What Keeps Technology and Engineering Teachers in the Classroom? A National Mixed Methods Study

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WHAT KEEPS TECHNOLOGY AND ENGINEERING TEACHERS IN THE CLASSROOM? A NATIONAL MIXED METHODS STUDY

By

Cory J. Ortiz

A dissertation submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Career and Technical Education

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UTAH STATE UNIVERSITY
Logan, Utah

2022
ABSTRACT

WHAT KEEPS TECHNOLOGY AND ENGINEERING TEACHERS IN THE CLASSROOM? A NATIONAL MIXED METHODS STUDY

By

Cory J. Ortiz, Doctor of Philosophy

Utah State University, 2022

Major Professor: Tyson Sorensen, Ph.D.
Department: Applied Sciences, Technology, & Education

The purpose of this study was to identify factors that predict Technology and Engineering Education (TEE) teachers’ persistence in teaching and to examine the experiences of TEE teachers in relation to retention. This study addressed six research questions regarding TEE teachers’ persistence intentions, using an explanatory sequential mixed-methods approach (QUAN → qual).

The quantitative phase used survey data to address five research questions, and the qualitative phase used semi-structured interviews to address one research question. The population targeted were TEE teachers who were a part of the Engineering Technology Education Division (eTED) of the Association of Career and Technical Education (ACTE), $N = 1,327$. A total of $n = 101$ teachers participated in the quantitative phase. Four teachers participated in a qualitative follow-up interview.

Survey responses were analyzed according to each research question. Personal and professional characteristics were analyzed using descriptive statistics and non-parametric tests to assess the relationship between personal and professional characteristics and persistence intentions. Additionally, two predictive regression models...
were used to address predictors of persistence. The first assessed the relationship between persistence intentions and sense of belonging, sense of efficacy, and job satisfaction. This regression model found job satisfaction to significantly predict persistence intentions. The second assessed the predictors of job satisfaction using sense of efficacy and sense of belonging as predictors. This model found sense of belonging predicted teacher job satisfaction. A mediation analysis was conducted assessing the mediation effects of job satisfaction between sense of belonging and persistence intentions. It was found job satisfaction mediated the relationship between sense of belonging and persistence intentions. This research found that most in-house professional development to support TEE teachers in their persistence intentions was perceived to be less effective than professional associations and state agencies’ professional development.

Recommendations include shifting focus from teacher salary and benefits to working conditions for retention. Additionally, districts should collaborate with HR directors to craft more meaningful professional development. Further work is needed to examine predictors of TEE teacher job satisfaction.
PUBLIC ABSTRACT

What Keeps Technology and Engineering Teachers in The Classroom? A National Mixed Methods Study

Cory J. Ortiz

Teacher retention is a significant issue impacting educational agencies around the country. Factors that have been found to be predictors of teacher retention include sense of belonging, sense of efficacy, and job satisfaction. Many personal and professional characteristics of a teacher also have been found to predict teacher retention. The purpose of this research was to explore how these factors predicted Technology and Engineering Educators’ (TEE) teachers’ persistence to remain in the teaching profession. Furthermore, this research sought to identify programs that existed to help support TEE teachers in their persistence intentions.

This research found teacher job satisfaction was a significant predictor of TEE teachers’ persistence intentions, while teacher sense of efficacy and teacher sense of belonging were not. Additionally, this research found job satisfaction was predicted by teacher sense of belonging. This research also found that most in-house professional development offered to teachers to support persistence intentions was perceived as ineffective to TEE teachers, while professional development offered through professional associations and state agencies was perceived as being more beneficial.
DEDICATION

This work is dedicated to many. First, this work is dedicated to my family and friends; this work would not be possible without your love and support. You all have been so understanding with the many late nights I have had to work in the pursuit of my education. Your encouragement has been key to my success. Thank you especially to my loving wife, Molly, who has sacrificed more than her fair share, my parents who taught me never to give up, my grandparents who taught me what hard work looks and feels like, my parents-in-law, Gary and Nancy, for never-ending encouragement, and to the rest of my family and friends who have given support, who are too numerous to name, for your continued support of my quest to learn.

Second, this work is dedicated to all of the teachers who pour their heart and soul into the education of their students. In my humble eye, there is not a career more noble than working to shape the future generation through teaching. This work is also dedicated to all of the educators who have supported my learning. My journey through education has not been straightforward; being a first-generation college attendee and graduate, I am a trailblazer for my family. Without the love and support from all of my teachers, I would not be here today. Additionally, I have benefited from many great mentors in my career; from my undergraduate program to my first-year teaching, and throughout my graduate work, I have relied on great mentors to help guide and direct my education. Though too many to name, you know who you are.

Thank you.
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Beyond faculty support, I would like to acknowledge the support of many friends, family, and colleagues. Many old friends and colleagues helped in many ways to support this research. Thank you to those of you who helped provide feedback during the development and validation of the survey instrument used in this study. I would like to recognize Kari Lamoreaux, who spent countless hours helping to properly edit and format this document. Additionally, I would like to acknowledge my grandparents, Frank
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CHAPTER I

INTRODUCTION

Research suggests teachers choose to remain in teaching for a number of factors. These factors are both intrinsic and extrinsic in nature and include such things as the exhilaration of contributing to students’ learning, salary, benefits, and public recognition (Johnson et al., 2005). However, these intrinsic and extrinsic rewards are often not enough to keep teachers in the profession, and high teacher turnover continues to exist. Across all educational fields, teacher retention is an issue of grave concern. According to the report, Teacher Turnover: Why it matters and what we can do about it from the Learning Policy Institute (2017), the United States has a teacher attrition rate of 8% annually. The same report suggests the number of teachers leaving the profession each year accounts for close to 90% of annual teacher demand while less than a third of national teacher attrition is due to retirement (Carver-Thomas & Darling-Hammond, 2017b).

The issue of teacher turnover is starker when parsing out teacher age groups. Within one year of beginning their teaching career, 10% of teachers will leave the profession, while half of all teachers will leave the profession or move schools before the end of their fifth year (Gray & Taie, 2015). With so many teachers leaving the profession, school districts are spending millions of dollars to fill teaching positions. At the national level, this monetary figure adds up to $2.2 billion annually (The Alliance for Excellent Education, 2014).

Teacher turnover not only costs the educational system billions of dollars but also negatively affects learning. In a study involving 850,000 New York City fourth and fifth-
graders over eight years, student achievement was significantly lower in grades with higher teacher turnover (Ronfeldt et al., 2013). Echoing these findings, a report conducted by the National Commission on Teaching and America’s Future (Barnes et al., 2007) found the financial and human cost associated with chronically hiring teacher replacements hinders professional development that normally would be used to close the student achievement gap. Resources are taken from professional activities, such as Professional Learning Communities (PLC), extension activities, intervention activities, mentorship, and are allocated instead to hiring committees that have to search from coast to coast for qualified candidates.

Of those who leave the profession, teachers’ attrition in the area of Career and Technical Education (CTE) is well documented around the country (Wilkin & Nwoke, 2011). This attrition is of particular concern as CTE plays a major role in providing skilled workers for the American economy. CTE provides an important pathway to college and career readiness for high school students by offering each student opportunities to personalize their education based on their individual career interests and unique learning needs (Utah Board of Education, 2019). CTE students have the opportunity to participate in career pathway classes that are intended to provide students with industry-recognized credentials of value that help students break into their career of interest (Advance CTE, 2020). Furthermore, CTE programs help prepare students for all 20 of the fastest-growing occupations identified in the Department of Labor’s 2010-2020 Occupational Outlook Handbook (Gordon, 2014).

Beyond the merit of providing students with skills required to succeed in a career, CTE programs of study are beneficial to student academics. Among 9th-graders in public
schools in 2009 who went on to concentrate in CTE, 94% graduated from high school, while those who did not go on to concentrate in CTE graduated at a rate of 86% (U.S. Department of Education, 2019). High-quality CTE programs have been shown to reduce dropout rates, encourage participation in postsecondary education, and enable students to earn dual enrollment either through concurrent enrollment at technical colleges or universities or through industry-endorsed certificates (College & career readiness & success center, 2013). These, in turn, increase enrollment in postsecondary CTE programs and thus the pipeline into diverse and technical careers.

Within the umbrella of CTE, a subgroup of teachers is of particular interest. Teachers in the area of Science, Technology, Engineering, and Math (STEM), and subsequently, Technology and Engineering Education (TEE), are harder hit by the teacher shortage than others (Nguyen et al., 2020). Despite being one of the fastest-growing and largest educational pathways, STEM education and TEE suffer from an increasing shortage of faculty (National Association of State Directors of Career and Technical Education, 2010). This shortage is due in part to the nature of STEM education; science and math are traditionally taught by core teachers, while technology and engineering classes are taught by Career and Technical Education (CTE) teachers endorsed in the area of technology and engineering. For over a decade, those within the area of TEE have been experiencing one of the largest shortages of teachers in the United States (National Association of State Directors of Career and Technical Education, 2010). As a result, TEE has been identified as a critical need concerning teacher shortages in nearly every state (Wilkin & Nwoke, 2011).
There are consequences if CTE positions go unfilled. As CTE actively works with industry to fill the pipeline for the future workforce of the United States, failure to fill CTE teacher positions result in gaps within CTE program pathways, degraded program performance, and, ultimately, increased economic cost (College & Career Readiness & Success Center, 2013; Holecek et al., 2016; Rojewski, 2002). As TEE teachers teach in one of the fastest-growing and largest CTE pathways, the success of TEE is key to the United States maintaining global competitiveness through a highly-skilled STEM workforce (Gonzalez & Kuenzi, 2012).

**Statement of the Problem**

When subgroups of teachers are studied, teachers within the area of CTE appear to leave the profession at rates higher than their peers. A 2018 survey of 796 CTE teachers conducted by the Student Research Foundation found that 37% of the teachers sampled plan to leave the teaching profession within the next five years as opposed to 13.3% of math and science teachers, 12.6% of humanities teachers, 14.3% of special education teachers and 11.3% of elementary teachers (Carver-Thomas & Darling-Hammond, 2017b; Student Research Foundation, 2019).

CTE suffers from issues embedded in teacher preparation. For example, the number of annual bachelor degrees awarded in TEE, an area embedded within CTE, has decreased from 6,368 in 1970 to 164 in 2018 (Figure 1), while the number of universities preparing technology and engineering education teachers has decreased from 203 to 32 during the same time period (Figure 2) (Volk, 2019). Furthering this issue, the majority of TEE teacher preparation programs in the United States have closed, and the few that
are still open suffer from low enrollment despite programs having near 100% job placement; no new university preparation programs have been created to replace those that have closed (Volk, 2019).

**Figure 1**

*The Decline of TEE Graduates 1970 - 2018*

![Graph showing the decline of TEE graduates from 1970 to 2018](image)


This lack of qualified, traditionally trained TEE teachers has led K-12 programs around the country to rely on recruiting industry experts who then seek alternative licensure to fill the teaching need (Volk, 2019). In a nationwide review of teachers using the Schools and Staffing Survey administered by the U.S. Department of Education, Ernst and Williams (2015) found TEE teachers are more likely to receive certification through an alternative certification program than teachers in other disciplines (21.6% vs. 14.5%). Although alternative licensing programs may seem to be addressing the
nationwide teacher shortage, those prepared through such routes leave the profession at higher rates than those completing a traditional program (Harris et al., 2003).

**Figure 2**

*The Decline of TEE Teacher Preparation Programs 1970 - 2018*

![Graph showing the decline of TEE teacher preparation programs from 1970 to 2018.](image)


Beyond the lack of prepared teachers, there exists a high degree of career mobility in CTE (Walter & Pellock, 2004); the attrition of CTE teachers is considered a serious and ongoing problem in the United States, which has drawn the attention of policymakers, researchers, and administrators over the past few decades (Ruhland, 2001). Half of the United States currently has major teacher shortages in CTE, with larger shortages expected in large part due to a lack of teacher retention (Jacques & Potemski, 2013). Heath-Camp and Camp (1990) found 15% of CTE teachers quit within their first
year, and more than half left the profession within six years, highlighting a serious issue with teacher retention. More recently, in a national study, Warnick et al. (2006) found only one-half of agriculture education teachers reported they were highly likely to remain in the profession for more than three years, and only one-third reported a high likelihood of remaining more than five years. Furthermore, in a report from the 2011–2012 Schools and Staffing Survey, Hensley et al. (2016) found 32% of CTE teachers would leave teaching as soon as possible if offered a higher paying job.

In TEE, teacher retention has been consistently highlighted as one of the foremost issues facing the discipline (Moye, 2009; Newberry, 2001; Ritz, 2006; Ritz, 1999; Weston, 1997; Williams et al., 2019). The staffing issues of the TEE profession are twofold: there is a significant issue with recruitment into teacher education programs, which is compounded by a lack of programs, and the retention of practicing teachers is low. Neither those recruited into TEE from traditional teacher preparation programs nor those recruited through alternative licensing programs persist in teaching. With the staggering shortage of traditionally prepared TEE teachers, the influx of teachers coming through alternative pathways without formal educational training, and the high turnover rates exhibited by teachers; studies are needed that focus on the factors predicting retention of practicing TEE teachers.

Very few studies exist that have examined why TEE teachers remain. The last study to examine this question was conducted over a decade ago (Steinke & Putnam, 2007). While Steinke and Putnam’s study highlighted the school’s collaborative work environment, professional development, and yearly raises as elements for keeping TEE teachers in the profession, these three elements have changed since their study. Furthermore, their study examined TEE teacher retention from a descriptive standpoint.
without examining the strength or statistical significance of relationships of the factors of TEE retention.

My study focused on the issue of teacher retention in TEE and enabled the collection of relevant and timely data on a national scope related to TEE teacher retention. By determining the predictors of TEE teacher retention as well as exploring the nuances of the TEE teachers’ career experience as it relates to career decision making, my study provided valuable information for CTE directors, school district administrators, teacher educators, state specialists, and other stakeholders toward informing retention and professional development programming.

**Statement of the Purpose**

The purpose of this study was to identify the factors that predict TEE teachers’ persistence in teaching and examine TEE teachers’ teaching experiences in relation to retention. This study sought to address two primary research questions. First, what factors predict TEE teachers’ intended persistence in teaching? Second, what TEE teaching experiences influence career persistence intentions? Simply put, this study sought to answer the question, “What keeps the Technology and Engineering Education teacher in the classroom?”
Research Questions

The following research questions guided this study:

1. How do personal and professional characteristics impact TEE teachers’ intended persistence in teaching?
2. How does sense of belonging impact TEE teachers’ intended persistence in teaching?
3. How does sense of efficacy impact TEE teachers’ intended persistence in teaching?
4. How does job satisfaction impact TEE teachers’ intended persistence in teaching?
5. What institutional-related programs exist to support TEE teachers in their persistence intentions?
6. How do TEE teachers characterize their teaching experience and intended persistence?
   - How do institutional-related factors and personal factors (e.g., family dynamics, professional experience) influence TEE teachers’ career experience and career persistence intentions?
   - How do TEE teachers talk about career commitment?
Limitations

I identified the following limitations in pursuit of this study:

1. Only TEE teachers who were a part of the Engineering Technology and Education Division (eTED) of the Association for Career and Technical Education (ACTE) were surveyed, which means teachers who taught in the area of TEE who were not a part of the ACTE eTED division were excluded in this study.

2. As the proposed sample came from a national association, frame error might exist.

3. Because this study focused on TEE teachers, it is not generalizable to teachers of other subjects or grade levels, including those in other CTE areas.

4. Because data were collected using an online questionnaire requiring self-reported data, a threat to validity may exist.

5. My opinions and experiences as a researcher might have resulted in bias in this study. Although I attempted to remain as objective as possible, personal biases may have influenced the research decisions regarding the topic, development of the instrument and variables selected, data collection, data analysis, and conclusions and implications.

6. Only four participants were interviewed for the qualitative phase of this study. This means that this study may lack depth that may have been possible through additional interview data.
Assumptions

I made the following assumptions in the pursuit of this study:

1. The constructs of sense of belonging, sense of efficacy, and job satisfaction can all be measured by an instrument adapted for this study.

2. TEE teachers in this study have the capability to complete the online questionnaire, know the answers asked of them, and answer items honestly, completely, and thoughtfully.

3. The sample of TEE teachers who are a part of the ACTE’s eTED who responded to this study was representative of the nation’s population of technology and engineering teachers.

Significance of the Research

Much of the contemporary literature about CTE focuses mainly on course offerings, student population, special programs, and teacher background. Research regarding teacher retention exists in some of the areas within the umbrella of CTE (e.g., Hasselquist & Graves, 2020; Self, 2001; Warnick et al., 2006); however, little existing research examines the factors that influence teacher retention in TEE despite decades of research highlighting retention as an issue in technology education (Moye, 2009; Newberry, 2001; Ritz, 2006; Ritz, 1999; Weston, 1997; Williams. et al., 2019). This lack of research is an issue as TEE is integral to preparing the future workforce. Despite many initiatives targeting STEM education over the last few decades, STEM careers are still experiencing a dramatic shortage that, in some cases, is defined as a crisis (Emerson.com,
2018). TEE teachers are essential to maintaining the United States as a global competitor as they are one of the first to introduce high school students to STEM education formally and thus the STEM career pipeline (Gonzalez & Kuenzi, 2012).

My study sought to identify such factors of teacher retention in TEE with a national scope using ACTE’s eTED as a data frame. The existing small body of literature on TEE retention was expanded through this study, and I provided implications and recommendations for the profession. These, in turn, can be used to inform human resource offices and CTE directors in school districts on the factors that contribute to their TEE teachers’ long-term persistence in the classroom.

**Definition of Terms and Acronyms**

The following terms are used throughout the chapters of this study.

*Alternatively licensed teacher*

A technology and engineering teacher who was certified at the completion of any program other than a traditional university teacher preparation program.

*Teacher sense of belonging*

The extent to which teachers feel respected and supported by their colleagues.

(Pesonen et al., 2021).

*Teacher sense of efficacy*

A belief that teachers have in their abilities to organize and execute courses of action required to accomplish specific teaching tasks in their classroom.

(Tschannen-moran et al., 1998, p. 233).
Teacher job satisfaction

Refers to a sense of fulfillment, gratification, and satisfaction teachers feel from working in teaching (Collie et al., 2012; Locke, 1969)

Teacher's persistence intentions

The intent of teachers to exit the teaching profession before retirement.

Technology and engineering educator

Any middle school or high school instructor or teacher of technology and engineering. This term may also be used interchangeably with technology and engineering teacher or technology and engineering instructor.

Traditionally licensed teacher

A technology and engineering teacher who was certified at the completion of a traditional university teacher preparation program.

The following acronyms are used throughout the chapters of this study.

ACTE - Association for Career and Technical Education

CTE - Career and Technical Education

CTSO – Career and Technical Student Organization

eTED – Engineering Technology Engineering Division (ACTE)

FCS – Family and Consumer Education Teacher

T&I – Trade and Industrial CTE Teacher

TEE - Technology and Engineering Education

STEM – Science Technology Engineering Math
Summary of the Procedure

I followed the steps below in pursuit of this study:

1. A problem was identified, showing a need for a study identifying factors that predict teacher intentions to persist in TEE.
2. A review of the existing literature was performed to determine what research currently addressed the problem and what additional research was needed.
3. An appropriate population was identified for this study.
4. An appropriate design for the study was determined.
5. A formal proposal for the study was written.
6. Approval to perform the research study was obtained from the Institutional Review Board (IRB) for the protection of human subjects at Utah State University (Appendix B).
7. An email with the survey link was sent out to all eTED members through ACTE’s eTED Presidency.
8. A follow-up email was sent out based on ACTE’s internal policy and IRB recommendations regarding research.
9. Data from the survey was compiled, cleaned, then ran through R for statistical analysis.
10. Nonresponse bias was assessed.
11. Data was analyzed.
12. Quantitative data was used to inform interview questions for the qualitative data collection.
13. Participants for the qualitative phase were identified and contacted.
14. Interviews were conducted, coded, and analyzed.

15. Results were then explained, and inferences were made.

16. Conclusions were then written and reported.
CHAPTER II
REVIEW OF LITERATURE

Introduction

The purpose of this study was to describe the personal and professional characteristics of Technology and Engineering Education (TEE) teachers and examine factors that contribute to TEE teacher retention. This study sought to answer the question, “What keeps the Technology and Engineering Education teacher in the classroom?” This chapter will review the theoretical framework used to guide this study, the state of teacher turnover, and factors that contribute to teacher career satisfaction and turnover.

To understand the nuances of teacher retention, a review of literature provided a framework that identified critical aspects of career theory and teacher retention. Research in teacher attrition has expanded significantly over the decades due to a growing shortage of certified teachers entering the workforce (Mason & Matas, 2015). This research sought to identify factors contributing to TEE teachers choosing to stay or leave the teaching profession. Despite much research in teacher attrition, little work has been done in Career and Technical Education (CTE), specifically in TEE, to identify these factors.

Theoretical Framework

Career Construction Theory

Career construction theory addresses how careers are made through personal constructivism and social constructionism by asserting that individuals construct
representations of reality, but individuals do not construct reality itself. This theory views careers from a contextualist perspective, one that sees development as driven by adaptation to an environment (Savickas, 2005). Viewing careers from constructionist and contextual perspectives directs attention to self-construction (Savickas, 2013). With self-construction central to the theory, three perspectives arise out of the foundations of career construction theory: self as an actor, self as an agent, and self as an author (Savickas, 2013). Through the lens of career construction theory, Savickas (2013) stated that “the theory highlights the role of two meta-competencies—adaptability and identity—in coping with vocational development tasks, occupational transitions, and work traumas” (p. 179), where adaptability instills the skill and the will to direct one’s own work-life, and identity imposes meaning on vocational behavior and work activities.

Another key aspect of career construction theory is how, through the power of narrative, career construction theory addresses what, how, and why people construct their careers as they translate their storied identity into work roles and identity (Del & Rehfuss, 2011; Savickas, 2005). Within the framework posed by career construction theory and the model of adaptation, it is suggested people exert control over their careers by adaptively applying a set of psychosocial resources, which aid in the management of these expectations and the integration of the self at work over time (Rudolph et al., 2019).

As this theory provides a way of thinking about how individuals choose work based on a lifespan developmental approach viewed through the lens of construction, its theoretical underpinnings can be used to explain why individuals choose to remain in careers based on the continuous process of adaption (Del & Rehfuss, 2011; Rudolph et
al., 2019; Savickas, 2005, 2013). This theory will serve as the underlying theory for this study.

**Chapman’s Model of Teacher Retention**

Various models have built on career construction theory by identifying specific factors related to adaptability and identity correlated to teacher retention. These factors can be described as the psychosocial resources identified in career construction theory. One such model is Chapman’s model of teacher retention. Grounded in social learning theory, this framework posits the belief psychological functioning can be explained in terms of the interaction of personal characteristics, previous behavior (e.g., learning), and environmental determinants; the potential for behavior to occur is affected by a person’s generalized expectancy for reinforcement (Chapman, 1983).

This model of teacher retention can be further broken down into seven factors: 1) personal characteristics, 2) educational preparation, 3) initial commitment, 4) quality of first employment, 5) integration into teaching, 6) external influences, and 7) career satisfaction (Chapman, 1983, 1984). Chapman (1983) claimed, these factors impact career satisfaction and affect a teacher’s decision to leave or stay in the teaching profession. Figure 3 is a visual representation of Chapman’s model. According to Chapman (1983):
To understand a teacher’s decision to persist in or leave teaching, it is necessary to take into account (a) the personal characteristics of the teacher, (b) the nature of teacher training and early teaching experience, (c) the degree to which the teacher is socially and professionally integrated into the teaching profession, (d) the satisfaction teachers derive from their career, and (e) the external environmental influences impinging on the teacher’s career (p.47).

Figure 3

Chapman’s Model of Teacher Retention

Personal Characteristics

Many personal characteristics influence teacher retention rates and have long been correlated to teacher retention (Chapman, 1983; Theobald, 1990). These correlates include gender, race and ethnicity, and academic ability.

