3	4	5	Simplify my everyday life
27. I enjoy being	Together with other people	1	2	3	4	5	By myself

		1	2	3	4	5	
28. To be flexible in social settings	Is not important to me	1	2	3	4	5	Is really important to me
29. New friendships are something	I make easily	1	2	3	4	5	I have difficulty making
30. Meeting new people is	Difficult for me	1	2	3	4	5	Something I am good at
31. When I am with others	I easily laugh	1	2	3	4	5	I seldom laugh
32. For me, thinking of good topics of conversation is	Difficult	1	2	3	4	5	Easy
33. My family's understanding of what is important in life is	Quite different than mine	1	2	3	4	5	Very similar to mine
34. I feel	Very happy with my family	1	2	3	4	5	very unhappy with my family
35. My family is characterized by	Disconnection	1	2	3	4	5	Healthy coherence
36. In difficult periods, my family	Keeps a positive outlook on the future	1	2	3	4	5	Views the future as gloomy
37. Facing other people, our family acts	Unsupportive of one another	1	2	3	4	5	loyal towards one another
38. In my family, we like to	Do things on our own	1	2	3	4	5	Do things together
39. I can discuss personal issues with	No one	1	2	3	4	5	Friends/family members
40. Those who are good at encouraging me are	Some close friends/family members	1	2	3	4	5	nowhere
41. The bonds among my friends is	Weak	1	2	3	4	5	Strong
42. When a family member experiences a crises or emergency	I am informed right away	1	2	3	4	5	It takes quite a while before I am told
43. I get support from	Friends/family members	1	2	3	4	5	No one
44. When needed, I have	No one who can help me	1	2	3	4	5	Always someone who can help me
45. My close friends/family members	Appreciate my qualities	1	2	3	4	5	Dislike my qualities

46. Would you be willing to discuss your experiences transitioning to a teaching role?
- o Yes
- o No

47. If so, please supply your contact information (name, email, phone number):

Source for Items 11-43: Friborg, O., Barlaug, D., Martinussen, M., Rosenvinge, J. H., & Hjemdal, O. (2005). Resilience in relation to personality and intelligence. *International Journal of Methods in Psychiatric Research, 14*(1), 29–42. https://doi.org/10.1002/mpr.15

APPENDIX D

Interview Script

Thanks again for your willingness to participate in this project. I am conducting this as part of the dissertation requirement for my doctorate at Pepperdine University. As a reminder, participant is entirely voluntary, you can decline to answer any question, withdraw from the study, or request that the audio-recording to be turned off at any time. All information you provide remain confidential.

Please tell me, in as much detail as possible, about your experiences transitioning from your past job in a STEM-related field to becoming a STEM secondary teacher.

Possible Prompts (only if needed):

- How did your perception of yourself change, if at all, through this experience?

- How did your perception of the future change, if at all, through this experience?

- In what ways, if at all, did your work approach shift?

- In what ways, if at all, did your level of comfort in social settings shift through this experience?

- Tell me about the ways your family (or friends/significant others) supported you, if at all, through this experience?

- In what ways, if at all, did you rely on the support of family, friends, or others when you faced challenges through this experience?

- How did you manage your classrooms?

- How did you manage your planning?

- How did you manage your grading?

Thanks so much for sharing your experience!

APPENDIX E

IRB Approval Letter

Pepperdine University
24255 Pacific Coast Highway
Malibu, CA 90263
TEL: 310-506-4000

NOTICE OF APPROVAL FOR HUMAN RESEARCH

Date: July 26, 2021

Protocol Investigator Name: Donald Selway

Protocol #: 21-05-1590

Project Title: RESILIENCE IN EARLY SECOND CAREER STEM TEACHERS EMPLOYED IN PUBLIC SECONDARY SCHOOLS

School: Graduate School of Education and Psychology

Dear Donald Selway:

Thank you for submitting your application for expedited review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. As the nature of the research met the requirements for expedited review under provision Title 45 CFR 46.110 of the federal Protection of Human Subjects Act, the IRB conducted a formal, but expedited, review of your application materials.

Based upon review, your IRB application has been approved. The IRB approval begins today July 26, 2021, and expires on July 25, 2022.

The consent form included in this protocol is considered final and has been approved by the IRB. You can only use copies of the consent that have been approved by the IRB to obtain consent from your participants.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Please be aware that changes to your protocol may prevent the research from qualifying for expedited review and will require a submission of a new IRB application or other materials to the IRB. If contact with subjects will extend beyond July 25, 2022, a continuing review must be submitted at least one month prior to the expiration date of study approval to avoid a lapse in approval.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at community.pepperdine.edu/irb.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

Sincerely,

Judy Ho, Ph.D., IRB Chair

cc: Mrs. Katy Carr, Assistant Provost for Research