Gender. The effects of gender on teachers' decisions to stay or leave the teaching profession have been "complex and somewhat inconsistent" (Chapman, 1983, p. 43). Although gender alone does not appear to be significant (Allensworth et al., 2009; Chapman & Hutcheson, 1982), the importance of gender may be in its relation to other key factors (Bloland & Shelby, 1980; Stinebrickner, 1998). For example, women are more likely than men to switch careers earlier in their professional lives due to family lifestyle issues related to marriage and child-rearing (Chapman, 1983; Quartz, 2003). Guarino et al. (2006) echoed this finding. A review of empirical literature regarding teacher retention found female teachers typically had higher attrition rates than male teachers. Given that family dynamics and the labor market are constantly changing and this research is not content-area specific, it is difficult to know if these findings are still true today and applicable to specific content areas.

Race and Ethnicity. Historically, teaching has been a vehicle of upward mobility for minorities whose occupational alternatives may be limited (Falk et al., 1981). Two of the avenues in which race influences teaching career stability are in regard to career satisfaction and the homogeneity of the classroom. Compared to their white counterparts, African-American teachers have been more satisfied and stable in the teaching profession than other races (Allensworth et al., 2009; Chapman, 1983). Teachers who are racially different from their administrators, teachers, and students have been
found to leave teaching at a significantly higher rate than teachers who are not racially different (Allensworth et al., 2009; Chapman, 1983). In a review of literature on teacher attrition, Guarino et al. (2006) discussed several notable findings regarding teacher attrition. Of the findings that dealt with race and ethnicity, Guarino et al. (2006) found Caucasians formed larger proportions of new teachers than minorities and minority teachers tended to have lower attrition rates than Caucasian teachers. Determining if these differences in the number and the persistence of minority teachers still exist in education is important in holistically assessing teacher attrition.

**Academic Ability.** Guarino et al. (2006) connected academic ability to teacher retention. He found teachers with higher measured academic ability, such as those measured by standardized test scores, were more likely to leave the teaching profession. Additionally, he found college graduates with higher measured academic ability were less likely to enter teaching than were other college graduates. They suggested these findings could be explained by the economic labor market theory, which attributes increased career mobility to those with higher academic ability. This means while academic ability was connected to teacher attrition, it might actually be career mobility enabled by academic ability that leads to teacher attrition. Thus, further research is needed.

**Professional Characteristics**

Professional characteristics of a teacher have been identified as correlates of teacher retention. These correlates include the level of education obtained by the teacher, the educational preparation of the teacher, and the initial commitment and quality of the first teaching experience of the teacher.
**Level of Education Obtained by the Teacher.** According to specific capital theory, as an investment into education increases, an individual's commitment to the profession increases, making a person less likely to leave the profession (Bloland & Shelby, 1980; Chapman, 1983; Maringe, 2015). Similarly, Oaklander (1969), as cited by Chapman, found a direct relationship between higher levels of education and increased teacher mobility among veteran teachers. However, Chapman (1983) counters that although this theory has been supported through research in the general labor force, researchers have little agreement regarding education attainment and teacher retention. Chapman (1983), himself, found there is no relationship between educational attainment and mobility of teachers within the profession. He suggested this finding is to be expected because there will likely always be a high frequency of teachers furthering their education due to state requirements to obtain additional certification, licensing, and endorsements. The lack of agreement among researchers suggests further research is needed to determine if the level of education attained affects teacher retention.

**Educational Preparation.** Traditionally, the path to a teaching career would work through the following progression: obtaining an education degree, serving as a student teacher, and passing a state licensure exam. In the 1980s, alternative paths to certification emerged to meet the demands of the teacher shortage (Shuls & Trivitt, 2015). These paths are available to individuals who have not completed an undergraduate degree or equivalent in the field of education and vary by state and, in some cases, school districts. They encompass a variety of practices, ranging from emergency certifications given to individuals with no teaching experience or training to programs designed to license and/or certify individuals who have an undergraduate degree and/or requisite
experience in the field in which they plan to teach. Most alternative certified teachers possess abundant technical skills within their discipline but lack the basic skills necessary to operate effectively in the classroom (Bowling & Ball, 2018).

Traditionally, CTE teachers in the areas of agriculture, family and consumer sciences, business, marketing, and technology and engineering education entered the teaching profession through a four-year baccalaureate degree. Conversely, teachers in trade and industrial (T&I), manufacturing, automotive, and health occupations enter teaching based on their occupational competence and years in the workforce. The lack of educationally prepared teachers has resulted in more teachers in all CTE content areas relying on alternate paths to licensure (Walter & Gray, 2002). This means more CTE teachers possess technical and industry-related knowledge through their occupational experiences but lack academic teacher preparation.

The development of teaching methods has been linked to teacher retention. In a study using survival analysis, teachers prepared through teacher preparation programs were significantly more likely to remain in the classroom than alternatively licensed teachers (Van Overschelde & Wiggins, 2020). However, Ingersoll et al. (2014) found in their study of teacher retention that the type of college, degree, entry route, or certificate mattered little to teacher attrition. What mattered more was the substance and content of new teachers’ pedagogical preparation. They found those who had more training in teaching methods and pedagogy, specifically in practice teaching, observation, and feedback, were less likely to leave the profession after their first year on the job. This means regardless of the path taken to licensure, teacher training is a factor in teacher retention.
**Initial Commitment and First Teaching Employment Experience.** Teaching has been considered an easy-in, easy-out career, which results in low professional commitment, which in turn fosters significant career mobility (Chapman, 1983). Lauglo (1975) reported the findings of a Norwegian study, which found university students’ commitment to teaching during their teaching education training was related positively to their persistence in teaching.

Chapman (1983) noted repeated concerns in the literature regarding the discrepancy between how teachers perceive their teacher preparation program and their first years of teaching experience. During their first-year teaching in their own classroom, teachers often found that they were not as well prepared as they had thought they were and they faced unanticipated gaps in their professional competencies (Johnson et al., 2004; Rust, 1994). Chapman (1983) argues teachers need a better sense of what school is all about and a reality check concerning what schools actually do. He found teachers experiencing early frustration may abandon their careers, as their experiences lead to job dissatisfaction. This frustration is further exacerbated as those experiences shape novice teachers’ professional and social patterns that affect retention. Teachers who have positive first-year teaching experiences are thought to be more likely to persist in their schools (Chapman, 1983; Johnson et al., 2004). These findings suggest more attention needs to be focused on supporting teachers during their first year of teaching.

**Sense of Belonging**

Sense of belonging can be defined as the extent to which an individual feels socially connected, accepted, supported, and included by other people in various social
contexts (Baumeister & Leary, 1995). When applied in a school context, the concept of a sense of belonging “refers to the extent to which teachers feel respected and supported by their colleagues” (Pesonen et al., 2021, p. 426). Individuals who have close relationships with others and feel a sense of belonging perform better mentally and physically (Baumeister & Leary, 1995; Pesonen et al., 2016; St-Amand et al., 2017).

Research in teacher identity suggests several themes, along with the overarching conceptualization that identity is relational, interactional, constructed, and performed in context (Burns & Richards, 2009). Because of this, identity can be viewed as being in relation to discursive, social, cultural, and institutional elements (Burns & Richards, 2009). In one study with teachers who were teaching ‘out of field’ (teaching in areas they were not licensed for), it was found teachers’ sense of self in relation to the out-of-field subject in which they taught can depend not only on content knowledge but also whether they have stories to tell, the depth of their understanding and the connections they can make, knowledge of learners at different year levels, and commitment to the subject department (Hobbs, 2013). This commitment to the subject department can lead to the teacher feeling a higher or lower sense of belonging.

Isolation and individualism in teaching have been observed in all major studies dealing with the work environment of teachers (Glickman et al., 2017). One author, DuFour, (2011), notes that:

Teachers work in isolation from one another. They view their classrooms as their personal domains, have little access to the ideas or strategies of their colleagues, and prefer to be left alone rather than engage with their colleagues or principals. Their professional practice is shrouded in a veil of privacy and personal autonomy and is not a subject for collective discussion or analysis. Their schools offer no infrastructure to support collaboration or continuous improvement, and,
in fact the very structure of their schools serves as a powerful force for preserving the status quo (p. 57).

Chang (2009) points out the physical isolation of a teacher can lead to psychological isolation “due to the isolated culture, teachers may become frustrated, bored, and depleted as they privately struggle with their anxieties” (p.193). While teachers of all content areas may experience some sense of isolation, those who are singletons (the only teacher in the school who teaches the classes they teach) are likely to feel even more isolated.

**Social and Professional Integration into Teaching.** Social integration, professional integration, and teacher retention are related. Social integration plays an important role in theories of turnover in work organizations; having close friends employed by the same organization can serve to reduce job turnover (Chapman, 1983). The more involved a teacher is in the professional aspect of their job and the more social ties the teacher has to the faculty and staff in the school, the more likely teacher will remain in the profession (Chapman, 1983; Chapman & Hutcheson, 1982).

It has been found teachers associate their roles and responsibilities within the school environment to their social interactions with other educators (Muller et al., 2011). Muller et al. stated “positive relationships and interactions with colleagues, as well as knowing how one fits into these social and professional structures, is important in fostering teachers' resilience” (p. 552). When applied to the field of education, social integration becomes complicated due to the isolation teachers feel from their peers resulting from the structure of school. Teachers, especially those in CTE classes, tend to be individualistic as opposed to collaborative. This is a result of CTE courses typically being taught by a single teacher in a given content area at a school (Blevins, 2016). In
many cases, CTE teachers will have no other colleagues who teach in a common content area at a given school to participate in Professional Learning Communities (PLCs).

Collaborative school environments in which teachers work together to offer and receive support are environments that promote teacher retention. According to Chapman & Hutcheson (1982), teachers who remained in the profession were more oriented toward interpersonal rewards such as the recognition and approval of family, close friends, and supervisors than those who left teaching. Additionally, recognition and approval received from administrators or supervisors were found to be related positively to the career satisfaction of those who remained in teaching (Chapman, 1983; Chapman & Lowther, 1982).

Professional integration into teaching encompasses a variety of factors. Chapman (1983) stated the four most important indicators were: (a) salary, (b) the extent to which individuals assign importance to selected criteria of professional success, (c) the extent to which individuals believe they have achieved goals that are widely valued, and (d) the extent to which individuals feel they are competent and have the necessary skills and abilities. Individuals tend to search for work environments that will let them exercise their skills and abilities, express their values and attitudes, and take on agreeable problems and roles. Chapman and Hutcheson (1982) found teachers who remained in education differed significantly from teachers who left, regarding their self-rated skills and abilities and the importance the teacher assigned to selected criteria of success. Chapman and Hutcheson stated that actual levels of skills and accomplishments are most likely related to the encouragement and rewards teachers receive from administrators, and
consequently, their decisions to stay in or leave the teaching profession. Thus, social integration into the classroom is likely a key factor to teacher retention.

**Sense of Efficacy**

A key conceptual strand of theory and research identified teacher sense of efficacy as a type of sense of efficacy grew out of the work of Albert Bandura (1977). This theory explains how much effort people put forth, how long they will persist in the face of obstacles, how resilient they are in dealing with failures, and how much stress or depression they experience in coping with demanding situations (Bandura, 1977, 1994). The construct of sense of efficacy refers to an individual’s belief in their capability “to organize and execute the courses of action required to manage prospective situations” (Bandura, 1995, p.2). Sense of efficacy is task-specific and regulates effort, choice, and persistence and is differentiated from more global constructs, such as self-esteem, through its direct connection to a specific task (Chen et al., 2004; Gardner, 1998).

Teacher efficacy is a belief that teachers have in their abilities to organize and execute courses of action that are required to accomplish specific teaching tasks in their classroom (Tschannen-moran et al., 1998). Teacher burnout, which can be described as a chronic state of exhaustion due to long-term interpersonal stress within the teaching profession, has been strongly correlated with teacher efficacy (Schwarzer & Hallum, 2008; Skaalvik & Skaalvik, 2007). Tschannen-moran et al. (1998) stated the development of a strong teacher sense of efficacy can pay dividends of higher motivation, greater effort, persistence, and resilience across the span of a teaching career. This statement suggests teacher efficacy is likely an integral part of teacher retention.
**Job Satisfaction**

Job satisfaction refers to a sense of fulfillment, gratification, and satisfaction one feels from working in an occupation (Locke, 1969). The work of Super and Hall (1978) identified values relate to job satisfaction. These values include career challenge, autonomy in the workplace, and the perceived rewards offered by one’s employer.

Concerning teaching, the modern classroom is vastly different than one from a few decades ago. Through federal legislation such as No Child Left Behind, teachers now work in the era of accountability and high-stakes testing. This change has propagated many new daily challenges for teachers that have been attributed negatively to job satisfaction and commitment (Shaw, 2016). One of the main factors attributed to teachers leaving or considering leaving the profession is career dissatisfaction (Boyd et al., 2011). Boyd et al. (2011) operationalized teacher career satisfaction into the following factors: relationship with colleagues, autonomy in the classroom, school facilities, respect from parents/students, ability to help students, emphasis on testing, school safety, teaching assignment, teaching philosophy, district policy, student behavior, and administrator support. Of these factors, Boyd et al. (2011) found support from administrators, student behavior, and district policy to be the most important aspects influencing teachers to leave.

Teacher career commitment and retention is a problem that researchers have attempted to understand through the concept of job satisfaction (Tillman & Tillman, 2008). According to previous research, teacher job satisfaction has been identified as a reliable predictor of teacher retention and commitment (Watson et al., 2010). Teachers’ job satisfaction has been associated with their motivation (Barnable & Burns, 1994),
well-being (Vansteenkiste et al., 2007), and commitment to teaching (Feather & Rauter, 2004). Chapman and Lowther (1982) suggest that job satisfaction of those in teaching careers is different from many other careers in the following constructs: career challenge, autonomy in the workplace, and the perceived rewards offered by one's employer. These perspectives are echoed in the more contemporary work of Glickman et al. (2017).

What initially appears as job autonomy is felt by many teachers as isolation (Glickman et al., 2017; Gonzalez et al., 2015). Job challenge can be limited as teachers tend to teach the same class and content year after year, as the activities of a classroom teacher after 20 years of teaching may not differ significantly from that of a second-year teacher (Chapman & Hutcheson, 1982; Chapman & Lowther, 1982). Concerning reward and compensation, a teacher realizes a salary increase for each year of experience identical to that received by all others of comparable experience. However, when compared to other careers, teaching has been unstaged from entry to exit (there is no progression of stages that one can expect to advance without leaving the classroom) (Glickman et al., 2017). High performance or merit is seldom recognized through financial reward. Instead, when available, additional compensation is typically based on completing additional education. This combination of factors is unique to teaching and creates a complex system that influences job satisfaction and should be explored to better understand how these factors affect teacher retention.
External Influences

**Institutional Factors**

Institutional factors have been connected to teacher retention. Across all subject areas, research has connected teacher attrition to salary, school administration, teaching subject, and school culture (Boe et al., 1997; Hill & Jones, 2020; Ingersoll, 2001a; Liu & Ramsey, 2008; Stinebrickner, 1998; Van Overschelde & Wiggins, 2020). While not specific to TEE teachers, factors related to retention of other CTE teachers include a passion for the subject, competition, multiple responsibilities, time, satisfaction, administrative, collegial, and community support, as well as teacher empowerment (Hasselquist & Graves, 2020; Lemons et al., 2015).

**Salary and Other Compensation.** Teacher pay is a well-documented issue regarding teacher retention, though many studies do not take into account the interaction of salary with other factors (Johnson et al., 2005). Teacher pay is repeatedly cited as a factor influencing teacher retention (Bond, 2001; Guarino et al., 2006; Rumberger, 1987). Research indicated the more teachers are paid, the more likely they will remain in the profession (Beck-frazter, 2005; Di Carlo et al., 2007). The starting salary for teachers lags behind that for other professionals in business and industry, especially those with similar educational merit, and the teacher compensation system lacks differentiation by expertise and quality of work (Grissmer & Kirby, 1987; Rumberger, 1987). In particular, teachers from a STEM background who can command higher salaries in the private sector tend to leave teaching for high-paying jobs in the industry (Murnane et al., 1991). Bond (2001) examined the effects of salary on teacher recruitment, teacher retention, and student outcomes, finding that states with large gaps between teachers and similarly
educated professionals at the bachelor’s level have higher dropout rates, higher teacher turnover, and lower 8th grade math scores.

Beyond salary, teacher benefits are also noteworthy in regard to teacher attrition. Historically, teaching retirement benefits was some of the best, which proved to be a recruitment and retention tool. A study conducted by RAND Corporation found teacher retention was significantly lowered by increasing the retirement age. This same study found teacher retention was sensitive to salary and retirement benefits, affecting teachers at all points in their careers (Knapp et al., 2016). Specific to CTE, higher salaries and better benefits have lured many teachers into the private sector (Lemons et al., 2015).

In contrast to most current research, there are a small number of interview and survey studies that explored how teachers perceive pay in relation to other factors as they make career decisions that suggest pay is not the sole, or in some cases, the primary factor responsible for teachers’ career decisions (Johnson et al., 2005). Similarly, Hanushek and Rivkin (2007) concluded salary affects mobility patterns less than other factors such as working conditions, facilities, safety, and leadership quality. Combined, these studies show while salary and retirement benefits are important factors when looking at teacher retention, they are likely additional factors that need to be considered.

**Mentoring Programs.** In teaching, mentoring has been widely used to support goals of teacher professional development and induction by supporting teachers in adapting to their school contexts and aiding in teaching new teachers how to successfully deliver the curriculum (Wang et al., 2008). Gilles et al., (2017) said “mentor teachers are the best people to help novices with the ins and outs of teaching – pedagogy, planning, management, strategies, advise and time” (p. 84). Because of how powerful mentoring
programs have proven to be, many school districts incorporate mentoring as an important component of teacher induction programs (Glickman et al., 2017). Beginning teachers have reported having an assigned mentor, especially one who provides feedback on teaching through an observation and feedback cycle, is a powerful form of support (Gilles et al., 2017). Additionally, Ingersoll and Strong (2011) concluded support programs result in increased retention of beginners, improved teaching, and higher student achievement. Key features of quality mentoring for new teachers are as follows: support, guidance, and orientation (Ingersoll & Smith, 2003). Schools that provided mentoring and induction programs, particularly those related to collegial support, had lower turnover rates among beginning teachers (Guarino et al., 2006).

Briggs (2008) suggested when it comes to mentoring, careful consideration of who mentors whom is needed. She recommends mentors be paired with mentees of like subject areas or content knowledge to be most successful. Although mentoring has been used as a program to support teacher retention, it may not be effective if singleton teachers are paired with teachers from different content areas.

**School Climate, Culture, and Leadership.** The heart and soul of a school is the climate and culture (Glickman et al., 2017; Macneil et al., 2009). Schools with strong cultures have more motivated teachers (Macneil et al., 2009). Gruenert (2008) stated although climate and culture are intertwined and often used interchangeably, they are distinguishable, each as different aspects of the organization. School climate “is thought to represent the attitude of an organization,” and culture is the “collective personality” of an organization with climate dictating culture (Gruenert, 2008, p. 57). Both concepts are essential in creating the look and feel of a school, and both can affect a teacher’s job
satisfaction within the organization (Macneil et al., 2009). School culture, particularly the building administrator, plays a role in the retention of teachers (Deever et al., 2020). A school district may have more significant initiatives in line with its mission and might be engaging in district-wide school improvement initiatives, but the school principal is the driving force behind a school's operation and daily function. The type of leadership, culture, and climate the principal exhibits and establishes sets the stage for how teachers, students, parents, and other stakeholders will interact. The school administrator defines the climate and working conditions in which the teacher works (Gruenert, 2008). Principals must serve as leaders supporting best practices (Colley & Kent, 2002) and be aware and empathetic to the needs of their teachers (Weller, 1982).

Findings showed administrative support plays a large part in shaping teachers’ attitudes toward teaching, commitment, and satisfaction (Allensworth et al., 2009; Deever et al., 2020; Grissmer & Kirby, 1987; Ingersoll, 2001b; Johnson et al., 2005). Many of these studies have investigated what leadership style and characteristics created a school climate and culture that promoted teacher job satisfaction and commitment, and as a result, increased student learning. Carlson (2012) found school leadership style had a direct impact on the teachers’ level of job satisfaction in the school. The study found “effective principals create an environment where teachers feel and sense of collaboration and support, and as a result, are dedicated to their jobs” while “ineffective principals fail to create such a climate, leaving the teachers to feel a sense of isolation, leading to dissatisfaction with their jobs and a higher probability they will leave their teaching positions” (Carlson, 2012, p. 52).
Ingersoll and Smith (2003) reported that data suggested the root of the teacher shortage is largely influenced by the working conditions of schools. Schools with higher proportions of minority, low-income, and low-performing students tended to have higher attrition rates (Guarino et al., 2006). Furthermore, school leadership had an effect on teacher turnover. In a study by Boyd et al. (2011), school administration was the most important aspect influencing a teacher’s decision to leave. Additionally, in a review of literature, Guarino et al. (2006) suggested schools that provide teachers with more autonomy and administrative support have lower levels of teacher attrition and migration.

However, Song et al. (2011) concluded CTE teachers approached job autonomy differently from other professionals: a supportive learning climate and school leadership are essential to an innovative school climate and turnover reduction. Recognizing that different teachers perceived job autonomy and school culture slightly differently than general education teachers means administration can better support the different needs of all teachers when it comes to school climate and culture in order to improve teacher retention.

**Opportunity for Advancement and Recognition.** Chapman and Hutcheson (1982) established a connection between the way a teacher perceived their professional success and their decision to stay in or leave education. For those staying in teaching, greater recognition by building administration was related to greater career satisfaction (Chapman & Lowther, 1982). One of the key findings in a study conducted by Richmond (2006) was that principals needed to support teachers in part through recognition for a job well done to better retain teachers. Recognition from the other members of the school faculty is an essential working condition for teachers (Kelchtermans, 2017). The teaching
career is unstaged from entry to exit (Glickman et al., 2017). Teaching careers are ‘flat,’ lacking both successions of titles and economic advances beyond an early career stage (Talbert, 1986). In a study of 2,054 practicing classroom teachers, opportunities for advancement were one of the key external factors for job satisfaction in teaching (Kim & Loadman, 1994). These studies highlight the need to provide opportunities for career advancement and recognition to support teacher persistence.

**Workload.** Teaching in CTE is demanding, often because of the added responsibilities of advising Career and Technical Student Organizations (CTSOs), managing and maintaining equipment and laboratories, and facilitating cooperative education experiences (e.g., internships, establishing and maintaining relationships with industry partners, sitting on advisory boards, etc.) for which other teachers in a school are not generally responsible (Hensley et al., 2016). These added responsibilities of CTE teachers can lead to working additional hours that may exceed the typical 40-hour week, thus leading to teacher burnout.

*Opportunity Outside of Education*

Teachers with degrees in areas that are more easily transferrable to outside of education (e.g., science, engineering, and math) are more likely to leave the teaching profession than other teachers (Guarino et al., 2006; Nguyen et al., 2020; Stinebrickner, 1998). This is likely a result of opportunities available to transition to other careers without needing additional job-related or academic training. This is of particular concern in teaching areas within CTE as, by nature of the content, teachers licensed in CTE fields have a strong background in some type of trade or skill. The easy transition, coupled with
reduced benefits associated with educational careers, such as retirement and other benefits, is pushing teachers to private-sector jobs.

Walter and Pellock (2004) conducted a research study with the living population of undergraduate graduates of a university's Career and Technical Teacher Education (CTTE). These researchers found although nearly three out of every four CTTE graduates (74.1%) began their career as an instructor, less than half as many of the graduates reported being instructors in their second job, and only 13.7% of the total respondents remained in their original position for their entire career. Walter and Pellock (2004) concluded the high degree of career mobility associated with the CTTE degree provides a variety of pathways available in the workforce education profession. The availability of these pathways may be a factor in teacher attrition.

Teacher Attrition and Turnover

Teacher turnover, also called attrition, is a serious and ongoing problem in this country and internationally and is one that has received significant attention over past decades (Ingersoll, 2001a). Teacher turnover and attrition have been defined in the literature as being comprised of two facets: 1) “movers” who are teachers who leave one school or district for another; and 2) "leavers" who are teachers who exit the profession temporarily or permanently (Ingersoll, 2001b). Teacher turnover is not a new issue; as early as the mid 1950s, school board presidents listed teacher turnover as one of the top problems facing schools (McQuinn, 1957). In the 1980s, teacher dissatisfaction and teacher attrition became an issue in elementary and secondary education schools. Ingersoll (1997) explained:
Three trends … appeared to be converging: increasing student enrollments; decreasing numbers of college graduates, especially women, choosing to become teachers; and increasing teacher retirements due to a “graying” teaching workforce. If these trends did indeed continue, the analysts predicted, sooner or later, there would simply be too few qualified teachers available to adequately staff all the nation's classrooms. Until recently, however, it was impossible to empirically examine these claims because of a lack of data, especially at the national level, on the demand for teachers, the supply of teachers and, the gap between the two (p. 42).

To solve the problem of the growing teacher shortage across the United States, many school districts have started to focus on increased recruitment. However, this is only part of the solution (Gersten et al., 2001). Merrow (1999) examined national attempts to fill the teacher shortage, including major recruitment and incentive efforts by various states, and concluded enhanced teacher recruitment is not the answer: “we’re misdiagnosing the problem as ‘recruitment’ when it’s really ‘retention.’ Simply put, we train teachers poorly and then treat them badly--and so they leave in droves” (par. 10). The lack of new teachers combined with current teacher attrition would suggest “we” have fixed the problem.

**Current Situation**

The teaching profession is currently plagued with a serious and lasting teacher shortage. Teachers in all subject areas and at all levels in the United States are leaving their classrooms at alarming rates. In general, approximately 25% of new teachers in the US leave the teaching profession before the third year on the job (Skaalvik & Skaalvik, 2011). In 2015, former Texas education chief Michael Williams said the biggest threat to the Texas education system is the current teacher shortage (Daniel, 2015). The same year, the Nevada State Board of Education president described the state’s teacher shortage as
“horrific” after a report on Nevada’s teacher shortage highlighted the state was short nearly 1,000 teachers (Millard, 2015).

A 2015 report from the Learning Policy Institute found from supply and demand estimates that there is an estimated annual teacher shortage of approximately 64,000 teachers in the 2015–16 school year. It predicted the shortage would grow to 300,000 by 2020 and 316,000 by 2025 (Sutcher et al., 2016). Another report filed in 2017 found 75% of California school districts were facing a growing teacher shortage resulting in many districts hiring teachers with substandard credentials (Carver-Thomas & Darling-Hammond, 2017a). This same report discovered the number of intern teaching credentials conferred to teachers in California had increased by nearly five times over two years.

If graphed on a curve, teacher attrition by age commonly looks like a ‘U-shape’ (Grissmer & Kirby, 1987; Johnson et al., 2005). Teacher turnover tends to start high for early career teachers, level out and decrease after five to seven years, then dramatically increase again after ten years (Grissmer & Kirby, 1987).

New teachers are particularly vulnerable to turnover. Nationally, most teacher attrition occurs across all disciplines within the first three years of teaching (Gray & Taie, 2015; Ingersoll & Smith, 2003). Although the reported attrition rates vary, most studies indicated that approximately half of all teachers would leave before their fifth-year teaching.

**Turnover and Attrition in CTE**

Turnover in Career and Technical Education is not different from turnover in other teaching areas; the attrition of CTE teachers is considered a serious and ongoing problem in the United States which has drawn the attention of policymakers, researchers, and administrators over the past few decades (Ruhland, 2001). Half of the United States
has major teacher shortages in CTE with larger shortages expected in the near future from teacher retirements, retention issues, and issues stemming from teacher preparation programs (Jacques & Potemski, 2013).

Teacher attrition and turnover are critical issues in CTE in terms of both instructional and financial impacts (Song et al., 2011). Song et al. (2011) indicated student performance is increasingly important for CTE due to the increased requirements stemming from federal legislation such as the No Child Left Behind Act (2008) and the Carl D. Perkins CTE Improvement Act (2016). According to Threeton (2006), the Carl Perkins Act “places greater accountability on integration of academic standards, which is aligned directly with the ‘No Child Left Behind’ movement” (p. 69).

Camp and Heath-Camp, (2007) found 15% of CTE teachers left their jobs within the first year of teaching, while more than half quit within only six years. Similarly, in a nationwide study assessing 208 beginning agriculture teachers, Warnick et al. (2010) found only one-half of these teachers reported they were highly likely to remain in the profession for more than three years, and only one-third reported a high likelihood of staying more than five years. This research coincides with Walter and Pellock (2004), who also indicated a high degree of career mobility exists in CTE.

In a report on the 2011 – 2012 Schools and Staffing Survey results, Hensley et al. (2016) found 32% of CTE teachers would leave teaching as soon as possible if offered a higher paying job. Additionally, Hensley et al. (2016) found although schools were more likely to report having academic vacancies than CTE vacancies (90% vs. 33%), they were also more likely to report having difficulty filling their CTE vacancies than filling their academic ones (57% vs. 39%).
In a study on retention of Trade and Industrial (T&I) CTE teachers, Self (2001) reported T&I teachers left teaching due to feelings of dissatisfaction more often than any other reason. The top reasons reported for dissatisfaction were lack of recognition and support, student discipline problems, poor student motivation, and poor salary. Self (2001) identified several unique characteristics of T&I teachers. Of those, two characteristics are of note regarding teacher retention: (1) more often than not, T&I teachers have entered the classroom following experience in the workforce, and (2) licensure requirements in many states allow T&I teachers to forego traditional teacher training routes toward certification, leaving the teacher without formal training in pedagogy, classroom management, curriculum design and more.

T&I teachers “enter the classroom as content-level experts who may have acquired their content expertise through a combination of formal industry training and informal on-the-job experiences” (Burns et al., 2005). When T&I teachers make the career transition from industry to teaching, they must acquire professional teaching competencies needed by a teacher. In a study concerning mentorship in T&I programs, Osgood (2001) found “structuring teams with appropriate matching of novices to veterans for the purpose of mentoring is beneficial to both parties” (p. 32).

Those who teach in agricultural education are faced with additional hurdles that lead to teacher attrition. In an article on the experiences of first-year agricultural education teachers, Warnick et al. (2006) stated: “While beginning agriculture teachers experience the challenges similar to other beginning teachers during their initial years, the added expectations of supervising agriculture experience programs (summer student projects) and advising the FFA (Career and Technical Student Organization) chapter,
increase the demands and the potential for challenges” (p. 601). In this national study, nearly 90% of teachers reported a positive perception regarding the overall experience of their first year of teaching, though a majority of the participants were unsure of their long-term plans (Warnick et al., 2006). Fewer than half reported they were likely or highly likely to be teaching at 10 years.

Not all of CTE is facing turnover as a result of career satisfaction. In a study of Family and Consumer Sciences (FCS) teachers, Bartley and Sneed (2004) found high levels of satisfaction with their teaching careers, leisure activities, and home life were reported. In another study looking more into the FCS teacher attributes, nearly 66% of respondents in Tripp’s (2006) study indicated they were “very” satisfied with their current FCS teaching assignment. The varying results between CTE disciplines with regard to teacher attrition suggest the factors influencing teacher retention should not be generalized across disciplines; instead, disciplines should be researched separately.

**Turnover and Attrition in TEE**

Few studies have been reported addressing the specifics of turnover and retention of secondary TEE teachers. The bulk of the literature on the TEE teacher shortage is based on that of supply and demand from teacher education programs. The existing research does not contain the full national scope as the research has been focused on responses from the state office of education supervisors to report on data, which has garnished responses approximately 84% of states (Moye et al., 2012). The International Technology Engineering Education Association (ITEEA) (formally ITEA) is a professional association that provides leadership, research, and curriculum development.
The *Technology Teacher*, ITEEA’s professional journal, published articles that discussed the early issues of TEE teacher supply and demand as early as the late 1980s. In 1997, Weston (1997) described the state of the TEE profession concerning teacher supply and demand as a ‘downward spiral’ with significantly more demand for TEE teachers than available in the supply pipeline. Weston (1997) indicated this was a multi-faceted issue with a higher than average increase in the need for technology teachers due to expansion in technology education programs, increasing student enrollment, and attrition resulting from career teachers retiring. Weston (1997) argued the profession at large needed to meet the teacher shortage challenge by sending students into teacher education through both traditional and alternative means.

Over a decade later, John Moye (2009a) found that on an annual basis, fewer institutions were offering technology education teacher licensure programs, and fewer teachers were being produced. Furthermore, Moye (2009a) found the decreasing number of new technology education teachers would not meet the estimated demand between the fall of 2009 and 2014, confirming the TEE profession is continuing to be plagued by an issue of supply and demand. In their concluding remarks, Moye (2009a) stated: “If the technology education profession is to survive, the time for action to ensure that survival is NOW!” (p.88) and recommended TEE takes steps to better create a unified definition nationally, increase enrollment in teacher preparation programs, and create more robust mechanisms to monitor the supply and demand for TEE teachers in each state. Moye published again in 2009 the findings of their dissertation (Moye, 2009b). In this publication, Moye stated, “It is the responsibility of each technology education teacher to aid in the recovery of the critical technology education teacher supply-and-demand
situation. Unfortunately, there are fewer and fewer technology teachers to aid in that recovery” (p.35).

Most recently, Volk (2019) published a seminal piece in *The Journal of Technology Education* titled *The Demise of Traditional Technology and Engineering Education Teacher Preparation Programs and a New Direction for The Profession* discussing the dire straits the TEE profession faces. Volk (2019) reported the number of annual bachelor degrees awarded in TEE has decreased from 6,368 in 1970 to 164 in 2018, while the number of universities preparing TEE teachers has decreased from 203 to 32 during the same period, confirming the prediction by Moye (2009a) and Weston (1997) of the downward trend of teachers entering TEE preparation programs. In reference to closing teacher education programs, Volk (2019) stated:

> Traditional technology and engineering teacher education is following the path of subjects such as Latin and Philosophy—subjects that once needed universities to produce specialized, trained, and highly qualified teachers. Sadly, these programs are no longer relevant and, for the most part, long gone. Requiescat in Pace. (p. 13)

In reference to teacher supply and demand in the area of TEE, (Nadahi & Ritz, 2003) stated issues outside of teacher preparation are causing the TEE teacher shortage and “factors such as poor working conditions, lack of administrative and community support and economic, political, and school reform efforts are contributing to the teacher shortage” (p. 28). This meant the TEE profession not only had to contend with the issue of teacher supply in preparation programs but also with teacher retention with current practitioners.
The Effects of Teacher Turnover

The high rate of teacher turnover has not been without cost. Teachers have consistently been identified as the single most important school-based determinant of student achievement (Miller et al., 2008; Rowe, 2003). With turnover affecting one of the single most important school-based determinants of student learning, the cost of teacher turnover can be seen impacting schools and school systems in a variety of ways, including academic costs from reduced student achievement, direct financial costs dealing with the constant hiring, and programmatic costs associated with a supply shortage of qualified teachers to fill vacancies.

Researchers have noted teaching quality is diminished, program planning is disrupted, student learning is reduced, and operating costs increase due to teacher turnover (Barnes et al., 2007; Gonzalez et al., 2015; Macdonald, 1999). In one study, researchers found turnover negatively affects student achievement in mathematics and English language arts. This study found teacher attrition significantly and negatively impacts student achievement, with a larger effect on students in schools with large populations of low-performing and Black students (Ronfeldt et al., 2013).

Losing a teacher means losing familiarity with school practices, curriculum, involvement with students, parents, and community. According to (Carver-Thomas & Darling-Hammond, 2017b), the more new teachers a school has on staff, the less knowledge base and cohesion there is at the school. Equity in schools is also affected by the high attrition of teachers as schools in more diverse and higher poverty areas tend to be harder to staff (Guarino et al., 2006).

Schools lose early career teachers who are often replaced with other novice teachers, who, on average, fall victim to the same vicious cycle of teacher attrition. Berliner (2001)
suggested it takes between five and seven years for novice teachers to develop meaningful expertise in their practice. This cycle of novice teachers being replaced by other novice teachers prohibits the teaching profession from gaining the experience necessary to develop expertise in teaching, thereby influencing student learning (Johnson et al., 2005). To fill the need in the education system, CTE teachers in every state have entered the classroom under-certified, receiving emergency, temporary, or provisional certifications through alternative licensing programs (Devier, 2019).

Beyond the academic cost of teacher attrition, a high financial cost can be attributed to the recruiting and retainment of teachers. School districts are spending millions of dollars to fill teaching positions as a result of the high attrition in the profession. High turnover schools are costly to operate as they are often trapped in a cycle of teacher hiring and replacement, leading to a significant drain on their financial resources. Costs range from just over $4,000 (USD) to replace a teacher in a rural school district in New Mexico to over $17,000 (USD) to replace a teacher in Chicago (Barnes et al., 2007). At the national level, this monetary figure adds up to $2.2 billion dollars (USD) annually (The Alliance for Excellent Education, 2014). Given the financial and human costs of teacher attrition, understanding the factors that influence teachers’ persistence intentions is critical.
Conceptual Framework

Based upon the theoretical framework (career construction theory and Chapman’s model of teacher retention) and literature review outlined in this section, I developed a conceptual model (Figure 4) for this research study. This framework served as a guide in this research study. The conceptual framework for this study consisted of factors associated with what keeps TEE teachers in the classroom and variables attribute to career satisfaction. Additionally, little is known about the relationship between TEE teachers’ personal and professional demographics and teachers’ turnover intentions. This framework provides a foundation for addressing the research questions posed by this study in Chapter 1 of this study.

Figure 4

Conceptual Framework
CHAPTER III

METHODOLOGY

The purpose of this study was to identify the factors that predict Technology and Engineering Education (TEE) teachers’ persistence in teaching and to examine the teaching experiences of TEE teachers in relation to retention. In other words, this study sought to answer the question, “What keeps the Technology and Engineering Education teacher in the classroom?” I used an explanatory sequential mixed-methods approach (Figure 1) to address the stated research questions (QUAN → qual) (Creswell, 2015; Schoonenboom & Johnson, 2017). The basic design intent was to first use quantitative methods, then use qualitative methods to help explain the quantitative results in more depth (Creswell, 2015, p. 123). My primary focus was to use the qualitative phase of this study to address Research Question 6 and to provide context to the ‘why’ behind the quantitative phase. The following procedure outlined by Creswell (2015) was used in pursuit of this study:

1. Collect and analyze quantitative data.
2. Examine the results of the quantitative analysis to determine what results will need further exploration and what questions to ask participants.
3. Conduct qualitative data collection and analysis.
4. Draw inferences about how the qualitative results help explain the quantitative results.

In the quantitative phase, I used survey research methodology to predict factors related to career persistence in TEE. The qualitative phase used one semi-structured
interview per participant to describe the factors of TEE teachers’ intended persistence in teaching. I used both descriptive and correlational methods to address the stated research Questions 1 – 5, and thematic coding for Question 6. Descriptive methods were used to explain the relationships between career persistence and the personal and professional characteristics of TEE teachers. I distributed the survey to a listserv of teachers who are part of the Engineering Technology Education Division (eTED) of the Association of Career and Technical Education (ACTE). Dissemination of the survey was completed using the online platform Qualtrics. The qualitative interviews were conducted with four teachers sampled from the respondents of those who participated in the quantitative phase. I sampled these four teachers for maximum variation on the basis of gender, teacher license type, ACTE region, and years of teaching in accordance with the research questions addressed in this study.

Figure 5

*Explanatory Sequential Mixed Method Design*

Quantitative Research Methodology

Quantitative Sample

The population targeted for this study were all of the TEE teachers who are a part of ACTE’s eTED, N = 1,327. Access to this population is provided through ACTE leadership during the 2021-2022 school year. A written commitment was obtained from the national eTED president offering support in disseminating the survey used in this study to the entirety of the eTED membership (R. Krumsiek, personal communication, January 6, 2021). To best obtain the required elements for the data frame in this study and to conform to the privacy policies set forth by ACTE, I used the sampling strategy as follows:

1. An email with the survey link was sent out to all eTED members through the ACTE’s eTED presidency (Appendix D).
2. A follow-up email was sent in accordance with ACTE’s internal policy regarding research (Appendix E).
3. Nonresponse bias was assessed.
4. Data were analyzed.
5. Quantitative data were used to inform interview questions for the qualitative data collection.
6. Results were then explained and inferences made.

Based on an a-priori power analysis using G-Power, using 0.15 as an estimated effect size (f), 0.05 alpha probability, 0.95 power (1 − β), and three predictors, this study needed n = 119 total respondents for generalizability (Erdfelder et al., 2007). A medium effect size was used for this calculation, assuming the regression model was going to find
a medium effect and was not based on previous research. Furthermore, based on the recommendations of Cohen (2013, p. 616), to ensure stability and sufficient power when testing a regression model, a minimum sample size of 41 + k is recommended, where k is the number of predictors. This is an update from previous literature as Cohen states, “In the past, it was suggested a sample size that is 10 times the number of predictors would yield adequate power, but this is reasonable only when dealing with at least five predictors” (2013, p.616).

The model used in this study used three predictors of interest and one outcome variable of interest, which means a sample size of 44 was needed to have sufficient power within the model. The inclusion criteria for teachers to participate in this study were as follows: the teachers must be 18 years of age, a current member of ACTE’s eTED, interested in participating in this study, and currently teaching at least one TEE course; all others were excluded.

Instrumentation

The survey instrument (Appendix F) consisted of questions developed and adapted to assess the quantitative research questions posed in this study. This study used a survey instrument that utilized items that were researcher derived and adapted from previously validated survey instruments used in studies exploring the following constructs and measures about TEE teachers: 1) personal and professional characteristics, 2) career persistence, 3) sense of belonging, 4) job satisfaction, 5) sense of efficacy, and 6) institutional factors.
Measures

For this study, I used previous studies, existing literature, and published instruments to guide the development of the survey. In some cases where previous surveys did not exist, I crafted items aligned with the research questions in consultation with a committee of experts. This committee was comprised of educational researchers, teacher specialists, education human resource directors, and school administrators. Additionally, two open-ended questions were added to the survey asking teachers about factors that might lead them to leave the profession early. These questions were added based on feedback from the pilot phase as well as to help guide the development of the questionnaire used in the qualitative phase. Table 1 identifies where items from each construct in this survey originated, along with additional information about each measure.

Table 1

Summary of Measures used to Develop the Survey Instrument for This Research

<table>
<thead>
<tr>
<th>Construct</th>
<th>Scale</th>
<th>Number of statements</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal &amp; professional characteristics</td>
<td>Frequency, percent</td>
<td>7</td>
<td>Developed by researcher</td>
</tr>
<tr>
<td>Sense of belonging</td>
<td>6-point Likert</td>
<td>8</td>
<td>Roberts et al., (1995)</td>
</tr>
<tr>
<td>Sense of efficacy</td>
<td>6-point Likert</td>
<td>12</td>
<td>Tschannen-Moran &amp; Hoy, (2001)</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>6-point Likert</td>
<td>5</td>
<td>Judge, et al., 1998</td>
</tr>
<tr>
<td>Institutional factors</td>
<td>Frequency, percent,</td>
<td>17</td>
<td>Developed by researcher</td>
</tr>
<tr>
<td>Persistence intentions</td>
<td>6-point Likert</td>
<td>6</td>
<td>Derived from Sorensen (2015)</td>
</tr>
</tbody>
</table>

*Note: All Likert scaled questions used a 6-point scale to eliminate neutral responses*
Teacher Personal and Professional Characteristics

The survey instrument developed for this study consisted of personal and professional demographic items. The personal demographic items in this survey pertained to gender (male and female), state in which the teacher teaches, and teacher salary ($30,000 – $45,000, $45,000 – $60,000, $60,000 – $75,000, $75,000 – $90,000, and up). Professional demographic items in this survey pertained to teaching career length disaggregated between TEE teaching duration and total time in the profession, teaching license type (licensure via alternative means, licensure via traditional teacher education means, licensure via emergency authorization, and other), and school classification (middle school and high school). These measures were developed by the researcher. Teacher career length was a continuous variable, while gender, licensing type, school classification, and state were categorical variables.

Persistence Intentions

I assessed teachers’ persistence intentions using measures derived from Sorensen (2015) and written by the researcher in consultation with a committee of experts. For the purposes of this study, six statements regarding teachers’ intentions to remain or leave the profession were crafted. These survey items were represented on a six-point Likert scale ranging from “Strongly agree” to “Strongly disagree” with the neutral option being omitted. Sample items include the following: I plan to remain a TEE teacher until I retire, and I plan to leave the teaching profession sometime before I am eligible to retire.
Sense of Belonging

I assessed teacher sense of belonging using measures adapted from the “Sense of Belonging to School” scale developed by Roberts et al. (1995). The original survey consisted of 13 items with an internal consistency of $\alpha = 0.89$. Questions in this construct pertained to cooperative effort, decision-making involvement, faculty structure, social environment, amongst others. These survey items were represented on a six-point Likert scale ranging from “Strongly agree” to “Strongly disagree” with the neutral option omitted. Of the 13 original items, 6 were selected from the original instrument for use in this study through a systematic review from the researcher and input from a committee of experts. Sample items include the following: In my school, there is a great deal of cooperative effort among staff members, and in my school, teachers, including myself, take a major role in shaping the school's norms, values, and practices.

Job Satisfaction

I assessed teachers’ career satisfaction using measures adapted from the Job Satisfaction Survey published by Judge et al. (1998). Judge (1998) found the reliability of this five-point scale was $\alpha = 0.88$. The original questionnaire contained five items, two of which were reverse coded, on a seven-point scale ranging from “Strongly disagree” to “Strongly agree.” For the purposes of this study, all five items were selected and represented on a six-point scale with the neutral option omitted. Sample items include the following: I feel satisfied with my present job, and I consider my job rather unpleasant.
**Sense of Efficacy**

I developed the scale used to measure teacher sense of efficacy using established sense of efficacy instruments. Specifically, the Teacher’s Sense of Efficacy Scale (TSES) short form containing 12 items was adapted and used (Tschannen-Moran & Hoy, 2001). This scale separates sense of efficacy into three subconstructs: instruction, with a reliability of $\alpha = 0.91$; management, with a reliability of $\alpha = 0.90$ and engagement, with a reliability of $\alpha = 0.87$. Each construct contains four items. All efficacy variables were measured on a six-point scale ranging from “Strongly disagree” to “Strongly agree” with the neutral option omitted.

Not all of the items in the original instrument were used in this study. Some of the items were replaced with questions pertaining to a teacher’s technical knowledge in an attempt to align with challenges that CTE teachers may be facing. These items ask respondents about their comfort and familiarity with delivering technical education, amongst other things. For the purposes of the data analysis, this study aggregated all three of the subconstructs of teacher sense of efficacy as defined by Tschannen-Moran & Hoy (2001) into one measure of overall teacher sense of efficacy. Sample items include the following: I can motivate students who show low interest in school work, and I know the content well enough to teach it effectively to my students.

**Institutional Factors**

The survey instrument developed for this study asked respondents to “select all that apply” regarding the following programs intended at keeping TEE teachers in the profession: competitive pay, district content area-specific professional development,
leadership development opportunities, new teacher induction programs, professional association professional development, state professional development programs, and teacher mentor program. The survey used by this study used flow-through logic that would flow the programs selected by respondents into statements that allowed respondents to select how much the programs influenced the respondents' decision to remain as a TEE teacher with Likert-scale options from ‘not at all’ to ‘a great deal’ on a five-point Likert scale.

Additional items concerning facilities administration, building administration, community support, financial support, district administrative support, licensing issues, high stakes testing, and additional education requirements were included. Teachers were asked to identify to what extent each of the above-stated factors influenced their decisions to remain in the profession on a six-point scale ranging from “Strongly Disagree” to “Strongly Agree” with the neutral option omitted. These factors were based on themes in contemporary research, informal interviews with teachers, teacher specialists, and district administrators.

Pilot, Validity, and Reliability

I piloted the survey used in this study with 25 teachers who teach in the area of TEE in the state of Utah before sending it to the research sample at large. The 25 teachers came from my ACTE contacts throughout the state of Utah. Teachers who participated in the pilot study were instructed to ignore the survey link was sent via ACTE during the implementation of the national sample.
Since the survey instrument was administered only once, I used Cronbach’s alpha coefficients to calculate the reliability estimates for both the pilot study and post hoc (See Table 3). An alpha of .65–.80 is often considered “adequate” for a scale used in human dimensions research (Taber, 2018). The reliability constructs from the pilot study had scores ranging from .66 for the construct of persistence intentions to .88 for the construct of teacher efficacy. Though all constructs were within the ‘adequate’ range, I modified some of the elements in the construct of persistence intentions in an effort to increase reliability. This was done by bolding text in negatively coded items and rearranging items in a way to be less confusing to the reader. Content experts were also consulted during the survey’s adaptation to address and control for content and face validity (Creswell & Poth, 2018).

### Table 2

*Construct Reliability Estimates of the Survey Instrument*

<table>
<thead>
<tr>
<th>Instrument construct</th>
<th>Pilot study</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cronbach’s α</td>
<td>n</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>.71</td>
<td>25</td>
</tr>
<tr>
<td>Persistence intentions</td>
<td>.66</td>
<td>25</td>
</tr>
<tr>
<td>Sense of belonging</td>
<td>.86</td>
<td>25</td>
</tr>
<tr>
<td>Teacher sense of efficacy</td>
<td>.88</td>
<td>24</td>
</tr>
</tbody>
</table>

As a result of the pilot, I added two questions that were open-ended in nature, inquiring about factors that may be pushing a teacher out of the profession. These open-ended questions were then used to develop the qualitative questionnaire discussed later. Additionally, the pilot study showed that there was not enough granularity on the top end of the question regarding teacher salary. A change was made, adding another selection at
the top end of the salary choices. The results of a post-hoc analysis yield results of Cronbach’s $\alpha$ between .87 and .94, which indicated that all of the construct reliabilities were robust (Taber, 2018).

Quantitative Data Collection.

Table 3 details each construct and variable type and its corresponding research questions and statistical measure. I disseminated the survey instrument used in this study to all TEE teachers in ACTE’s eTED via ACTE’s official communication channel (Appendix D). A singular survey reminder in accordance with ACTE policy was used to bolster the response rate, which was sent two weeks later and after responses from the original email tapered off. The follow-up email was sent via the same official communication channels as the original. Because the survey link was anonymous, there was no way to determine who took the survey. The follow-up email consisted of a statement thanking those who took the survey and requesting they disregard the message and reminding those who had not taken it to take it (Appendix E).

Response Rate

The total response rate for this study was 10.97% ($n = 121$). Of the responses, 16.53% ($n = 20$) were excluded as the respondents did not meet the inclusion criteria of the study. This means the viable response rate after removing those who did not meet the inclusion criteria was 7.61% ($n = 101$). While this number may seem low, the respondents who were removed from the analysis were removed as they were not current TEE teachers. Upon further investigation, a number of those in the eTED were current teacher
specialists or administrators and thus not eligible to be included in the study. The specific details for how many members of eTED are practicing teachers versus administrators or teacher specialists were not available to me, so the exact response rate was not possible to calculate. Due to some missing data points, the responses range from 81 respondents to 89 respondents for the analyses.

**Table 3**

*Statistical Measurements by Construct and Variable Type*

<table>
<thead>
<tr>
<th>QUAN research question</th>
<th>Construct/variable</th>
<th>Variable type</th>
<th>Statistical measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Demographics, professional - Years of Experience</td>
<td>Continuous</td>
<td>Mean, range, median, SD</td>
</tr>
<tr>
<td>1</td>
<td>Demographics, professional - State teaching in</td>
<td>Categorical</td>
<td>Frequency, percent</td>
</tr>
<tr>
<td>1</td>
<td>Demographics, professional - Teaching Credential</td>
<td>Categorical</td>
<td>Frequency, percent</td>
</tr>
<tr>
<td>1</td>
<td>Demographics, professional - Teaching preparation type</td>
<td>Categorical</td>
<td>Frequency, percent</td>
</tr>
<tr>
<td>1</td>
<td>Demographics, personal – gender</td>
<td>Dichotomous</td>
<td>Frequency, percent</td>
</tr>
<tr>
<td>2</td>
<td>Sense of belonging</td>
<td>Continuous 1-6 Scale</td>
<td>Mean, SD</td>
</tr>
<tr>
<td>3</td>
<td>Teaching Sense of Efficacy</td>
<td>Continuous 1-6 Scale</td>
<td>Mean, SD</td>
</tr>
<tr>
<td>4</td>
<td>Career Satisfaction of TEE teachers</td>
<td>Continuous 1-6 Scale</td>
<td>Mean, SD</td>
</tr>
<tr>
<td>5</td>
<td>Institutional supports</td>
<td>Categorical</td>
<td>Frequency, Percent</td>
</tr>
</tbody>
</table>
Quantitative Data Analysis

The data I collected through Qualtrics was downloaded as Comma Separated Values (CSV), then imported into the statistical analysis program, R. The data were cleaned, wrangled, and transformed in a systematic way to allow for analysis according to the research questions in this study (e.g., wide vs. long form, omit missing where applicable). I tested data to verify conformity to regression and parametric statistical assumptions. These tests included testing for outliers and normality, linearity, homoscedasticity of variance, and independence. Furthermore, a post-hoc power analysis was conducted using G-Power to verify sufficient power existed using achieved effect size \[ F^2 = \frac{r^2}{1-r^2} \text{ where } r^2 \text{ is the adjusted } r^2 \], achieved sample size, α level, and the number of predictors to make statistical claims.

Table 3 contains a list of variables measured by this study and how they correspond with each research question, survey items, and measures. Data analysis was comprised of computing descriptive statistics and regression analysis for the survey data collected. Specifically, descriptive statistics, consisting of frequency (count), standard deviation, and means (for the dependent variable of persistence intentions) were analyzed regarding demographic characteristics (Q1) and institutional factors (Q5). Ordinary Least Squares (OLS) regression analyses were conducted regarding the relationships between persistence intentions and sense of belonging (Q2), persistence intentions and sense of efficacy (Q3), persistence intentions and job satisfaction (Q54). I tested the assumptions of linear regression, including linearity of residuals, independence of residuals, normality of residuals, collinearity, and equal variance of residuals. In addition to the assumptions of regression, I verified there were enough respondents in each category to run a stable
regression with enough power. To assess the relationship between the predictors and outcome variable of interest, I ran a multiple regression using persistence intentions as the outcome of interest, sense of belonging, sense of efficacy, and job satisfaction as predictor variables. All R code and output used in this dissertation are included in Appendix I.

**Checking for Non-Response Bias**

Several methods can be used to control for nonresponse bias. One such method is to contact and follow-up with non-responders (Rogelberg & Stanton, 2007). In an effort to control and adjust for nonresponse bias, I identified teachers who teach in the area of TEE who were non-responders in this study through internet searches and ACTE contacts. These contacts were contacted via email and phone call, and I verified these contacts were members of ACTE and non-responders to the survey. These non-responders were then asked via email to complete a condensed version of the survey focusing on all items in the constructs of persistence intentions, sense of belonging, sense of efficacy, and job satisfaction and the professional demographic variable of license type via Qualtrics. In addition to these identified non-responders, three late responders to the quantitative survey who responded several weeks after the dataset was exported from Qualtrics were aggregated into the non-response group.

I calculated means scores from each construct of interest; then non-responders were compared to those of responders in this study using a two-sample Wilcoxon Rank Test (Colombo, 2000; Rogelberg & Stanton, 2007). A total of \( n=19 \) teachers were used for assessing nonresponse bias in this study. It is important to note that in an effort to
gather a representative non-response sample, teachers from multiple states were sampled. Non-parametric tests were required to assess non-response bias as a result of the non-responders and responders’ data failing to meet the required statistical assumptions for parametric tests. Responses were tested using the constructs in the survey instrument (i.e., sense of belonging, sense of efficacy, job satisfaction, and persistence intentions) in a two-sample Wilcoxon Rank Test to compare responders and non-responders to determine the presence of nonresponse bias. Because multiple variables were being compared, I used the Bonferroni correction to account for Type I error inflation (Cohen, 2013). A total of four variables were measured. At the adjusted alpha level, I found no constructs in the pilot survey to be significant, thus leading to the conclusion that non-response bias was not present in the data.

**Statistical Assumptions**

Prior to analysis, I tested statistical assumptions in the data for parametric, non-parametric, and regression tests to ensure the data were not biased and met the necessary statistical assumptions. Further assumptions were tested including multicollinearity, homoscedasticity, heteroscedasticity, and skewness.

Regarding the non-response bias test, data were tested for normality using the Shapiro-Wilk normality test and equal variances. The data violated the assumption of normality. Due to this assumption violation, I used a two-sample Wilcoxon rank test to compare the responders’ and non-responders’ groups.

Regarding the assumptions of regression, tolerance, variation inflation factors, condition values, and Eigenvalues were calculated, and residuals were plotted. No issues
of concern were present in any of the assumptions with the regression model used in this study. Output of the analysis is available in Appendix I.

**Qualitative Methods**

Creswell and Poth (2018) described five qualitative study approaches, narrative research, phenomenology, grounded theory, ethnography, and case study. Each of these approaches individually has value in qualitative research and, in some cases, can be combined. In this study, I used a case study approach to collect and examine data relating to teacher retention in the area of TEE. According to Yin, case studies can be used to explain, describe, or explore events and phenomena in everyday contexts where they occur (Crowe et al., 2011; Yin, 2017). According to Creswell and Poth (2018), a case study must be bounded, “meaning it can be defined or described within certain parameters” (p. 97). In this study, participants in the qualitative phase were bounded by the following parameters: participants must have participated in the quantitative data collection phase and indicated an interest in participating in a follow-up interview, and participants must have met all other inclusion criteria outlined in the quantitative phase.

Though this study used an explanatory sequential mixed-methods approach, the qualitative phase of this study was smaller in scope than the quantitative phase. The qualitative data collection was used to address Research Question 6 and to help provide context regarding the interpretation of the quantitative findings.
Qualitative Sample

According to Creswell (2015), “if the intent of the design is for the qualitative data to explain the quantitative results, the individuals in the qualitative sample need to be drawn from the pool of participants in the quantitative sample” (p. 78). This study used teachers who participated in the quantitative data collection phase for the collection of qualitative data to support the explanatory mixed-methods design. At the conclusion of the quantitative survey instrument, an additional survey was available to participants to indicate their willingness to participate in a qualitative follow-up (Appendix G). The link to the second survey was included in the ending statement of the quantitative questionnaire. Respondents had to click on the link to the additional survey, as opposed to being automatically being directed to the recruitment questionnaire.

I identified a diverse group of four TEE teachers for participation in the qualitative data collection. Teachers in the qualitative sample were recruited at the conclusion of the quantitative data collection through the use of a question asking them to click on a link if they were willing to participate in a follow-up interview. These teachers were purposefully sampled for maximum variation based on licensing type, biological sex, years of experience, and ACTE region.

Quantitative Data Collection and Interview Development

The qualitative research questions posed in this study sought to address the essence of TEE teachers’ role in the education system and how various factors contribute to their persistence in teaching. In this study, I used one semi-structured interview per qualitative participant as the primary data source. These interviews were one-on-one,
took place via the online meeting software Zoom, and were recorded. I rehearsed the interviewing protocol before beginning the study and before each interview.

After the quantitative data collection took place, I transitioned into the qualitative phase of this study. The interview questions used in the semi-structured interviews (Appendix H) were developed based on the literature surrounding the proposed research questions along with the results of the quantitative data collection. Additionally, statistical findings (i.e., significant and insignificant predictors and descriptive findings) and two open-ended questions used in the quantitative survey instrument helped guide the development of the interview questions. Using the statistical software NVivo, I conducted a thematic analysis on the open-ended responses \((n=100)\) through systematic coding. This resulted in five emergent themes: administration, career demands, opportunity, salary, and support (Table 4). The developed interview questions were further vetted and validated through consultation with a committee of experts comprised of educational researchers, teacher specialists, human resource directors, and practicing teachers.

**Table 4**

*Thematic Analysis of Open-Ended Questions from the Quantitative Questionnaire*

<table>
<thead>
<tr>
<th>Themes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career demands</td>
<td>70</td>
</tr>
<tr>
<td>Opportunity</td>
<td>49</td>
</tr>
<tr>
<td>Salary</td>
<td>43</td>
</tr>
<tr>
<td>Support</td>
<td>36</td>
</tr>
<tr>
<td>Administration</td>
<td>26</td>
</tr>
</tbody>
</table>

*Note: \(n = 100\)*
Qualitative Data Analysis

Yin, Merriam, and Stake are three seminal authors who are commonly cited regarding case study procedures (Creswell et al., 2007). Yin’s epistemological commitments fell in line with positivism and defined a case study as a good approach when “how or why questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context” (Yin, 2003, p. 1). According to Yin (1994), case studies have well-defined steps that can be used as a methodological roadmap to case study design. Additionally, Yin stated that for case study design, five components are especially important: “the study’s question, its propositions (if any), its unit(s) of analysis the logic linking the data to the propositions; and the criteria to interpret the findings” (Yin, 2003, p. 27).

Concerning validity and reliability, Yin emphasized researchers need to guarantee construct validity through the triangulation of multiple sources of evidence, chains of evidence, and member checking; internal validity through the use of established analytic techniques such as pattern matching; external validity through analytic generalization; and reliability through case study protocols and databases (Yazan, 2015; Yin, 2003).

The primary qualitative data sources in this study were recorded semi-structured interviews. This interview data was analyzed, transcribed, and coded using NVivo. During the coding process, I removed statements that were irrelevant, overlapping, or repetitious. The remaining statements were then clustered into meaningful themes. The transcripts were then reanalyzed as needed using member-checking.

The central focus of the qualitative data analysis was a content analysis, focusing on data categorization, tagging, and thematic analysis. The process proposed by this
study followed the procedures suggested by Creswell and Poth (2018). This process involved the “data analysis spiral” where I, as the researcher, worked through the following processes: 1) managing and organizing the data, 2) reading and memoing emergent ideas, 3) describing and classifying codes into themes, 4) developing and assessing interpretations, and 5) representing and visualizing the data.

**Qualitative Validity, Credibility, and Trustworthiness.**

In qualitative research, establishing trustworthiness and credibility is imperative. To be accepted as trustworthy, qualitative research must demonstrate data analysis was conducted in a precise, exhaustive, and consistent manner through recording, systematizing, and disclosing the methods of analysis with enough detail to enable the reader to determine whether the process was credible (Nowell et al., 2017). Case study construct validity can be maintained through the triangulation of multiple sources of evidence and member checking; internal validity can be maintained through the use of established analytic techniques such as pattern matching; external validity can be maintained through analytic generalization; and reliability can be maintained through case study protocols and databases (Yazan, 2015).

To establish trustworthiness in this study, I utilized thick description, member checks, and triangulation of data sources to collect and analyze data (Lietz et al., 2006). Creswell and Poth (2018) state the use of member checks asks participants to reflect on the accuracy of an account and to allow participants the opportunity to add what may be missing from a preliminary assessment of the qualitative data. I conducted member checks by sending video transcripts to participants to allow them to assess the accuracy of
transcription and add to their responses. Additionally, triangulation of the data sources used in this study was done by cross-checking interview data and quantitative data results.

Regarding the coding and thematic analysis of the qualitative data, I followed the guidelines of O’Connor & Joffe (2020) and used a minimum of two independent coders to maintain trustworthiness and to avoid preconceived notions of researcher bias. Additionally, the second researcher was used to assess intercoder reliability. Because the qualitative phase of this study was small with four semi-structured interviews each lasting between 10 and 15 minutes, all of the qualitative data were double coded. Once each of the two researchers identified codes, their codes were compared, and an intercoder reliability score was calculated by computing a percentage of agreement between codes. Initially, a reliability score of less than 75% was found. After considering inconsistencies and revising the coding frame, codes were rechecked, and reliability was recalculated. This new intercoder reliability had a reliability score of 100%, meaning the other researcher and I agreed unanimously on the coding scheme and themes from the qualitative data.

The validation process proposed in this study was aligned with Creswell and Poth (2018), where the accuracy of the findings is best described by the researcher and research participants. This process of assessing accuracy involves extensive field time and thick descriptions, which allows readers to make decisions regarding transferability through the rich detail (Creswell & Poth, 2018). Data were analyzed by looking for systemic factors that influence research results rather than focusing exclusively on
individual characteristics. When reported on, data excerpts and researcher interpretations were distinguished.

**Positionality Statement**

Holmes (2020) said, “it is essential for new researchers to acknowledge that their positionality is unique to them and that it can impact all aspects and stages of the research process” (p. 2). Additionally, a positionality statement “captures how the researcher is positioned, personally, socially, and politically, in relation to the study’s context” (Hampton et al., 2021, p. 126). Because the positioning of the researcher is a critical ontological component of studying social phenomena, not addressing how one’s position influences research can become a threat to the result’s credibility (Hampton et al., 2021). As such, the following is my positionality statement regarding my personal and professional background.

I am a Caucasian male of Hispanic and Latino descent who has spent the last seven years in the field of education. I grew up in a suburban neighborhood on the west side of Salt Lake City in a small family with one older brother. I attended public school from grades K-5 and 8-10 and charter schools from grades 6-7 and 11-12. I am a first-generation college attendee and graduate. Both of my parents worked blue-collar careers. Education was heavily emphasized as I was growing up. Attending a university after high school was an expectation, and I was expected to pay my own way. As such, I obtained my first job at age 14 for a local school district doing custodial work and started saving for college.
Immediately after high school graduation, I enrolled in a university 100 miles away from where I grew up. I transitioned to an undergraduate major of TEE after realizing my love for working with my hands and teaching. Upon graduating with my undergraduate degree, I took a position in an inner-city school district where I worked primarily with students of poverty at the junior-high level, teaching manufacturing, robotics, and engineering. During my time with the school district, I was able to participate in a program where I worked for a large defense contractor for several months on high-end and large-scale projects. Shortly thereafter, I took a graduate teaching assistantship with a university where I pursued a master’s degree and a Ph.D. in TEE. During this time, I taught university classes while working through my coursework. I also was immersed in projects that required significant grant writing and collaboration with CTE teachers around the region.

In the middle of my doctoral program, COVID-19 struck the world. This resulted in a change of direction where I took a position as a CTE district specialist for the same inner-city school district where I started my career. At this time, I took a short leave of absence from my graduate work to focus on my new position. In this position, I worked primarily with industry partners in establishing connections between CTE pathways and industry internships for upperclassmen. Because of the nature of the small school district, I also worked as the support for all CTE teachers between school level and district level initiatives. This support included aiding first-year CTE teachers who typically came from industry and were teaching through some alternative licensing pathway. This position was short-lived, as the opportunity to move to a university faculty position came to me a year after taking the district specialist position.
I have spent my career in education, specifically dealing with CTE programs both at the secondary and post-secondary levels. Furthermore, I am a graduate of one of the few remaining university TEE programs that has been on the decline for the last 20 years. Through my teaching and my work as a district specialist, I have been directly affected by the teacher shortage impacting CTE. The district I worked in suffered from immense teacher turnover and struggled with recruiting qualified teachers. The majority of teachers we hired came from alternative pathways and had no formal education training.

During my experience as a teacher specialist, I had to work “double duty” working as both a teacher specialist and as a classroom teacher due to a lack of personnel. During this time, I worked as a classroom teacher part-time as the primary instructor, prepared substitute plans for a long-term substitute who was covering a partial contract and fulfilled my duties as a CTE area specialist. Additionally, I have seen the effects of teacher turnover within my own graduating class from a teacher preparation program. Many of the classmates that I graduated with left the profession shortly after university graduation. Many of these classmates took positions for higher pay in industry or left the profession due to burnout.

These experiences impact this study design in data collection, analysis, and the interpretation of findings because they formed my ontological and epistemological beliefs. My experiences created my view of the world and situated my philosophy of education. My prior experiences in the profession and as a student, along with my knowledge, play foundational roles in how I interpret qualitative data. While bias may exist in this study, I will use thick descriptions when describing qualitative findings, member checks to ensure accuracy of transcriptions and interpretations, and data
triangulation. Additionally, another researcher member-checked the codes to maintain trustworthiness and avoid preconceived notions of researcher bias.
CHAPTER IV

RESULTS

The purpose of this study was to identify the factors that predict Technology and Engineering Education (TEE) teachers’ persistence in teaching and to examine the teaching experiences of TEE teachers in relation to teacher retention. Specifically, this study sought to answer the question, “What keeps the TEE teacher in the classroom?” This study was guided by the following research questions and sub-questions:

1. How do personal and professional characteristics impact TEE teachers’ intended persistence in teaching?

2. How does sense of belonging impact TEE teachers’ intended persistence in teaching?

3. How does sense of efficacy impact TEE teachers’ intended persistence in teaching?

4. How does job satisfaction impact TEE teachers’ intended persistence in teaching?

5. What institutional-related programs exist for TEE teachers’ intended persistence?

6. How do TEE teachers characterize their teaching experience and intended persistence?

   ▪ How do institutional-related factors and personal factors (e.g., family dynamics, professional experience) influence TEE teachers’ career experience and career persistence intentions?
How do teachers talk about career commitment?

The population targeted for this study were all of the TEE teachers who were a part of the Engineering Technology Education Division (eTED) of the Association of Career and Technical Education (ACTE), $N = 1,327$. Results in this study are separated into two sections, quantitative and qualitative. The quantitative section examines the results from Research Questions 1 – 5, while the qualitative section examines Research Question 6.

**Quantitative Results**

**Research Question 1**

This research question sought to address the following: How do personal and professional characteristics impact TEE teachers’ intended persistence in teaching? Characteristics described in this research included teachers’ career status (e.g., early career, middle career, and end career), gender, school served (e.g., middle school and high school), type of teaching license earned, teacher salary, and ACTE region.

The teachers who participated in this research represented experience levels in teaching TEE from first-year teachers to those having 50 years of teaching experience, with the mean of years teaching being 12. I grouped teachers into three categories concerning career status, early-career, middle-career, and end-career. Early-career teachers were categorized as those who have been in the profession less than five years, middle-career teachers were categorized as those who have been in the profession between five and 19 years, and end-career teachers have been in the profession 20 or more years. The majority of the respondents (50%) were mid-le career status with the
fewest being end-career (19%). Teachers with the highest mean score for persistence intentions were end-career teachers with a mean of 4.6 ($SD = 0.9$), while the lowest were middle-career teachers with a mean of 3.7 ($SD = 1.5$). Frequency of career status and descriptive statistics of career status by persistence intentions are in Table 5.

### Table 5

*Distribution of Respondents Career Status by Persistence Intentions*

<table>
<thead>
<tr>
<th>Career status</th>
<th>f</th>
<th>%</th>
<th>Persistence intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Early</td>
<td>25</td>
<td>30.49</td>
<td>3.8</td>
</tr>
<tr>
<td>Middle</td>
<td>41</td>
<td>50.00</td>
<td>3.7</td>
</tr>
<tr>
<td>End</td>
<td>16</td>
<td>19.15</td>
<td>4.6</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree

Due to assumption violations dealing with normality and there being more than two groups, I used the non-parametric Kruskal-Wallis test to identify if any significant differences existed among career status in regard to the variable of persistence intention. This calculation yielded insignificant results ($p = .12$), meaning there was no significant difference among the means of persistence intentions of teachers in different career status groups. Additionally, years in teaching was left as a continuous variable and tested using the non-parametric Mann-Whitney test due to violations of normality. This test again yielded insignificant differences ($p = .29$) among years of teaching and persistence intentions, meaning persistence intentions were not significantly different based on the number of years teaching in TEE.
The sample of TEE teachers also represented all five ACTE regions with the majority of respondents being in Region V (32%) and the minority of respondents (6%) coming from region III. Teachers with the highest mean score for persistence intentions resided in Region III with a mean of 4.6 ($SD = 1.5$), while the lowest resided in Region V with a mean of 3.7 ($SD = 1.5$). Frequency of respondents’ region and descriptive statistics of respondents’ region by persistence intentions are in Table 6.

**Table 6**

*Distribution of Respondents ACTE Region by Persistence Intentions*

<table>
<thead>
<tr>
<th>ACTE region</th>
<th>$f$</th>
<th>%</th>
<th>Persistence intentions</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region I</td>
<td>6</td>
<td>7.14</td>
<td>4.2</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Region II</td>
<td>26</td>
<td>30.95</td>
<td>4.1</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Region III</td>
<td>5</td>
<td>5.95</td>
<td>4.6</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Region IV</td>
<td>20</td>
<td>23.81</td>
<td>3.9</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Region V</td>
<td>27</td>
<td>32.14</td>
<td>3.7</td>
<td>1.5</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree

Due to assumption violations dealing with normality and there being more than two groups, I used the Kruskal-Wallis test to identify if any significant differences existed among ACTE regions in regard to the variable of persistence intention. This calculation yielded insignificant differences ($p = .63$), meaning there were no significant differences in the means of persistence intentions in teachers who live in different ACTE regions of the United States.
Both males and females participated in this study, though more males than females were respondents. Of those who answered 55% \((n = 46)\) identified as male and 45% \((n = 38)\) identified as female, while 17 respondents did not answer. Teachers with the highest mean score for persistence intentions were male with a mean of 4.0 \((SD = 1.4)\), while the lowest were female with a mean of 3.8 \((SD = 1.5)\). Frequency of gender and descriptive statistics of gender by persistence intentions are in Table 7.

**Table 7**

*Distribution of Respondent’s Gender*

<table>
<thead>
<tr>
<th>Gender</th>
<th>(f)</th>
<th>%</th>
<th>Persistence intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(M)</td>
</tr>
<tr>
<td>Male</td>
<td>46</td>
<td>54.76</td>
<td>4.0</td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>45.24</td>
<td>3.8</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree

Due to violations regarding the assumptions of the \(t\)-test and the existence of only two groups in this demographic variable, I used the Mann-Whitney test to assess if significant mean score differences were present between genders regarding persistence intentions. This test yielded insignificant results \((p = .47)\), meaning gender mean scores for persistence intentions were not significantly different from one another.

Respondents represented teachers from both middle school and high school settings with the majority of respondents teaching at the high school (89%). Teachers with the highest mean score for persistence intentions were high school teachers with a
mean of 4.0 ($SD = 1.4$), while the lowest were middle school teachers with a mean of 3.9 ($SD = 1.4$). Frequency of school level and descriptive statistics of school level by persistence intentions are in Table 8.

**Table 8**

*Distribution of High school and Junior High / Middle School Teachers*

<table>
<thead>
<tr>
<th>School level</th>
<th>$f$</th>
<th>%</th>
<th>Persistence intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school</td>
<td>75</td>
<td>89.29</td>
<td>4.0 1.4</td>
</tr>
<tr>
<td>Junior high / middle school</td>
<td>9</td>
<td>10.71</td>
<td>3.9 1.4</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree

Due to violations regarding the assumptions of the $t$-test and the existence of only two groups in this demographic variable, a Mann-Whitney test was conducted to see if there were significant mean score differences between teachers who taught at the high school and middle school level regarding persistence intentions. This test yielded insignificant results ($p = .91$), meaning the mean scores for persistence intentions did not significantly differ between levels taught.

Teachers who responded to this study had earned licensure in methods from emergency authorization to traditional licensure from a teacher education program with the majority of respondents earning their license at the time of graduation from a traditional teacher education program (40%) with the fewest teachers earning their license through emergency authorizations (11%). Teachers with the highest mean score
for persistence intentions were licensed via alternative means with a mean of 4.2 ($SD = 1.3$), while the lowest were licensed through a traditional teacher education program with a mean of 3.6 ($SD = 1.4$). Frequency of teacher licensure and descriptive statistics of teacher licensure by persistence intentions are in Table 9.

**Table 9**

*Distribution of Respondents Licensure Type*

<table>
<thead>
<tr>
<th>Teacher license</th>
<th>$f$</th>
<th>%</th>
<th>Persistence intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>State issued at the time of graduation from a teacher preparation program</td>
<td>34</td>
<td>40.48</td>
<td>3.6</td>
</tr>
<tr>
<td>State issued at the time of completion of an alternative licensing program</td>
<td>30</td>
<td>35.71</td>
<td>4.2</td>
</tr>
<tr>
<td>Emergency authorization for while licensing requirements are met</td>
<td>9</td>
<td>10.71</td>
<td>4.1</td>
</tr>
<tr>
<td>Other:</td>
<td>11</td>
<td>13.10</td>
<td>4.1</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree

Due to assumption violations dealing with normality and the existence of more than two levels with this demographic variable, I conducted a Kruskal-Wallis test to identify if any significant differences existed among teacher license types in regard to the variable of persistence intention. This calculation yielded insignificant results ($p = .31$), meaning there were no significant differences in the means of persistence intentions of teachers who earned licensure through different methods.
Teachers from a range of salaries responded to the survey with the majority of respondents earning between $60,000 and $75,000 annually (44%) and the minority of respondents earning $30,000 - $45,000 (8%). Teachers with the highest mean score for persistence intentions were those earning between $30,000 - $45,000 with a mean of 4.1 ($D = 1.8$), while the lowest mean score were those earning $90,000 and up with a mean of 3.8 ($SD = 1.9$). Frequency of salary and descriptive statistics of salary by persistence intentions are in Table 10.

**Table 10**

*Distribution of Respondents Salary*

<table>
<thead>
<tr>
<th>Teacher Salary</th>
<th>$f$</th>
<th>%</th>
<th>Persistence Intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30,000 - $45,000</td>
<td>7</td>
<td>8.33</td>
<td>4.1</td>
</tr>
<tr>
<td>$45,000 - $60,000</td>
<td>37</td>
<td>44.05</td>
<td>3.9</td>
</tr>
<tr>
<td>$60,000 - $75,000</td>
<td>22</td>
<td>26.19</td>
<td>3.9</td>
</tr>
<tr>
<td>$75,000 - $90,000</td>
<td>9</td>
<td>10.71</td>
<td>4.0</td>
</tr>
<tr>
<td>$90,000 and up</td>
<td>9</td>
<td>10.71</td>
<td>3.8</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree

Due to assumption violations dealing with normality and the existence of more than two levels with this demographic variable, I conducted a Kruskal-Wallis test to identify if any significant differences existed among teacher salary range in regard to the variable of persistence intention. This calculation yielded insignificant results ($p = .99$), meaning there were no significant differences in the means of persistence intentions of teachers in different salary ranges.
Research Question 2, 3 and 4

Research Questions 2, 3, and 4 addressed the following research questions: 1) How does sense of belonging impact TEE teachers’ intended persistence in teaching? 2) How does sense of efficacy impact TEE teachers’ intended persistence in teaching? 3) How does job satisfaction impact TEE teachers’ intended persistence in teaching? These constructs were all measured using a six-point Likert-type scale (from 1 = strongly disagree to 6 = strongly agree and the neutral option being omitted). These constructs, while each comprised of multiple items, were converted to mean scores that were used as predictors. Tables 11, 12, and 12 show descriptive statistics for each of the predictors of interest by demographic grouping variable.

Table 11 shows end-career teachers have the highest job satisfaction with a mean of 4.3 (SD = 0.7) while early- and mid-career teachers are tied with a mean of 3.6 (SD = 0.8 for early-career and SD = 1.1 for mid-career). Additionally, job satisfaction varied some by ACTE region with Region III having the highest mean score of job satisfaction with a mean of 4.4 (SD = 0.7) while Region V had the lowest with a mean of 3.4 (SD = 1.2). Job satisfaction varied little between genders with females having a higher job satisfaction mean score of 3.9 (SD = 1.0) and males having a mean of 3.5 (SD = 0.9). School level differed with high school teachers having a lower job satisfaction with a mean score of 3.7 (SD = 1.0) and middle school teachers with a mean score of 4.3 (SD = 1.0) though only nine middle school teachers responded to this survey. Additionally, this study found teachers who were licensed under the “other” category had the lowest job satisfaction with a mean score of 3.5 (SD = 1.0), while teachers who were licensed from teacher education programs and alternative licensing programs were tied with a mean
score of 3.8 ($SD = 1.1$) for graduates of a teacher education program and $SD = 0.8$ for graduates of an alternative licensing program). Lastly, this study found teachers earning between $75,000 - 90,000 were the most satisfied in their job with a mean score of 4.1 ($SD = 0.9$), while teachers who earned between $30,000 - 45,000$ were the least satisfied with a mean score of 3.4 ($SD = 1.3$).

Table 12 shows the descriptive statistics for teacher sense of efficacy by demographic grouping variables. This table indicates across nearly all of the grouping variables teachers have a high degree of sense of efficacy with a mean score over 5. The exception to this is in regard to teacher license type, where those who are licensed under the category of emergency authorization have a mean score of 4.8.

Parsing the data by individual grouping variables, Table 13 shows end-career teachers have the highest teacher sense of efficacy with a mean of 5.3 ($SD = 0.4$) while early-career teachers had the lowest sense of efficacy with a mean score of 5.1 ($SD = 0.4$). Teacher sense of efficacy varied little by ACTE region with Region II having the highest mean score with a mean of 5.3 ($SD = 0.5$) while region all over regions tied with a mean score of 5.2 ($SD = 0.5 - 0.6$). Sense of efficacy varied little between genders with females and males having the same mean score of 5.2 ($SD = 0.5$ for females and $SD = 0.6$ for males). School level differed little with high school teachers having a higher teacher sense of efficacy score with a mean score of 5.2 ($SD = 0.5$) and middle school teachers having a mean score of 5.1 ($SD = 0.5$).

Additionally, this study found teachers who were licensed under the “emergency authorization” category had the lowest teacher sense of efficacy with a mean score of 4.8 ($SD = 0.8$). Teachers who were licensed from all other areas had a mean score of 5.3 ($SD$
Lastly, this study found teachers earning between $45,000 - $60,000 had the lowest sense of efficacy with a mean score of 5.0 ($SD = 0.6$) while teachers who earned between $30,000 - $45,000 and those earning between $75,000 - $90,000 had the highest teacher sense of efficacy with a mean score of 5.5 ($SD = 0.3$ for those earning between $30,000 - $45,000 and $SD = 0.5$ for those earning between $75,000 - $90,000).

Table 13 shows the descriptive statistics for teacher sense of belonging by demographic grouping variables. This table shows end-career teachers have the highest sense of belonging with a mean of 4.7 ($SD = 1.0$), while mid-career teachers had the lowest sense of belonging with a mean score of 4.1 ($SD = 1.2$). Teacher sense of belonging varied some by ACTE region with Region III having the highest mean score with a mean of 4.8 ($SD = 0.3$), while Region I and Region V tied with a mean score of 4.2 ($SD = 1.3$ for Region I and $SD = 0.1$ for Region V). Sense of belonging varied little between genders with females having a lower mean score of 4.2 ($SD = 2.1$) and males 4.4 ($SD = 0.31.1$). School level differed little with high school teachers having a lower sense of belonging score with a mean score of 4.3 ($SD = 1.1$) and middle school teachers having a mean score of 4.5 ($SD = 1.4$).

Additionally, this study found teachers who were licensed under the “emergency authorization” category had the lowest sense of belonging score with a mean score of 4.8 ($SD = 0.8$). Teachers who were licensed from all other areas had a mean score of 3.6 ($SD = 1.6$), while teachers who graduated from a teacher education program had the highest score with a mean score of 4.5 ($SD = 1.0$). Lastly, this study found teachers earning between $45,000 - $60,000 had the lowest sense of belonging score with a mean score of
4.2 ($SD = 1.3$), while teachers who earned between $30,000 - \$45,000$ had the highest sense of belonging with a mean score of 4.6 ($SD = 1.3$).

**Table 11**

*Descriptive Statistics for Job Satisfaction by Categorical Variable*

<table>
<thead>
<tr>
<th></th>
<th>Job satisfaction</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early career (0 – 5 years)</td>
<td>3.6</td>
<td>0.8</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Mid career (6 – 20 years)</td>
<td>3.6</td>
<td>1.1</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>End career (21 + years)</td>
<td>4.3</td>
<td>0.7</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>ACTE region</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region I</td>
<td>4.3</td>
<td>0.7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Region II</td>
<td>3.9</td>
<td>0.9</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Region III</td>
<td>4.4</td>
<td>0.7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Region IV</td>
<td>3.7</td>
<td>0.9</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Region V</td>
<td>3.4</td>
<td>1.2</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3.9</td>
<td>1.0</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3.5</td>
<td>0.9</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>School level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>3.7</td>
<td>1.0</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Junior high school</td>
<td>4.3</td>
<td>1.0</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>License type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State issued at the time of graduation from a teacher preparation program</td>
<td>3.8</td>
<td>1.1</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>State issued at the time of completion of an alternative licensing program</td>
<td>3.8</td>
<td>0.9</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Emergency authorization while licensing requirements are met</td>
<td>3.7</td>
<td>0.8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td>3.5</td>
<td>1.0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Salary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$30,000 - $45,000</td>
<td>3.4</td>
<td>1.3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>$45,000 - $60,000</td>
<td>3.7</td>
<td>0.9</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>$60,000 - $75,000</td>
<td>3.7</td>
<td>0.8</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>$75,000 - $90,000</td>
<td>4.1</td>
<td>0.9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>$90,000 and up</td>
<td>3.9</td>
<td>1.7</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree
Table 12

*Descriptive Statistics for Teacher Sense of Efficacy by Categorical Variable*

<table>
<thead>
<tr>
<th>Category</th>
<th>Teacher sense of efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td><strong>Career status</strong></td>
<td></td>
</tr>
<tr>
<td>Early career (0 – 5 years)</td>
<td>5.1</td>
</tr>
<tr>
<td>Mid career (6 – 20 years)</td>
<td>5.2</td>
</tr>
<tr>
<td>End career (21 + years)</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>ACTE region</strong></td>
<td></td>
</tr>
<tr>
<td>Region I</td>
<td>5.2</td>
</tr>
<tr>
<td>Region II</td>
<td>5.3</td>
</tr>
<tr>
<td>Region III</td>
<td>5.2</td>
</tr>
<tr>
<td>Region IV</td>
<td>5.2</td>
</tr>
<tr>
<td>Region V</td>
<td>5.2</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5.2</td>
</tr>
<tr>
<td>Male</td>
<td>5.2</td>
</tr>
<tr>
<td><strong>School level</strong></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>5.2</td>
</tr>
<tr>
<td>Junior high school</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>License type</strong></td>
<td></td>
</tr>
<tr>
<td>State issued at the time of graduation from a teacher preparation program</td>
<td>5.3</td>
</tr>
<tr>
<td>State issued at the time of completion of an alternative licensing program</td>
<td>5.3</td>
</tr>
<tr>
<td>Emergency authorization while licensing requirements are met</td>
<td>4.8</td>
</tr>
<tr>
<td>Other:</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Salary</strong></td>
<td></td>
</tr>
<tr>
<td>$30,000 - $45,000</td>
<td>5.5</td>
</tr>
<tr>
<td>$45,000 - $60,000</td>
<td>5.0</td>
</tr>
<tr>
<td>$60,000 - $75,000</td>
<td>5.4</td>
</tr>
<tr>
<td>$75,000 - $90,000</td>
<td>5.5</td>
</tr>
<tr>
<td>$90,000 and up</td>
<td>5.4</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree.
Table 13

Descriptive Statistics for Sense of Belonging by Categorical Variable

<table>
<thead>
<tr>
<th>Sense of belonging</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early career (0 – 5 years)</td>
<td>4.5</td>
<td>1.1</td>
<td>25</td>
</tr>
<tr>
<td>Mid-career (6 – 20 years)</td>
<td>4.1</td>
<td>1.2</td>
<td>40</td>
</tr>
<tr>
<td>End career (21 + years)</td>
<td>4.7</td>
<td>1.0</td>
<td>16</td>
</tr>
<tr>
<td>ACTE region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region I</td>
<td>4.2</td>
<td>1.3</td>
<td>6</td>
</tr>
<tr>
<td>Region II</td>
<td>4.3</td>
<td>1.2</td>
<td>25</td>
</tr>
<tr>
<td>Region III</td>
<td>4.8</td>
<td>0.3</td>
<td>4</td>
</tr>
<tr>
<td>Region IV</td>
<td>4.5</td>
<td>1.1</td>
<td>20</td>
</tr>
<tr>
<td>Region V</td>
<td>4.2</td>
<td>1.1</td>
<td>27</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4.2</td>
<td>2.1</td>
<td>36</td>
</tr>
<tr>
<td>Male</td>
<td>4.4</td>
<td>1.1</td>
<td>46</td>
</tr>
<tr>
<td>School level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>4.3</td>
<td>1.1</td>
<td>73</td>
</tr>
<tr>
<td>Junior high school</td>
<td>4.5</td>
<td>1.4</td>
<td>9</td>
</tr>
<tr>
<td>License Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State issued at the time of graduation from a teacher preparation program</td>
<td>4.5</td>
<td>1.0</td>
<td>33</td>
</tr>
<tr>
<td>State issued at the time of completion of an alternative licensing program</td>
<td>4.4</td>
<td>1.1</td>
<td>29</td>
</tr>
<tr>
<td>Emergency authorization while licensing requirements are met</td>
<td>3.6</td>
<td>1.6</td>
<td>9</td>
</tr>
<tr>
<td>Other:</td>
<td>4.4</td>
<td>1.1</td>
<td>11</td>
</tr>
<tr>
<td>Salary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$30,000 - $45,000</td>
<td>4.6</td>
<td>1.3</td>
<td>7</td>
</tr>
<tr>
<td>$45,000 - $60,000</td>
<td>4.2</td>
<td>1.3</td>
<td>36</td>
</tr>
<tr>
<td>$60,000 - $75,000</td>
<td>4.4</td>
<td>1.0</td>
<td>21</td>
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<tr>
<td>$75,000 - $90,000</td>
<td>4.3</td>
<td>1.0</td>
<td>9</td>
</tr>
<tr>
<td>$90,000 and up</td>
<td>4.5</td>
<td>1.1</td>
<td>9</td>
</tr>
</tbody>
</table>

Note. 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree
As all of the constructs were measured with the same scale, standardization of the scores was not necessary for the analysis of the data. Teacher sense of efficacy \((n = 89)\) had the highest mean score with a score of 5.24 and a standard deviation of 0.51, while teacher job satisfaction \((n = 86)\) had the lowest mean score with a score of 3.75 and a standard deviation of 0.89. This information is presented in Table 14 and is sorted by mean score of persistence intentions. Due to the high mean score and low standard deviation regarding the construct of teacher efficacy (5.24 on a six-point scale), there exists the possibility of the data experiencing a ‘ceiling’ effect where the majority of the data appears at the upper limit of the Likert-scale.

**Table 14**

*Descriptive Statistics and Correlations for Study Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>(n)</th>
<th>(M)</th>
<th>(SD)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher sense of efficacy (IV)</td>
<td>89</td>
<td>5.24</td>
<td>0.51</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2. Teacher sense of belonging (IV)</td>
<td>85</td>
<td>4.32</td>
<td>1.16</td>
<td>.384**</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4. Teacher job satisfaction (IV)</td>
<td>86</td>
<td>3.75</td>
<td>0.89</td>
<td>.229*</td>
<td>.486**</td>
<td>.681**</td>
<td>—</td>
</tr>
</tbody>
</table>

*Note.* 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree, IV = Independent variable, DV = Dependent variable

*\(^p < .05. \)**\(^* p < .001 \)

I calculated correlations (Pearson’s \(r\)) among all variables of interest, which found significant positive correlations \((p < .01)\) among sense of belonging and persistence intentions, job satisfaction and persistence intentions, and job satisfaction and sense of belonging. Additionally, I found significant \((p < .05)\) positive correlations between sense
of efficacy and job satisfaction. Correlations between sense of belonging and persistence intentions were moderately positive, while the correlations between teacher job satisfaction and teacher persistence intentions were positive and strong (Schober et al., 2018). Additionally, the correlations between sense of efficacy and sense of belonging and job satisfaction and sense of belonging were positive and moderately strong.

I used a multiple regression model to assess the predictive relationship using persistence intentions as the outcome of interest and teacher efficacy, job satisfaction, and sense of belonging as predictors. This model found job satisfaction significantly predicted TEE teacher’s persistence intentions, \( p < .0005, F (1, 77) = 746.7, \) adjusted \( R^2 = .4667 \) (Table 12). Sense of efficacy and sense of belonging were not significant predictors in this model. Based on the adjusted \( r^2 (.4667) \), this model accounted for 47% of the variance in TEE teachers’ persistence intentions with these predictors.

**Table 15**

*Summary of Multiple Regression Analysis for Variables Predicting Persistence Intentions to Remain in the Teaching Profession*

<table>
<thead>
<tr>
<th>Variable</th>
<th>SE</th>
<th>95% CI</th>
<th>B</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.156</td>
<td>-2.43</td>
<td>2.10</td>
<td>-0.165</td>
<td>-0.142</td>
</tr>
<tr>
<td>Teacher sense of efficacy</td>
<td>0.235</td>
<td>-0.39</td>
<td>0.53</td>
<td>0.069</td>
<td>0.293</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>0.134</td>
<td>0.71</td>
<td>1.24</td>
<td>0.976</td>
<td>7.289</td>
</tr>
<tr>
<td>Teacher sense of belonging</td>
<td>0.123</td>
<td>-0.22</td>
<td>0.26</td>
<td>0.019</td>
<td>0.156</td>
</tr>
</tbody>
</table>

*Note. \( R^2 = .487. \) Adjusted = .467. (p < .001)*
I conducted a post-hoc power analysis to verify sufficient statistical power existed to make generalizable claims from the multiple regression model. Based on the Adjusted $R^2$, I calculated effect size ($F^2$) using the following formula, $F^2 = \frac{R^2}{1-R^2}$. This calculation yielded an $R^2$ of .85, which is a large effect size. An effect size $F^2$ of greater than 0.35 is considered large (Cohen, 1988). Using G-Power, I used the following parameters in calculating power: $F^2 = .85$, $\alpha = .001$, sample size $n = 85$, and three predictors of interest (Erdfelder et al., 2007). This calculation yielded an obtained power of $1 - \beta = .999$.

Due to the significant correlations found among the predictors of interest and the findings from the aforementioned multiple regression model using persistence intentions as the outcome of interest, I analyzed another multiple regression model, using job satisfaction as the outcome and teacher sense of belonging and teacher sense of efficacy as predictors. This model found teacher sense of belonging significantly predicted TEE teacher’s job satisfaction, $p < .0005$, $F (2, 78) = 12.43$, adjusted $R^2 = .222$ (Table 16). Sense of efficacy did not significantly predict job satisfaction in this model. Based on the adjusted $r^2$ (.222), this model accounted for 22% of the variance in TEE teachers’ job satisfaction with these predictors.

I conducted a post-hoc power analysis to verify sufficient statistical power existed to make generalizable claims from this additional multiple regression model. Based on the Adjusted $R^2$, I calculated effect size ($F^2$). This calculation yielded an $F^2$ of .29, which is between a medium and a large effect size. Using G-Power, I used the following parameters in calculating power: $F^2 = .29$, $\alpha = .001$, sample size $n = 85$, and two predictors of interest (Erdfelder et al., 2007). This calculation yielded an obtained power
of $1 - \beta = .842$, which is greater than the accepted convention of .80, meaning sufficient power existed in this model.

**Table 16**

*Summary of Multiple Regression Analysis for Variables Predicting Teacher Job Satisfaction*

<table>
<thead>
<tr>
<th>Variable</th>
<th>SE</th>
<th>95% CI</th>
<th>B</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LL</td>
<td>UL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.963</td>
<td>-0.44</td>
<td>3.33</td>
<td>1.445</td>
<td>1.500</td>
</tr>
<tr>
<td>Teacher sense of efficacy</td>
<td>0.199</td>
<td>-0.29</td>
<td>0.48</td>
<td>0.095</td>
<td>0.481</td>
</tr>
<tr>
<td>Teacher sense of belonging</td>
<td>0.093</td>
<td>0.23</td>
<td>0.59</td>
<td>0.412</td>
<td>4.417</td>
</tr>
</tbody>
</table>

*Note. R^2 = .242. R^2 adjusted = .222. (p < .001)*

The statistical significance found in the regression model using teacher job satisfaction as an outcome and sense of belonging and sense of efficacy as predictors indicated mediation effects might be present. Specifically, job satisfaction may mediate the effects of sense of belonging on persistence intentions. I conducted an additional analysis assessing mediation effects between persistence intentions, job satisfaction, and teacher sense of belonging, using job satisfaction as the mediating variable.

I first conducted mediation analysis by testing for direct effects between persistence intentions and teacher job satisfaction. Next, I tested the effects of the independent variable on the mediator; that is, I ran a model assessing how teacher sense of belonging predicted teacher job satisfaction. Then, I simultaneously tested the mediator (job satisfaction) alongside the independent variable (sense of belonging) for
effects on the independent variable (persistence intentions). From these models, I conducted a causal mediation analysis to estimate direct and indirect effects. Figure 6 shows the different regression models assessed in this mediation analysis. Figure 7 represents the mediation model analyzed and corresponding mediation coefficients.

Figure 6

Mediation Model Step
In this model, the average causal mediation effects, that is, the indirect effect of the sense of belonging on the teacher job satisfaction, were $0.42, p < .001$. The average direct effects describing the direct effect of teacher sense of belonging on teacher persistence intentions were $0.03$ and were not significant. The total effects (direct + indirect effects) of teacher sense of belonging on teacher job satisfaction were $0.45, p < .001$. Additionally, the proportion of the effect of teacher sense of belonging on teacher persistence intentions through the mediator of teacher job satisfaction was $0.92, p < .001$. Test statistics for the mediation analysis are found in Table 17.
The effect of teacher sense of belonging on teacher persistence intentions was fully mediated via teacher job satisfaction. As Figure 6 illustrates, the regression coefficient between teacher sense of belonging and persistence intentions and the regression coefficient between job satisfaction and teacher sense of belonging were both significant. The indirect effect was (.43)*(0.97) = .42. I tested the significance of this indirect effect using bootstrapping procedures. Unstandardized indirect effects were computed for each of 1,000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2.5th and 97.5th percentiles. The bootstrapped unstandardized indirect effect was .42, and the 95% confidence interval ranged from .28 to .59. Thus, the indirect effect was statistically significant (p<.001).

Research Question 5

This research question sought to address the following: What institutional-related programs exist for TEE teachers’ intended persistence? This research question was
addressed using questions that asked respondents to “select all that apply” regarding the following programs intended at keeping TEE teachers in the profession: competitive pay, district content area-specific professional development, leadership development opportunities, new teacher induction programs, professional association professional development, state professional development programs, and teacher mentor programs.

Teachers were then asked to address how much each program supported their intentions to remain in the profession on a five-point Likert scale ranging from “none at all” to “a great deal.” For the purposes of the data analysis, these rankings were assigned a numerical value based on the selection. The ranking of “none at all” received a value of 0, while the ranking “a great deal” received a value of four. Means and standard deviations were calculated for each program using these values as a way to quantify the influence each program had on teachers’ intention to remain in the profession. Table 18 indicates the frequency, mean, and standard deviation of responses regarding the presence of each of the institutional support programs.

Due to the structure and nature of the flow-through logic used by this question, not all teachers who selected available programs intended to support with persistence indicated how the program influenced their intention to remain. This led to frequency counts differing between programs identified and how those programs were perceived by teachers at supporting their persistence intentions. Programs most commonly identified by respondents included new teacher induction programs ($n = 62$), state professional development programs ($n = 57$), and professional association professional development programs ($n = 55$). Competitive pay was ranked as being the most influential with a mean
of 2.53 ($SD = 0.94$) while new teacher induction programs were ranked the lowest with a mean score of 0.50 ($SD = 1.27$).

Table 18

Distribution and Descriptive Statistics of Reported Institutional Programs

<table>
<thead>
<tr>
<th>Institutional programs identified</th>
<th>$f$</th>
<th>%</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>New teacher induction programs</td>
<td>62</td>
<td>18.84</td>
<td>0.59</td>
<td>1.27</td>
</tr>
<tr>
<td>State professional development programs</td>
<td>57</td>
<td>17.33</td>
<td>1.31</td>
<td>1.15</td>
</tr>
<tr>
<td>Professional association professional development</td>
<td>55</td>
<td>16.72</td>
<td>1.52</td>
<td>1.27</td>
</tr>
<tr>
<td>Teacher mentor program</td>
<td>52</td>
<td>15.81</td>
<td>0.94</td>
<td>1.27</td>
</tr>
<tr>
<td>Leadership development opportunities</td>
<td>44</td>
<td>13.37</td>
<td>1.51</td>
<td>1.26</td>
</tr>
<tr>
<td>District content area specific professional development</td>
<td>41</td>
<td>12.56</td>
<td>1.76</td>
<td>1.36</td>
</tr>
<tr>
<td>Competitive pay</td>
<td>18</td>
<td>5.47</td>
<td>2.53</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal

A total of 62 respondents, the most of any program assessed in this study, indicated new teacher induction programs existed as a program to help with teacher retention in their district. Despite this program being the most identified institutional program available to teachers to support in-career persistence, teachers ranked the program the lowest, with a mean score of 0.59 ($SD = 1.27$). The majority of respondents (70%) noted the new teacher induction programs offered by school districts influenced them “none at all” while the fewest (5%) noted teacher induction programs influenced them “a great deal,” “a lot,” and “a moderate mount” to stay in the profession. Table 19 indicates the distribution of new teacher induction programs’ influence on teachers’ intention to remain.
Behind new teacher induction programs, teachers in this study ranked state professional development the second most frequently available program. A total of 57 respondents in this study indicated state professional development programs existed as a program to help with teacher retention in their district. This program was ranked higher than new teacher induction programs but still lower compared to other programs with a mean score of 1.31 ($SD = 1.15$). The majority of respondents (32%) noted the state professional development programs offered by school districts influenced them “a little,” while the fewest (4%) noted state professional development influenced them “a great deal” to stay in the profession. Table 20 indicates the distribution of state professional development programs’ influence on respondents’ intention to remain in the teaching profession.

**Table 19**

*Distribution of New Teacher Induction Programs Influence on TEE Teachers’ Intention to Remain*

<table>
<thead>
<tr>
<th>New teacher induction program perceived influence</th>
<th>$f$</th>
<th>$%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>3</td>
<td>4.92</td>
</tr>
<tr>
<td>A lot</td>
<td>3</td>
<td>4.92</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>3</td>
<td>4.92</td>
</tr>
<tr>
<td>A little</td>
<td>9</td>
<td>14.75</td>
</tr>
<tr>
<td>None at all</td>
<td>43</td>
<td>70.49</td>
</tr>
</tbody>
</table>

*Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal*

$n = 62, M = 0.59, SD = 1.12$
The third most frequently identified program available to teachers to support their persistence intentions was professional association professional development. A total of 55 respondents indicated professional association professional development programs existed as a program to help with teacher retention in their district. This program was ranked higher than new teacher induction programs and state professional development but was still lower compared to other programs with a mean score of 1.52 ($SD = 1.27$). The majority of respondents (28%) noted the professional association professional development programs offered by school districts influenced them “none at all,” while the fewest (6%) noted this professional development influenced them “a great deal” to stay in the profession. Table 21 indicates the distribution of professional association professional development influence on teachers’ intention to remain in the profession.

**Table 20**

*Distribution of State Professional Development Programs Influence on Teachers’ Intention to Remain in the Profession*

<table>
<thead>
<tr>
<th>State professional development perceived influence</th>
<th>$f$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>2</td>
<td>3.64</td>
</tr>
<tr>
<td>A lot</td>
<td>8</td>
<td>14.55</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>11</td>
<td>20.00</td>
</tr>
<tr>
<td>A little</td>
<td>18</td>
<td>32.73</td>
</tr>
<tr>
<td>None at all</td>
<td>16</td>
<td>29.09</td>
</tr>
</tbody>
</table>

*Note.* 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal

$n = 57$, $M = 1.31$, $SD = 1.15$
The fourth most frequently identified program available to teachers to support their persistence intentions was teacher mentor programs. A total of 52 respondents indicated teacher mentor programs existed as a program to help with teacher retention in their district. This program was ranked the second-lowest, only ahead of new teacher induction programs with a mean score of 0.94 ($SD = 1.27$). The majority of respondents (52%) noted the mentor programs offered by school districts influenced them “none at all” to stay in the profession, while the fewest (6%) indicated teacher mentor programs influenced them “a lot.” Table 22 shows the distribution of teacher mentor programs’ influence on respondents’ intention to remain in the teaching profession.

After new teacher mentor programs, teachers identified leadership development opportunities as a program that existed to help support teacher persistence. A total of 44 respondents indicated leadership development programs existed as a program to help with teacher retention in their district. This program was ranked higher than the lowest programs with a mean score of 0.94 ($SD = 1.27$). The majority of respondents (33%) noted the leadership development opportunities offered by school districts influenced

### Table 21

<table>
<thead>
<tr>
<th>Profession association perceived influence</th>
<th>$f$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>3</td>
<td>5.56</td>
</tr>
<tr>
<td>A lot</td>
<td>12</td>
<td>22.22</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>10</td>
<td>18.52</td>
</tr>
<tr>
<td>A little</td>
<td>14</td>
<td>25.93</td>
</tr>
<tr>
<td>None at all</td>
<td>15</td>
<td>27.78</td>
</tr>
</tbody>
</table>

*Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal, $n = 55$, $M = 1.52$, $SD = 1.27$*
them “a moderate amount,” while the fewest (9%) noted these opportunities influenced them “a great deal” and “a lot” to stay in the profession. Table 23 indicates the distribution of leadership development opportunities influence on teachers’ intention to remain.

**Table 22**

*Distribution of Teacher Mentor Programs Influence on TEE Teachers’ Intention to Remain in the Profession*

<table>
<thead>
<tr>
<th>Teacher mentor perceived influence</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>A lot</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>A little</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>None at all</td>
<td>26</td>
<td>52</td>
</tr>
</tbody>
</table>

*Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal, n = 52,*

*M = 0.94, SD = 1.27*

**Table 23**

*Distribution of Leadership Development Opportunities Influence on TEE Teachers’ Intention to Remain in the Profession*

<table>
<thead>
<tr>
<th>Leadership development perceived influence</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>A lot</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>14</td>
<td>32.56</td>
</tr>
<tr>
<td>A little</td>
<td>9</td>
<td>20.93</td>
</tr>
<tr>
<td>None at all</td>
<td>12</td>
<td>27.91</td>
</tr>
</tbody>
</table>

*Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal, n = 44,*

*M = 1.51, SD = 1.26*
A total of 41 respondents indicated district content-area-specific professional development existed as a program to help with teacher retention in their district. This program was ranked higher than most of the other programs identified by teachers, only behind the existence of competitive pay, with a mean score of 0.94 ($SD = 1.27$). The majority of respondents (24%) noted the district content-area-specific professional development programs offered by school districts influenced them “a moderate amount” and “none at all,” while the fewest (21%) selected “a great deal” to stay in the profession. Table 24 indicates the distribution of district content-area-specific professional development influence on respondents’ intention to remain in the teaching profession.

Table 24

*Distribution of District Content Area Specific Professional Development Influence on TEE Teachers’ Intention to Remain in the Profession*

<table>
<thead>
<tr>
<th>District professional development perceived influence</th>
<th>$f$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>5</td>
<td>12.20%</td>
</tr>
<tr>
<td>A lot</td>
<td>8</td>
<td>19.51%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>10</td>
<td>24.39%</td>
</tr>
<tr>
<td>A little</td>
<td>8</td>
<td>19.51%</td>
</tr>
<tr>
<td>None at all</td>
<td>10</td>
<td>24.39%</td>
</tr>
</tbody>
</table>

Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal

$n = 41, M = 1.76, SD = 1.36$

The least frequently identified program available to support teachers’ persistence was the existence of competitive pay. A total of 18 respondents indicated competitive pay
existed as a program to help with teacher retention in their district. Despite this program being infrequently identified, this program was perceived by teachers to have the most impact regarding their persistence intentions, with a mean score of 2.53 ($SD = 0.94$). The majority of respondents (41%) noted competitive pay offered by school districts influenced them “a moderate amount,” while zero respondents noted competitive pay influenced “none at all” to stay in the profession. Table 25 indicates the distribution of competitive pays’ influence on TEE teachers’ intention to remain in the profession.

**Table 25**

*Distribution of Competitive Pay Influence on TEE Teachers’ Intention to Remain in the Profession*

<table>
<thead>
<tr>
<th>Competitive pay perceived influence</th>
<th>$f$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>3</td>
<td>17.65</td>
</tr>
<tr>
<td>A lot</td>
<td>5</td>
<td>29.41</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>7</td>
<td>41.18</td>
</tr>
<tr>
<td>A little</td>
<td>2</td>
<td>11.76</td>
</tr>
<tr>
<td>None at all</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note. 0 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal

$n = 18, M = 2.53, SD = 0.94$

**Qualitative Results**

This study was conducted using an explanatory mixed-methods approach. In the qualitative phase of this study, I used semi-structured interviews to gather data to address the research questions of interest. I interviewed four participants individually, each of
whom was sampled for maximum variation. The purpose of these semi-structured interviews of this sequential explanatory mixed-method study was to answer Research Question 6 and to help explain the results obtained from the survey disseminated to the ACTE eTED teachers.

**Research Question 6**

This research question addressed the following: How do TEE teachers characterize their teaching experience and intended persistence? This question was comprised of two sub-questions. How do institutional-related factors and personal factors (e.g., family dynamics, professional experience) influence TEE teachers’ career experience and persistence intentions? And how do teachers talk about career commitment?

To address this question, I conducted interviews with teachers who expressed interest in the quantitative data collection phase. Interviews were recorded and transcribed verbatim. Transcriptions were then coded, and a thematic analysis was conducted. I used thick descriptions in this study to ensure participant’s voices and narratives were accurate to their experience. Thick descriptions are described by Ponterotto (2006) as:

Thick description accurately describes observed social actions and assigns purpose and intentionality to these actions by way of the researcher’s understanding and clear description of the context under which the social actions took place. Thick description captures the thoughts and feelings of participants as well as the often-complex web of relationships among them. Thick description leads to thick interpretation, which in turn leads to thick meaning of the research findings for the researchers and participants themselves, and for the report’s intended readership. Thick meaning of findings leads readers to a sense of verisimilitude, wherein they can
cognitively and emotively “place” themselves within the research context.
(p. 543)

**Qualitative Sample Characteristics**

For this study, I interviewed four teachers one-on-one using semi-structured interviews. These teachers were sampled for maximum variation based on teacher licensure, ACTE region, biological sex, and years of teaching experience. Both male and female teachers with a range of teaching experience from 8 years to 28 years were sampled. Additionally, teachers who earned their licensure through traditional means and those who earned their licensure from alternative means from various ACTE regions were sampled. Interviews were conducted using the online meeting platform Zoom and were recorded, transcribed, and coded. To protect privacy, teachers’ legal names were replaced with pseudonyms throughout this dissertation.

**Qualitative Participants**

Thomas was a veteran male teacher who taught in a poorer urban school district at the high school level and had 25 years of teaching experience at the time of his interview. This teacher was also teaching in the same district he grew up in. Geographically, he was located in ACTE Region II. Professionally, this teacher was licensed at the conclusion of a traditional teacher preparation program.

Kevin was a male teacher who was teaching at the middle school level at the time of his interview. Additionally, at the time of his interview, Kevin indicated it was his plan to leave the teaching profession at the end of the current school year after eight years of
teaching. This teacher was licensed at the conclusion of an alternative licensing program and was located in ACTE Region V.

Ricardo was a male teacher who had 11 years of teaching experience and resided in ACTE Region IV at the time of his interview. This teacher had earned an advanced degree in education, was nationally board-certified, was involved with many committees in the school, was older when he entered the teaching profession, and had obtained licensure through alternative means. For Ricardo, teaching was his second career outside of working in the military. Ricardo’s pedagogical philosophy included non-traditional approaches relating to elements of teaching, such as grades and student projects.

Talia was a veteran female teacher with over 28 years of experience. She was teaching at a school district that would be considered to be high poverty and at a school federally recognized as Title I at the time of her interview. She also resided in ACTE Region IV. Talia held multiple teaching endorsements in TEE and mathematics and was actively working on an administrative certificate.

**Emergent Themes**

The qualitative results yielded six emergent themes. These themes consisted of administration, professional resources, relationships, challenges facing the CTE teachers, salary and benefits, and general attitudes toward teaching. Seven subthemes also emerged in the analysis, which included the following: professional relationships, student relationships, district and building administration, professional development, funding, and professional associations. The theme of administration had the largest number of
references with 26 references, and the theme of general teacher attitudes had the fewest number of references with 10 total references (Table 26).

Table 26

Thematic Analysis of Interviews Conducted with Qualitative Participants

<table>
<thead>
<tr>
<th>Themes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>26</td>
</tr>
<tr>
<td>District</td>
<td>10</td>
</tr>
<tr>
<td>Building</td>
<td>14</td>
</tr>
<tr>
<td>Professional resources</td>
<td>25</td>
</tr>
<tr>
<td>Professional development</td>
<td>7</td>
</tr>
<tr>
<td>Funding</td>
<td>9</td>
</tr>
<tr>
<td>Professional associations</td>
<td>9</td>
</tr>
<tr>
<td>Relationships</td>
<td>17</td>
</tr>
<tr>
<td>Professional relationships</td>
<td>6</td>
</tr>
<tr>
<td>Student relationships</td>
<td>11</td>
</tr>
<tr>
<td>Challenges faced by TEE Teachers</td>
<td>17</td>
</tr>
<tr>
<td>Salary and Benefits</td>
<td>11</td>
</tr>
<tr>
<td>General attitudes toward teaching</td>
<td>10</td>
</tr>
</tbody>
</table>

Relationships

Relationships were an emergent theme in this qualitative data analysis. Within this theme, professional relationships and student relationships emerged as subthemes. Teachers interviewed in this study viewed their relationships as an effect on career commitment to the teaching profession all differently. In his interview, Thomas seemed to suffer a loss for words when asked about his career commitment. His response about things that keep him in the classroom was, “Right now? I don't know what's keeping me in right now, other than it's too early to retire.” Despite this, Thomas expressed a love for
teaching. He said: “I have loved, still love, teaching and working with kids; as many veteran teachers will say, it comes down to all the other bullshit that ultimately drives you out.” In the interview, Thomas identified the most influential element in keeping him in the classroom throughout his career. He stated: “As far as what kept me in the profession . . . it was the relationships I've built with other tech ed professionals.” Thomas continued with this line of thought and stated the following:

It's, it's actually relationships with other tech ed teachers, some that I have maintained over the years and my involvement in the past with [professional organization name] . . . working on curriculum development teams, and most recently trying to get involved with [another professional organization name] . . . Those are the things that have been more influential and keeping me reinvigorated and involved.

Kevin spoke of career commitment candidly in his interview. When asked about his career commitment and intended persistence, he indicated his plan was to leave the profession early at the end of the current school year after eight years of teaching. Kevin stated:

I actually am going to be leaving [the profession] early. Honestly, it's, it's just the students in general, just the classroom—that kind of thing. I'm just ready to do something different.

Ricardo spoke of relationships rather positively in his interview. He expressed a love for his profession and the things that come with teaching in an area like TEE. He spoke very highly of working with people when they are learning in a situation where they are allowed to succeed and learn through failure. In relation to this, he stated the following:

I like working with people when they're finding things out . . . I provide everything [the students] need to get in trouble and everything they need to succeed. And I'm very excited when they work with it and make the discoveries on their own. I can tell them stuff all day long . . . it might go in one ear and out
the other. When they discover it on their own, it's, it's real; it's doable. It's repeatable.

Watching students have a ‘light bulb’ moment seemed to invigorate Ricardo and motivate him to continue his work in teaching.

Talia was unique in her statements about relationships. She often spoke of students and her work with students. Talia originally studied math and computer science and was planning to work for industry but ended up in education. Initially, she stated one of the key elements keeping her in the profession was her love for the content area that she taught. She expanded on this by discussing how her content area helps describe the physical world by applying math to open-ended projects. She stated: “I like open-ended projects and the projects that we build, and going over the technical, you know, like the calculations and mathematical calculations.” She additionally discussed how she spends time tutoring students in areas outside of TEE. She ended the conversation about how the potential of her program closing down after she leaves due to an inability to recruit a qualified replacement causes enough stress and motivation to keep her teaching.

Talia made an interesting observation about the teaching profession in her interview. From her perspective, many of the young teachers do not persist long in the profession, and when they leave teaching, they do not come back. She stated: “you know, most of the teachers I work with are older and have been around like me for a while. And most of the young ones leave the whole program period. Which is really, really sad for our country.” In her experience, Talia has found engineering programs in schools to be closed down when a qualified teacher is not found, which leaves a school no other option but to eliminate the TEE program from CTE course offerings. Talia struggled with the idea of not having programs like her engineering program available to her students.
Administration was one of the key themes that emerged in the qualitative data analysis. District-level and school-level administrations emerged as subthemes in the interview data. Thomas and Talia spoke of administration as a negative element to career commitment and intended persistence, while Kevin indicated his administration was one of the elements possibly keeping him in the profession. Ricardo indicated that administration was important in his career persistence but did not indicate if currently his administration was aiding or hindering his career commitment.

When asked about administration and its connection to Thomas’ career commitment, Thomas stated, “It's school-based leadership, district-based leadership, that is more of a deterrent than anything else.” With further probing, Thomas indicated administration was a key element in his lack of career satisfaction.

It's, it's politics; it could be poor school-based leadership. You know, I've had principals and administrative staff who, I mean, for lack of a better way of putting it, know how to run a school or can run a school district. But here recently, our school-based leadership has been abysmal. Our district is in a good bit of turmoil . . . short answer, it's, yeah, it's I’m ready to get out the door.

Despite the issues facing Thomas regarding school-based leadership, Thomas felt some degree of optimism about the future of CTE in his school district. The school district had recently hired a new CTE director who was from an area that gave Thomas the impression that they were going to better understand the critical issues facing the district.

Talia felt as though her district was in a tight financial spot with CTE due to issues with administration. She stated her school had nearly no money to maintain programs this year. When asked to elaborate further, she stated that this was not a side effect of COVID-19 but rather mismanagement from the district administration. She
stated that her school ordered items that were then withheld from the central office rather than delivered to be used in instruction. Additionally, she stated there were severe budget reductions from the previous year, further exacerbating issues relating to administration.

Talia talked at length about how her ideal teaching load would be comprised of teaching both math and engineering. Though holding the proper endorsements, she discussed how she would never be able to teach the classes she is the most passionate about in her current school because the building principal is unwilling to allow her to teach upper-division math classes simultaneously with engineering classes. Talia stated: “there's no upward mobility in mathematics for me to teach the upper-division courses unless I leave this school and go to another one.”

Kevin’s feelings about school and district administration were quite different from the other teachers interviewed. When asked about how school administration impacted his career commitment and persistence in teaching, Kevin indicated he felt supported in his program by building administration.

As far as my principal goes, I felt very supported . . . I think not just supported, but trusted, like, they would go with anything that I deem as important or, you know, justifiable. So, yeah, I feel like they've got my back.

Kevin not only felt supported from building-level administration but also with district-level administration. Kevin stated, “I feel like I'm fortunate [name of school district] has been like, extremely supportive and, just, they just kind of go out of their way to keep CTE teachers happy.” Administration, neither at the school level nor at the district level, appeared to have a negative impact on Kevin’s career commitment.

Ricardo stated, “I think, I think if I lost the support of my admin, I’d probably go pretty quick.” He acknowledged issues with administration could become disheartening.
He indicated when things become tough, he focuses on busying himself by providing his students with everything he can. He characterized his approach to maintaining his degree of career commitment as a competition against himself. He stated the following:

It's kind of like a competition with myself, I've gotten hundreds of thousands of dollars worth of grants, . . . it always provides something new for my students. I mean, you know, everybody has 3d printers now, but we had 3D printers before people had 3d printers, we had virtual reality stuff in the classroom before most classes did, and I like that . . . I try to offer . . . lots of different things for my students. And as long as I can continue to do that, and continue to see the light bulb go off, and all those things. They have me hooked.

Ricardo’s career satisfaction stemmed from his work with his students. He used the successes from his students and service to the school through committees and grant projects as a way to keep himself energized and excited about teaching.

**Professional Resources**

Professional resources emerged as one of the central themes in this qualitative data analysis. This theme contained professional development, finding, and professional associations as sub-themes. All of the teachers interviewed spoke of professional development as being a factor leading to teacher job satisfaction and career commitment, if done in a way that the teachers needed. Funding seemed to be a factor attributing negatively to career commitment with Talia and Thomas. All of the teachers interviewed spoke highly of the professional associations they belong to concerning career commitment.

According to Ricardo, professional development from external sources is more important regarding career commitment. He stated, “I get that more from the external stuff that they allow me to do than the internal stuff they allow me to do.” This aspect of
conversation brought up a point of contention Ricardo feels with his school district. When Ricardo first started teaching, he was allowed four days a year for professional development. This has since been reduced to two days, and Ricardo now feels “it's almost like pulling teeth to get them to agree to let us go.” Ricardo did not state that any of the professional development programs offered by his school district were influential in keeping him in the profession.

Thomas echoed some of these same sentiments. He felt as though he gained more from outside organizations as opposed to the school district's professional development. In a follow-up email, Thomas stated state-level professional development was present and extremely helpful and that colleagues in TEE from throughout the state who were involved with state-level professional development, professional associations, and student organizations were by far the most influential in keeping him in the teaching profession. Conversely, Thomas stated that the professional development for TEE teachers offered at the district level was neither present nor helpful.

Talia also echoed the feelings of the other teachers interviewed. She did not speak of any school offered professional development that was influential in keeping her in the profession. She stated there was a disconnect between what she felt the district should be doing to keep teachers versus what has been done regarding teacher professional development. She stated: Instead, she discussed the benefits she received from the professional development she had participated in with Project Lead the Way. At her school, she teaches Project Lead the Way curriculum, which is a national engineering curriculum that requires teachers to engage in rigorous training that certifies a teacher to deliver the curriculum (Project Lead the Way, 2017). This training uses a model similar
to ‘train the trainers’, where teachers work through all the learning material in a given class as a student with a master teacher facilitating teacher learning. These immersive trainings create professional learning communities that encourage teacher collaboration, even years after the initial training. Talia stated she liked this professional development because it was specific to engineering. Additionally, she felt as though the organization updated its curriculum regularly and provided teachers with what they needed to be successful.

Along these same lines, Talia stated the professional development offered through national associations has been helpful, though she wished they had more engineering-related content. Talia had planned to present at the national level through a professional association, though she ended up running out of time to craft the presentation. She also mentioned the school district she teaches at paid for membership dues for a national association but no longer does, which seemed to be a point of slight contention.

Salary and Benefits

An additional theme that emerged in the qualitative data analysis was the importance of salary and benefits. All of the teachers spoke somewhat highly of their salary and benefits and expressed that the benefits are somewhat underrated.

In regards to salary and other benefits, Thomas took the standpoint that salary should not be the key focus of teacher retention programs and suggested the reason why we hear of salary as a key issue is for political reasons. His statements gave the impression teaching benefits were a neutral to slightly positive influence on career persistence. He stated the following:
By and large, I'm kind of critical that most of the conversation around teacher retention, or what it's needed for schools, revolves around salary and benefits. I mean, honestly, I rather enjoy the holidays and summers off, I think that's huge compensation. You know, the healthcare definitely makes things easier. So I mean, there's a lot of advantages that I think maybe aren't appreciated as much by my colleagues . . . it's really a political game. But what I see was so much of the conversation focused on salary and benefits, and that overshadows all the other issues that overburden educators. I think the current situation is exacerbating, and still, the conversation is about salary and benefits.

During the member-checking process of the data analysis, Thomas sent a follow-up email to this interview. In that email, Thomas stated salary and benefits are important to consider in teacher retention but should be by no means the only factor that is of interest to pertinent stakeholders.

When asked about what was keeping him in the profession, Kevin stated salary and benefits were a positive influence on his staying in the profession. He stated the following: “benefits, I would say is a good one. That keeps me in it. And, in my case, the subject matter that I'm teaching.” Kevin expressed passion for the subject matter throughout the interview and discussed how the benefits associated with teaching are underrated. He stated, “I consider, you know, the consistent breaks and the long breaks a big benefit.”

Teaching was Ricardo’s second career, and he stated he lives well for someone with his salary. He stated he was planning to teach to supplement his income for however long it takes for him to be able to collect a “real retirement” from his previous employer. He indicated salary was not something that was hindering his career commitment. He stated:

I live far better than most people on what I get. So money doesn't keep me going back. It would be nice to get more. But again, I enjoy what I'm doing. I enjoy showing up every day. I enjoy working with the students.
In her interview, Talia expressed an interest to make more money since she had the credentials to do so in industry but did not indicate if salary was currently a contributor for or against career commitment.

**General Attitudes Towards Teaching**

General attitudes towards teaching were another key theme that emerged in the qualitative data analysis. Ricardo contrasted his current profession with his previous along the lines of career advancement. In his previous career, there was a defined career ladder with a career progression. In teaching, that same type of career ladder does not exist. He stated the following:

> From my career in the military, it's always move up and on move up and on, and in teaching, I could do exactly the same thing every day for the rest of my career. But I'm not wired that way.

This led to Ricardo seeking involvement in every aspect of the school he could. He stated he joins all the committees he can and involves his students in all of the external competitions possible through organizations like ACTE. He shared an anecdote of one student winning a national competition that came with $1,000 of prize money and free entry into a conference.

Ricardo seems to be a leader in his school. This is seen through his involvement in extra school-based committees, such as the school leadership committee. Additionally, Ricardo discussed that after he earned his national board certification, other teachers followed suit. School administration is an important element in keeping Ricardo in the classroom.
In Kevin’s interview, he spoke of how students were one of the leading causes of his dissatisfaction with the profession. His responses gave the indication he did not feel the same sense of intrinsic reward as other teachers. Kevin stated:

I always have people that say like, oh, wait, you love working with kids and stuff like that. And I just never felt that . . . I hear people talking about how they just want to make that difference. And they just want to help the kids, and they love being around them. But I’ve just never, I haven’t had that experience.

Kevin expressed passion for the subject matter, but not for working with children, and that the lack of passion for working with children was leading to his desire to pursue an alternative career.

Talia expressed a connection to the profession and gave the impression she would continue teaching as long as she could. In part, this connection is felt through a sense of service Talia can give by staying in the profession. She felt as though by staying in the teaching profession, she could ensure students are provided the opportunity they deserve to study technology and engineering. For without her continued service, the technology and engineering program may be shut down due to a lack of qualified teachers to fill her position when she leaves.

**Challenges Faced by TEE Teachers**

Other major obstacles facing the profession also emerged as a theme in the qualitative data analysis regarding teacher career commitment. Thomas spoke of other major issues associated with his career commitment and persistence intentions impacting teachers’ career commitment in his school district. Specifically, Thomas brought up concerns with safety and school violence. “We had a shooting that occurred at the school; there’s been a lot of student tension and violence.” Thomas indicated these issues,
coupled with issues arising from COVID-19, are likely the result of some of the turnover in administration and dissatisfaction amongst teachers in the region and across the country.

Talia seemed to internalize and take some personal responsibility regarding some of the big struggles the TEE profession is facing. She discussed one of the key factors keeping her from retiring is a fear about what will happen to the existing engineering program at her school after she leaves the profession with the current state of recruiting teachers in the technology and engineering profession. She stated:

'It's really hard to get somebody qualified to come in and teach what we teach. When we leave the program, we don't know, you know, if they'll find a qualified person . . . I think that's the best thing that actually motivates me to keep on teaching because I like it so much that I want the students to be happy about it. And I don't want the program to ever go away. And I'm worried about that all the time.'

Talia gave the impression she faced an internal struggle between the desire to retire and ensuring opportunity for the children at her school. She indicated she would try and stick in the profession a bit longer but didn’t know how long that would be.
CHAPTER V
CONCLUSIONS & RECOMMENDATIONS

The methodology outlined in Chapter 3 used an explanatory mixed-methods approach to address the stated research questions (QUAN → qual) with more emphasis being placed on the quantitative phase of the study (Creswell, 2015; Schoonenboom & Johnson, 2017). The basic design intent was to first use quantitative methods, then use qualitative methods to help explain the quantitative results in more depth (Creswell, 2015).

The purpose of this study was to identify the factors that predict TEE teachers’ persistence in teaching and to examine the teaching experiences of TEE teachers in relation to career retention. Essentially, this study sought to answer the question, “What keeps the Technology and Engineering Education teacher in the classroom?” The population targeted for this study was all of the TEE teachers who are a part of the Engineering Technology Education Division (eTED) of the Association of Career and Technical Education (ACTE), $N = 1,327$.

Summary of Findings

Research Question 1

This research question sought to address the following: How do personal and professional characteristics impact TEE teachers’ intended persistence in teaching? Characteristics described in this research included teachers’ career status (e.g., early-career, middle-career, and end-career), gender (male and female), school served (e.g.,
middle school and high school), type of teaching license earned (licensed via alternative pathway, licensed via teacher education program, licensed via emergency authorization, and other), teacher salary ($30,000 – $45,000, $45,000 – $60,000, $60,000 – $75,000, $75,000 – $90,000, and up), and state the teacher was teaching in. In the data analysis in this study, the state variable was aggregated by ACTE region.

Respondents to the quantitative portion of this study were balanced, coming from all ACTE regions across the United States. Additionally, the respondents were somewhat balanced in regard to gender with males comprising 55% of the respondents and females comprising 45% of the respondents. License type was also represented across all areas with respondents being representative between being licensed from a traditional teacher education program (41%) and being licensed from an alternative program (36%). I did not find any significant mean score differences using the Mann-Whitney test and the Kruskal-Wallis test among any of the personal and professional characteristics and TEE teacher persistence intentions.

**Research Question 2, 3 and 4**

Research Questions 2, 3, and 4 addressed the following research questions: How does sense of belonging impact TEE teachers’ intended persistence in teaching? How does sense of efficacy impact TEE teachers’ intended persistence in teaching? How does job satisfaction impact TEE teachers’ intended persistence in teaching? These research questions were addressed using regression models and a follow-up mediation analysis. The first regression model used teacher persistence as the outcome of interest with sense of belonging, teacher efficacy, and job satisfaction as predictors. An additional regression
model was analyzed using teacher job satisfaction as the outcome variable and teacher sense of belonging and sense of efficacy as predictors. Additionally, a mediation analysis was conducted using teacher job satisfaction as a mediator between teacher sense of belonging and teacher persistence intentions.

In this study, I found teacher sense of efficacy and sense of belonging did not significantly predict teachers’ persistence intentions, nor did job satisfaction. I did, however, find teacher job satisfaction was a significant predictor of TEE teachers’ persistence intentions. Additionally, I found teacher job satisfaction was predicted by sense of belonging. In the follow-up mediation analysis, I found job satisfaction completely mediated the effects between sense of belonging and persistence intentions.

**Research Question 5**

This research question sought to address the following: What institutional-related programs exist for TEE teachers’ intended persistence? This research question was addressed using questions that asked respondents to “select all that apply” regarding the following programs intended at keeping TEE teachers in the profession: competitive pay, district content-area-specific professional development, leadership development opportunities, new teacher induction programs, professional association professional development, state professional development programs, and teacher mentor programs.

Teachers who participated in this study indicated the most prevalent programs available in their district aimed at supporting teacher retention were new teacher induction programs ($n = 62$), while competitive pay was the least prevalent program ($n = 18$). Despite so many teachers indicating teacher induction programs were a program
aimed at supporting teacher retention, the majority stated the program helped them “none at all” (70%) while the fewest (5%) stated the program helped them “a great deal.”

Several programs available to teachers to support teacher persistence were perceived to offer more support than others. Professional development offered through professional associations (n = 55) was reported by 22% of the respondents as helping “a lot” and 19% of the respondents as helping “a moderate amount.” Another program that was perceived more positively by teachers were leadership development opportunities (n = 44) where the majority of those who selected the program (33%) indicated that the program offered “a moderate amount” of support.

**Research Question 6**

This research question addressed the following: how do TEE teachers characterize their teaching experience and intended persistence? This question contained two sub-questions: 1) How do institutional-related factors and personal factors (e.g., family dynamics, professional experience) influence TEE teachers’ career experience and career persistence intentions, and 2) how do teachers talk about career commitment?

To address this question, I conducted one-on-one semi-structured interviews with teachers who expressed interest in participating in a qualitative interview during the quantitative data collection phase. Participants were interviewed via the online meeting platform Zoom. Questions used in this interview were derived from results in the quantitative data collection phase through results in the statistical models as well as responses from open-ended questions asked in the quantitative questionnaire. Results from the open-ended questions in the quantitative data collection were coded then
analyzed for themes. These themes, along with statistical findings from the quantitative survey, informed the interview protocol development.

The thematic analysis and coding from the interviews yielded six themes. These themes consisted of administration, professional resources, relationships and career commitment, challenges facing CTE teachers, salary and benefits, and general attitudes toward teaching. Seven subthemes also emerged in the analysis, which included the following: professional relationships, student relationships, district and building administration, professional development, funding, and professional associations. The results of the qualitative interviews indicate TEE teachers largely struggled with teaching due to a number of factors ranging from administration to student issues, thus leading to a low career commitment. Additionally, factors that have been thought of as being influential, such as salary, teacher licensure, and gender, did not appear to be as important to career persistence in TEE teachers as some current research suggested.

**Conclusions and Implications**

Throughout this research, I sought to explore factors that attribute to TEE teachers’ intentions to remain in the classroom. I did this by quantitatively examining the effects of personal and professional characteristics, sense of belonging, sense of efficacy, and job satisfaction on persistence intentions. I then contextualized the quantitative findings by using qualitative data to help explain what was found in the quantitative survey. In this section, I will discuss conclusions and implications of this research as they relate to the research questions of interest.
**Research Question 1**

The findings in this study regarding personal and professional demographics are contrary to much of the existing body of research. In many studies (e.g., Bond, 2001; Chapman, 1983; Guarino et al., 2006; Johnson et al., 2004, 2005; Lauglo, 1975; Rust, 1994), teacher salary, license type, gender, and career status predict teacher turnover. In this study, I did not find any of the personal or professional demographic categories assessed to be significant predictors of persistence intentions in the TEE teachers who responded to the survey. These non-significant findings suggest perhaps TEE teachers come from a different population than the general population of teachers that has been the focus of much of the existing research and lead to the conclusion TEE teachers may base their persistence intentions on different factors.

Other studies (e.g., Briggs, 2008; Wright, 1991) discuss how a TEE classroom differs from a general education classroom, which may help explain why personal and professional characteristics do not predict TEE teachers' persistence intentions in this study even though other studies have identified these characteristics as predictors (e.g., Chapman, 1983; Guarino et al., 2006; Stinebrickner, 1998; Theobald, 1990). Contrary to the typical classroom, TEE teachers work in problem and project-based classrooms that allow a large amount of flexibility in pedagogical approaches and content. Additionally, these teachers tend to be the sole teacher teaching TEE content in their school, as pointed out by Thomas in the qualitative interviews. These differences may lead the average TEE teacher to base their persistence intentions on other more unique factors.

One of the important non-significant findings of this study regarding teachers’ personal and professional characteristics is neither teacher salary nor teacher licensing
type predicted teachers’ persistence intentions. This finding suggests that much of the contemporary rhetoric dealing with the need to increase teacher salaries and modify benefit packages to support teacher retention may not be as effective with TEE teachers as it is with other disciplines. Instead, school districts should prioritize other factors such as teacher workload in an effort to support teacher retention. Thomas echoed this sentiment; he indicated he felt as though the conversation around teacher retention, especially dealing with salary and other compensation, was political. He stated the salary increases that are passed are usually targeted at a specific subgroup of teachers (e.g., early career teachers) as opposed to the general population, which gives the impression the school districts are doing more with regard to salary and benefits than they really are because only a few teachers benefit from the increases. In practice, these salary increases tend to focus on attracting new teachers as opposed to retaining current teachers. Both Thomas and Kevin stated that the importance of salary and benefits associated with teaching were underrated. Ricardo stated he lived well for someone with his background and implied that salary was a neutral factor in persistence intentions.

Additional support that salary is not a significant predictor of teachers’ persistence intentions for these participants could be many TEE’s teachers’ career entry into education. With more TEE teachers coming into education as a second career, salary may be a smaller factor relating to persistence intentions. Choosing education as a second career suggests that the teacher consciously chose to leave one profession for another. In some cases, when teachers are recruited from industry, they will face a substantial pay cut, especially from higher-paying STEM careers, such as engineering.
Ricardo entered the teaching profession through alternative means after a career as a United States Navy Reservist. He mentioned he lived well for someone with his background and seemed to have the highest job satisfaction and persistence intentions of those interviewed. The finding that salary is not statistically significant reinforces the findings of Wright (1991), who found salaries in TEE teachers were not significantly related to the intention to quit the teaching profession. Further investigation is warranted regarding interactions between teacher salary and teacher persistence intentions.

Another key finding related to personal and professional characteristics is teacher license type did not significantly predict teachers’ persistence intentions. In fact, alternatively licensed teachers had a slightly higher, though non-significant, mean score for persistence intentions (4.2 vs. 3.6). This finding suggests the manner in which teachers receive their pedagogical training is not as important to TEE teachers as it may be for other disciplines. This finding is positive as many programs around the country are beginning to rely on alternative licensing pathways to staff TEE teaching positions, as shown by research (e.g., Wilkin & Nwoke, 2011) and reinforced by the finding that alternatively licensed teachers comprised nearly the same proportion of respondents in this study as those from traditional teacher education programs (36% vs. 40%).

**Research Question 2, 3 and 4**

This study used multiple regression analysis to determine the predictive relationship among TEE teachers’ persistence intentions and sense of belonging, sense of efficacy, and job satisfaction. The regression models are visually represented in Figure 8.
**Model Discussion**

The findings of this study found job satisfaction significantly predicted TEE teachers’ persistence intentions, while sense of belonging and sense of efficacy did not. However, due to predictors of interest correlating with one another and the findings of the originally proposed model, an additional model was analyzed assessing the predictive relationships among sense of efficacy, sense of belonging, and job satisfaction, using job satisfaction as the outcome variable. I found while sense of belonging significantly predicted job satisfaction and job satisfaction predicted persistence intentions, job satisfaction completely mediated the effects between sense of belonging and persistence intentions. This suggests teacher persistence intentions are complex, and the interplay among the factors that significantly predict these intentions needs to be further studied.

Finally, mediation analysis (Figure 6) was conducted among sense of belonging, job satisfaction, and persistence intentions using job satisfaction as the mediating variable. Although teacher sense of belonging was not a significant predictor of persistence intentions, based on the findings of the mediation analysis and the regression models it does predict job satisfaction, its importance can be seen. This suggests an effort should be made to increase TEE teachers’ sense of belonging, and if teachers are not satisfied with their job, they may be feeling a lesser sense of belonging at the school level.
**Sense of Belonging**

The scale I used to measure teacher sense of belonging was developed by Roberts et al. (1995) and adapted to fit the research questions in this study. The items in this instrument were targeted at teacher sense of belonging within a school setting. I found sense of belonging as measured with this scale had a mean score of 4.32 ($SD = 1.16$) on a six-point scale, meaning the average TEE teacher self-reported a moderate feeling when it came to sense of belonging. This means despite TEE teachers often being singletons in their content area at their school, as was shown in the qualitative data, the teachers who participated in this study still felt a moderate sense of belonging, which is somewhat surprising. Furthermore, alternative and traditionally licensed teachers scored 4.4 ($SD = 1.6$), which is virtually identical in this construct to teachers licensed from traditional pathways who scored 4.5 ($SD = 1.0$). This suggests the pathway to licensure is not as

*Note. * represents a significant predictor
important to sense of belonging as previous research might suggest (e.g., Walter and Gray, 2002).

An additional finding was the only category of teachers who had a sense of belonging mean score of less than 4 were teachers who were licensed via emergency authorization ($M = 3.6, SD = 6$). Though this study did not assess for significance in mean score differences in this construct, it is worth noting that this finding aligns with much of the existing research citing teachers who come from emergency licensing pathways tend to suffer from a lack of belonging when compared to other teacher license types.

Looking deeper into this, the qualitative interviews uncovered that TEE teachers tended to rely on relationships developed through professional associations as opposed to relationships developed in the school or district for support. This was pointed out by Thomas, who explicitly stated “I’ve been the sole tech ed teacher. So you know, without establishing relationships with teachers, either at another school, or, for me, typically, it was with other educators across the state, and through [professional association name].” This point was further reinforced by Ricardo, who in reference to programs influential in promoting teacher persistence and job satisfaction stated, “the stuff that I’m most excited about, I think happens outside of the school.” This means regardless of the origin, relationships are critical to sense of belonging.

The finding that the relationship between sense of belonging and persistence intentions was mediated by job satisfaction can perhaps be explained as the situation and setting of a TEE teacher differs greatly from that of a regular classroom teacher, thus, leading to a change in how TEE teachers perceive their sense of belonging. As pointed
out by Thomas, TEE teachers tend to be isolated both collaboratively and physically. They are often the only teacher in a school in their discipline, and their classroom/lab is often housed in a building separate from general education classes. This isolation leads TEE teachers to lean on other avenues, such as professional associations, for a sense of belonging. Thomas and Ricardo’s statements provide context for why the statistical findings found sense of belonging, when looked at from the school perspective, did not significantly predict TEE teachers’ persistence intentions. This study can thus conclude TEE teachers’ career persistence is not directly impacted by sense of belonging at the school level but instead is mediated by job satisfaction. Additional research is needed at a broader level to assess the effects of sense of belonging to organizations such as professional associations and regional consortiums and to determine the importance for TEE teachers to be given the opportunity to participate in professional organizations on TEE teachers’ persistence intentions.

**Sense of Efficacy**

Tschannen-Moran & Hoy (2001) developed the scale I used to measure teacher sense of efficacy, and I adapted it to fit the research questions in this study. This included omitting several of the elements from the original instrument and instead, using items that ask teachers about their ability to deliver technical concepts in an effort to better align with Career and Technical Education. I found sense of efficacy as measured with this scale had a mean score of 5.24 ($SD = 0.51$) on a six-point scale, meaning the average TEE teacher who responded to this study self-reported a high degree of teacher sense of efficacy, which was comprised of the constructs of engagement, instruction, and
management. Due to the high mean score and small standard deviation regarding the construct of teacher efficacy (5.24 on a six-point scale), there exists the possibility of the data experiencing a ‘ceiling’ effect where the majority of the data appears at the upper limit of the Likert scale. Additional research should be conducted using a more granular Likert scale to increase variation, thus removing the ‘ceiling’ observed in this data.

The finding that teachers reported a high degree of sense of efficacy is positive, given a high sense of efficacy has been shown to be an important characteristic of successful teachers (Schwarzer & Hallum, 2008; Tschannen-moran et al., 1998). In this study, all demographic groups scored 5 or higher on the Likert scale except for teachers who were licensed via emergency authorization. They had a mean score of 4.8 (SD = 0.4). This study did not test for significant mean score differences in this construct, though the finding that teachers who are licensed via emergency authorizations have lower reported sense of efficacy is congruent with much of the research assessing license types and teaching. Future research should disaggregate personal and professional characteristics within teacher efficacy and assess for significance among these groups.

In this study, I found sense of efficacy as measured with this scale did not significantly predict TEE teachers’ persistence intentions or job satisfaction. However, sense of efficacy was significantly correlated with both sense of belonging and job satisfaction. These possible relationships echo findings from existing research that suggest there is a relationship between sense of efficacy and job satisfaction (Aldridge & Fraser, 2016; Edinger & Edinger, 2018). Additional research is needed to quantify the relationship between a sense of efficacy and job satisfaction and thus TEE teachers’ persistence intentions to better understand how they interact.
The scale used in this study to measure teacher sense of efficacy was designed to be broken down into three subconstructs: efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management (Tschannen-Moran & Hoy, 2001). Because I did not use the complete original scale and because I added elements that were targeted at CTE teachers, I cannot reliably disaggregate sense of efficacy into these subconstructs. Although I used an aggregated mean score for teacher sense of efficacy for use in the predictive regression model, there may be value in replicating this study using the complete instrument by Tschannen-Moran & Hoy (2001) and disaggregating into the three original subconstructs to provide a more granular understanding of the interactions that exist among each of the three subconstructs of teacher efficacy and TEE teachers’ persistence intentions. Additionally, more research is needed to see if there are any interactions among the three subconstructs of teacher sense of efficacy and any of the other predictors that may mediate job satisfaction.

**Job Satisfaction**

The scale I used to measure job satisfaction was developed by Judge et al. (1998) and adapted to fit the research questions in this study. I found TEE teachers’ job satisfaction as measured with this scale had a mean score of 3.75 (SD = 0.89) on a six-point scale, meaning the average TEE teacher had a medium satisfaction with their job. This mean score is of some concern as there is a significant and strong positive correlation to TEE teachers’ persistence intentions. The additional significant and moderate positive correlation to sense of belonging and significant and weak positive
correlation to sense of efficacy further highlight the importance of job satisfaction and the moderate mean score identifies an area for improvement.

The data gathered in the qualitative phase of this study supported the quantitative findings in relation to job satisfaction, with sentiments about job satisfaction ranging from highly satisfied to dissatisfied. Ricardo, who expressed being highly satisfied, did not have any intentions to leave the profession. Additionally, Talia, who expressed being somewhat satisfied, shared a hope that she would be able to persist as a teacher. While Thomas, who wanted to leave the profession as soon as financially possible, and Kevin, who planned to leave the profession at the end of the current academic year, both expressed strong job dissatisfaction. Combined, the quantitative and qualitative research findings show TEE teachers report only average job satisfaction and thus may have low career commitment.

Additionally, I found job satisfaction significantly predicted TEE teachers’ persistence intentions in multiple regression. This finding is not surprising given current research shows job dissatisfaction is one of the main factors of teacher attrition (Boyd et al., 2001). In a follow-up mediation analysis, I found job satisfaction fully mediated the relationship between teacher sense of belonging and teacher persistence intentions. This means teachers base some of their job satisfaction on how they perceive they belong in their school setting and that job satisfaction is predicted in part by sense of belonging. Additionally, the large number of TEE teachers who have entered teaching through an alternative licensure pathway suggests TEE teachers other have greater career mobility if they want to leave the profession, thus further highlighting the importance of job satisfaction for TEE teachers.
Teachers who were interviewed in the qualitative phase of this study made numerous comments regarding how school administration impacted teacher job satisfaction. Thomas shared his frustrations with the lack of understanding between the school district CTE director and the CTE faculty, which he attributed to a high degree of administrator turnover. Conversely, Ricardo mentioned without the support of his administrator, he would likely leave the profession quickly. These findings suggest TEE teachers base their job satisfaction in part on administrative support at both the school and district levels. This conclusion further reinforces the findings of Wright (1991), who found that “A primary reason that technology teachers leave the profession is ‘lack’ of support by administration” (p.13).

As TEE teachers had a medium job satisfaction rate, and job satisfaction predicts persistence intentions, understanding the factors that predict TEE teachers’ job satisfaction and supporting the development of systems that contribute positively to satisfaction is important to prevent excess teacher turnover. As there was little recent literature on TEE teachers' job satisfaction at the time this dissertation was written, additional research is needed in this area. However, the need for this research is not new. A study done by Wright (1991) first made the case that TEE teachers’ job satisfaction is uniquely derived from variables that may not be found in other studies on teacher retention with content areas outside of CTE. Since that time, there have been numerous other authors who have reiterated the need for research unique to TEE teachers (Moye, 2009b; Moye et al., 2012; Volk, 2019). Thus, there is a need for research aimed specifically at TEE teachers and the factors that predict job satisfaction and persistence intentions,
Possible Interactions

Looking at the moderate and strong correlations between all predictors of interest that were presented in Chapter 4 (Table 14) and given there is at least one significant predictor of TEE teachers’ persistence intentions, this study suggests that a new model may be needed to explain TEE teachers’ persistence intentions through variable mediation and moderation. A more effective model may be to explain the relationships among sense of belonging, sense of efficacy, and job satisfaction, then to analyze how those factors predict persistence intentions in TEE teachers.

This research tested for mediation between sense of belonging and teacher persistence using job satisfaction as a mediator. The results of this analysis showed job satisfaction did significantly and completely mediate the relationship between sense of belonging and persistence intentions. Though sense of efficacy was not a significant predictor of job satisfaction or persistence intentions, more research is needed to quantify the relationship between sense of efficacy and the likelihood of a teacher to persist in the profession.

This proposed model suggests TEE teachers' job satisfaction is mediated by an interaction between sense of efficacy and sense of belonging, which then, in turn, predicts persistence intentions. Additionally, this model suggests teacher sense of belonging likely moderates job satisfaction and persistence intentions. This model is graphically represented in Figure 9.
**Research Question 5**

The findings in this study indicate there are many programs that exist to help teachers in their persistence intentions, though many are not perceived by TEE teachers as being influential in keeping teachers in the profession. Despite teacher induction programs being the most commonly selected program used to help in teacher retention, the majority of TEE teachers claimed these programs did not impact their persistence intentions. Another similar program available for participants to select was the existence of a teacher mentor program in their district. This program was again rated low, with the majority of teachers indicating this program had little to no effect on their persistence intentions.

With teacher mentor programs and teacher induction programs being ranked the lowest by TEE teachers in supporting persistence intentions, this study can conclude that traditional teacher onboarding may not be as impactful for TEE teachers as it may be for
teachers in different content areas. This finding is echoed in a dissertation published in 2008. Briggs (2008) concluded in order for mentoring programs to be effective for CTE teachers, programs should be focused and streamlined in an effort to not further extend already overburdened new teachers.

Additionally, Briggs (2008) found mentors for career and technical education teachers need to match subject areas or content knowledge to be the most helpful to new career and technical education teachers. For example, a mentor for a new TEE teacher needs to be another successful TEE teacher, as opposed to a teacher from another content area. The finding that teacher mentor programs and teacher induction programs are not ranked high by TEE teachers leads to the conclusion that school districts may not fully grasp the professional development needs of TEE teachers and possibly couple the professional development needs of TEE teachers with other content area teachers without acknowledging the different needs of teacher groups.

This finding may also be explained as TEE teachers are uniquely situated in a school as being alone in what they teach. This notion was reinforced by Thomas, who stated that he was a singleton TEE teacher at his school. If a TEE teacher is hired and placed with a mentor in another content area, the mentor teacher will likely not be able to provide the same type of support as a teacher from the same content area. Along these same lines, a teacher from the same content area from perhaps another school will not be able to provide the same support as a teacher from inside the building due to logistical constraints.

Teacher induction programs are likely ranked low by TEE teachers in supporting teacher persistence intentions as they are likely targeted at teachers in other content areas,
as opposed to TEE teachers. This makes sense given TEE teachers comprise a small percentage of the general population of a school. As was pointed out by Wright (1991), TEE teachers are uniquely situated in their classroom and approach learning from avenues that teachers from other content areas cannot. This leads to the conclusion more work should be done at the school level to align professional development needs of TEE teachers to what is offered through the school district.

Other institutional-related programs that support retention were rated somewhat higher by respondents in this study. These programs were state and professional association professional development opportunities. Teachers rated these programs higher than programs managed at the school or district level. These findings suggest that teachers perceive professional development from agencies outside their school building as more influential in supporting teacher persistence. This is perhaps the result of misalignment between the needs of CTE and TEE teachers and what is offered at the school or district level. State and national associations that are unique to TEE teachers likely better understand the needs of TEE teachers as these associations are typically comprised of current or former TEE teachers. Having first-hand experience teaching the content that is uniquely TEE provides these associations and state agencies the necessary insight to craft meaningful professional development to the TEE teacher.

These findings are supported by the qualitative findings in this study. In his interview, Thomas stated that the only effective professional development program he could remember his district offering was in regard to classroom management. This professional development came at a time when Thomas was shifting from teaching at the high school to teaching at the middle school. Thomas likely perceived this professional
development as being influential as it was timely in his transition; the professional development provided tools he needed to retool his classroom management system for the younger grades. Ricardo stated he was more excited by the opportunities from outside his district than inside his district. In his interview, Ricardo specifically discussed how he sought opportunities from his associations to pursue professional development, and recently, his district had begun to restrict the number of professional development days for teachers. He stated this restriction was a major point of contention within the CTE faculty.

School wide teacher professional development offered at a school level tends to deal with programs that are universally applicable to the majority of teachers in a school. With federal and state priorities aligning to performance on high stakes testing, these professional development opportunities tend to be focused on core subject areas that are tested. Thomas stated in his interview that TEE teachers are a ‘minority’ and gave the impression school administration did not really work to generally provide meaningful professional development to CTE programs. Additionally, all of the teachers interviewed stated that they perceived the professional development from outside of the school as more meaningful than what was done inside the school. These findings suggest more professional development should be offered to meet the needs of TEE teachers. Further research is warranted to assess TEE teacher professional development needs across the country.
Research Question 6

This research question was qualitative in nature and dealt with career commitment and persistence intentions of TEE teachers. Teachers interviewed expressed varying degrees of career commitment, and commitment seemed to be connected to their general attitudes toward teaching. For example, Kevin expressed his plan to leave the profession at the conclusion of this school year after eight years of teaching, while Ricardo, who entered the profession later in life after another career, seemed to enjoy teaching. One of the key differences between Kevin and Ricardo was how they spoke of their work attitudes. Kevin did not enjoy working with children, while Ricardo found great joy in watching students discover and learn. Both Kevin and Ricardo identified their relationships with students as a major factor in their attitude toward teaching and thus their persistence intentions.

Conversely, Thomas, a veteran teacher of 25 years, stated he liked teaching and liked working with students; however, the extraneous things that come with teaching is pushing him out of the profession. His interview gave a sense of overwhelming exhaustion, and his attitude toward teaching overshadowed the enjoyment he found working with students and led to his desire to leave the profession.

COVID-19

During the past two years, the world has experienced a worldwide pandemic from COVID-19. This pandemic has impacted every person in the United States and has profoundly impacted education through the suspension of face-to-face learning for millions of students. This pandemic has been called “the largest disruption to education in
history” (Engzell et al., 2021, p. 1). In some cases, nearly overnight, teachers had to move their teaching to some type of online format.

It would be remiss to dismiss the possible effects this pandemic has had on this research and the teaching profession at large. Though not directly addressed in the survey or interview used by this study, one qualitative participant discussed how the pandemic has directly impacted him in the classroom. Thomas discussed how in his school, they finally had all of the students under one roof after a year and a half of virtual or hybrid learning. TEE classrooms are largely laboratory-based and hands-on in nature, which poses a significant problem for many. Ricardo discussed how watching the lightbulb go on for a student was profoundly satisfying.

In online settings, TEE classrooms were not able to maintain the same degree of hands-on work as they could in traditional laboratory settings. If a teacher, such as Ricardo, bases their career satisfaction on watching a student experience a ‘light bulb moment,’ the past year could have significantly impacted a TEE teachers’ job satisfaction. With the COVID-19 pandemic still ongoing, the effects of worldwide school shutdowns on teachers and students will be studied for years to come. Further research is warranted on the effects of COVID-19 and teacher persistence in TEE. It is possible that COVID-19 might have influenced job satisfaction and TEE persistence intentions. If not for COVID-19, it is possible that constructs would have measured higher.
Limitations Revisited

Limitations are present in all research. The limitations of this research were discussed in Chapter 1 but are revisited here. While statistical checks were conducted to ensure the reliability and validity of the instrument used in this study, threats to internal validity may appear due to the self-report nature of the survey. Additionally, because of the low response to this study, the results of the study are not generalizable to all TEE teachers, so caution is advised when reading and interpreting the results of this study. For the qualitative phase of this study, only four participants were interviewed. This means this study may lack the depth that might have been possible through additional or longer interviews.

Concerning the respondents of this study, only TEE teachers who were a part of the ACTE’s eTED were surveyed, which means teachers who taught in the area of TEE who were not a part of eTED were excluded from this study. Additionally, as the proposed sample came from a national association, frame error might exist. Furthermore, this study focused on TEE, which means the findings of this study are not be generalizable to teachers of other subjects, including those in other CTE content areas.

Finally, my opinions and experiences as a researcher might have resulted in bias in this study. Although I attempted to remain as objective as possible, personal biases may have influenced the research decisions regarding the topic, development of the instrument and variables selected, data collection, data analysis, and conclusions and implications. In an effort to mitigate bias in the qualitative phase, I included a positionality statement in Chapter 3 of this dissertation.
Recommendations

This study explored the relationship between TEE teachers’ persistence intentions and personal and professional demographics, sense of belonging, sense of efficacy, and job satisfaction. Additionally, this study explored what programs exist in school districts to aid in the persistence intentions of TEE teachers. Knowledge from this research can be used to inform pre-service teacher preparation programs, human resource professionals, and CTE directors in training and retaining TEE teachers. Additionally, this research has implications regarding the importance of professional associations to TEE teachers. As such, I have the following recommendations for practice and further research.

Recommendations for Practice

1. States should shift focus on teacher retention away from teacher salary and benefits. New focus is needed on teacher working conditions and professional development needs.

2. Human resource directors and CTE directors should collaborate on the professional development needs of TEE teachers and create programs that are more aligned to their preceptive needs. Existing programs should be modified to fit the perceived needs of TEE teachers.

3. With teacher sense of belonging being a significant predictor of job satisfaction, school and district administration need to work to build inclusive faculties that encourage sense of belonging among faculty of all disciplines.

4. State CTE offices should expand their professional development offerings to include opportunities that are more beneficial to TEE teachers.
5. School districts should encourage and support TEE teachers who are singletons in their content area to seek out professional involvement to support their sense of belonging and professional development needs.

6. TEE teachers should seek out professional involvement through associations such as the Association of Career and Technical Educators (ACTE), Technology Student Association (TSA), the International Technology, Engineering, Educators Association (ITEEA) for their professional development needs.

**Recommendations for Future Research**

While this research had limitations, this research contributes to the limited but growing and necessary body of literature around TEE teacher retention. As such, I have the following recommendations for further research:

1. This study suggests using a new model to assess TEE teacher persistence intentions where job satisfaction mediates the effects of sense of belonging with the inclusion of sense of efficacy as a possible predictor. Additional research is needed to explore and validate this newly proposed model.

2. The findings of this study indicate teacher job satisfaction is a significant predictor of teacher persistence intentions. Additionally, this research found teacher sense of belonging predicted job satisfaction. Investigation is needed regarding the predictors of TEE teacher job satisfaction and predictors of sense of belonging to help support teacher persistence.
3. A larger study with additional TEE teachers from outside of ACTE should be conducted to bolster findings and generalizability. If the sample is not limited to professional associations, but professional association data is gathered, a comparison between professional associations and those who do not belong to professional associations may yield additional findings regarding the relationship between professional associations and TEE teachers’ sense of belonging and job satisfaction.

4. This research only examined the effects of an individual personal or professional characteristic on teacher persistence intentions. Further investigation of possible interactions between personal and professional characteristics and other variables predicting teacher persistence should be explored (e.g., teacher licensure type coupled with gender predicting teacher persistence intentions).

5. Additional research is warranted regarding factors that keep TEE teachers in the classroom. I suggest a study be conducted with end-of-career TEE teachers identifying factors that attribute to job satisfaction and career longevity.

6. Additional research regarding TEE teachers’ sense of belonging is warranted. This study found sense of belonging significantly predicted job satisfaction. This study used items that were specific to sense of belonging within a school setting. Findings in this study indicate TEE teachers may derive their sense of belonging from factors outside of the school system as opposed to inside the
school system. Research using an instrument that is less specific to school-based sense of belonging is needed.

7. This study suggests professional development needs of TEE teachers are not being met. A large-scale study is needed to assess the perceived professional development needs of TEE teachers.

8. This study found a slight, though non-significant, difference in mean scores between alternatively licensed teachers and traditionally prepared teachers in persistence intentions (4.2 vs. 3.6). Though non-significant, these findings are surprising and warrant additional research. This study should be replicated at a larger scale to explore possible differences between traditional and nontraditional teacher education in persistence intentions and job satisfaction.

9. This study used a heavily modified version of an existing instrument to assess teacher sense of efficacy in order to align with the elements that were centric around technical education. The authors of the original scale, Tschannen-Moran & Hoy (2001), originally broke down teacher efficacy into three subconstructs, efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management. Additional research is needed to replicate this study using the original scale to disaggregate teacher efficacy and measure the effects of the subconstructs of teacher sense of efficacy on teacher persistence.
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APPENDICES
Appendix A
Journal for Technology Education Copyright Permissions
Focus and Scope

The Journal of Technology Education provides a forum for scholarly discussion on topics relating to technology and engineering-related education. Manuscripts should focus on technology and engineering-related education research, philosophy, and theory. In addition, the Journal publishes book reviews, editorials, guest articles, comprehensive literature reviews, and reactions to previously published articles.

Technology and Engineering Education (T&EE) is a program that resides at the PK-12 school levels for all students and at post-secondary institutions for those students interested in teaching or obtaining employment in the technology or engineering fields. T&EE may be considered a stand-alone discipline or part of a larger discipline in science, technology, engineering, and mathematics (STEM). Regardless of the approach, T&EE focuses on technological and engineering literacy.

At the PK-12 grade levels, the goal is for students to develop technological and engineering literacy, regardless of career aspirations, through hands-on, contextual applications of technological and engineering concepts. T&EE students use a hands-on approach to solve technological problems using problem solving and creativity, while working under constraints, which involves the use of optimization and predictive analysis. At the PK-5 grade levels, technology and engineering concepts are integrated into existing coursework such as reading, mathematics, science, and social studies. Typical courses students would take at the 6-12 grade levels in a T&EE program would consist of (a) information and communication technologies, including computer-aided drafting and design, (b) engineering design, (c) construction technology, (d) manufacturing technology, (e) energy, power, and transportation technology, and (f) health, medical, agricultural, and related biotechnologies. Within these courses, students would utilize troubleshooting, research and development, invention and innovation, and problem solving. The focus of T&EE at the PK-12 levels is not to prepare future engineering majors/students, but to provide an education for all students.
Publication Frequency

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Open Access Policy

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Sponsors

Co-sponsored by: International Technology and Engineering Education Association Council on Technology and Engineering Teacher Education

History

Previous Editors: Mark Sanders 1989-1997; James LaPorte: 1997-2010; Chris Merrill 2010-2020

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The Institutional Review Board has determined that the above-referenced study is exempt from review under federal guidelines 45 CFR Part 46.104(d) category #2:

Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (i) The information obtained is recorded in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subject; (ii) Any disclosure of the responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, educational advancement, or reputation, or (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and the IRB conducts a limited IRB review to make required determinations.

This exemption is valid for five years from the date of this correspondence, after which the study will be closed. If the research will extend beyond five years, it is your responsibility as the Principal Investigator to notify the IRB before the study’s expiration date and submit a new application to continue the research. Research activities that continue beyond the expiration date without new certification of exempt status will be in violation of those federal guidelines which permit the exempt status.

If this project involves Non-USU personnel, they may not begin work on it (regardless of the approval status at USU) until a Reliance Agreement, External Research Agreement, or separate protocol review has been completed with the appropriate external entity. Many schools will not engage in a Reliance Agreement for Exempt protocols, so the research team must determine what the appropriate approval mechanism is for their Non-USU colleagues. As part of the IRB’s quality assurance procedures, this research may be randomly selected for audit during the five-year period of exemption. If so, you will receive a request for completion of an Audit Report form during the month of the anniversary date of this certification.

In all cases, it is your responsibility to notify the IRB prior to making any changes to the study by submitting an Amendment request. This will document whether or not the study still meets the requirements for exempt status under federal regulations.

Upon receipt of this memo, you may begin your research. If you have questions, please call the IRB office at (435) 797-1821 or email to irb@usu.edu.

The IRB wishes you success with your research.
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Appendix D
First Email to Participants
Dear ACTE Member:

As you all know, there is a significant teacher shortage in our area. An eTED National Fellow and doctoral student, Cory Ortiz, and his advisor, Dr. Tyson J. Sorensen are working to conduct research on the factors that attribute to teachers in our area leaving the profession. This research has important implications regarding the teacher shortage. Please fill out the survey if you teach one or more classes in the area of technology and engineering! The survey does not collect any identifiable information and is completely anonymous. It will take approximately 10 minutes to complete.

The hyperlink to begin the survey is found here: https://usu.co1.qualtrics.com/jfe/form/SV_5C3OwioGpAPMYfk

IRB Protocol #11981

Cory Ortiz, M.S.
Assistant Professor of Professional Practice
Utah State University
Aviation and Technical Education
ACTE eTED New Career Fellow class of 2022

Tyson Sorensen, Ph.D.
Assistant Professor, Agricultural Education
Utah State University
Applied Sciences, Technology, & Education Department
435-797-5741
Appendix E
Reminder Email to Participants
Dear ACTE Member:

If you have not already, please support Cory Ortiz, an eTED National Fellow and doctoral student, and his advisor, Dr. Tyson J. Sorensen on their important research on the factors that attribute to teachers in our area leaving the profession. This research has important implications regarding the teacher shortage. There are two aspects to this research: a short survey and an optional follow up interview. Please fill out the survey if you teach one or more classes in the area of technology and engineering! After you complete the survey, if you are interested, there will be a link to a new survey to screen you for participation in the follow up interview. If you choose to participate in the interview, it should take approximately 15 minutes. The survey does not collect any identifiable information and is completely anonymous. The survey will take approximately 10 minutes to complete.

The hyperlink to begin the survey is found here:
https://usu.co1.qualtrics.com/jfe/form/SV_5C3OwioGpAPMYfk

IRB Protocol #11981

Cory Ortiz, M.S.
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Appendix F
Survey Instrument
**Questionnaire**

**Survey Flow**

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<tbody>
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<tr>
<td>Standard: Exclusion Criteria (1 Question)</td>
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<td>Standard: Teacher Efficacy (1 Question)</td>
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<td>Standard: Sense of Belonging (1 Question)</td>
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<td>Block: Persistence Intentions (1 Question)</td>
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<td>Standard: Job Satisfaction (1 Question)</td>
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<td>Standard: Institutional Factors (6 Questions)</td>
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<td>Standard: Professional Demographic Questions (4 Questions)</td>
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<tr>
<td>Standard: Personal Demographic (3 Questions)</td>
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**Start of Block: IRB**

**Q88** You are invited to participate in a research study by Dr. Tyson J. Sorensen, an Assistant Professor and Cory Ortiz, a Graduate Student in Applied Sciences, Technology & Education, at Utah State University. **The purpose of this research** is to identify the factors that predict TEE teachers’ persistence in teaching and to examine the teaching experiences of TEE teachers in relation to retention. Simply put, this study seeks to answer the question, “What keeps the Technology and Engineering Education teacher in the classroom?”

**Your participation in this study is voluntary** and you may withdraw your participation at any time for any reason. You are able to skip questions if you wish. Only responses that are submitted will be analyzed. In the case that you want to end your participation in the study, simply close the web browser prior to the final question. Since this survey is anonymous, once you complete and submit it, we will not be able to withdraw you from the study.

**If you take part in this study**, you will be asked to complete one survey that will take approximately 10 minutes. There is no cost to you except your time. You may answer some or none of the questions. **This is a minimal risk research study.** That means that the risks of participating are no more likely or serious than those you encounter in everyday activities. The foreseeable risks include the potential for the loss of confidentiality. However, confidentiality will be kept to the extent permitted by the technology being used. Although every precaution will be taken to ensure confidentiality, the security of information collected from you online cannot be guaranteed. Information collected online can be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. In order to minimize those risks and discomforts, the researchers will securely store data collected in a restricted-access folder on Box.com. **We will make**
every effort to ensure that the information you provide remains confidential. We will not reveal your identity in any publications, presentations, or reports resulting from this research study.

We will collect your information via Qualtrics. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This survey data will be securely stored in a restricted-access folder on Box.com. All identifiers will be destroyed as soon as all data has been compiled in the electronic analysis program and quality confirmation is complete. As part of this survey, you will be asked if you are interested in being a part follow up research. If you indicate you are interested, you will be directed to another form where you will be asked additional information. This contact information will be retained for future contact to take part in that research.

While you will not be compensated for your participation in this research study, your responses will greatly contribute to the field of Technology and Engineering Education and our understanding of what factors contribute to the retention of teachers in the classroom.

You can decline to participate in any part of this study for any reason and can end your participation at any time. If you have any questions about this study, you can contact Tyson Sorensen, Ph.D. at tyson.sorensen@usu.edu or Cory Ortiz at cory.ortiz@usu.edu. Thank you again for your time and consideration. If you have any concerns about this study, please contact Utah State University’s Human Research Protection Office at (435) 797-0567 or irb@usu.edu and reference IRB Protocol #11981.

By clicking “Next” below and continuing to the survey, you agree that you are 18 years of age or older and wish to participate. You agree that you understand the risks and benefits of participation and that you know what you are being asked to do. You also agree that if you have contacted the research team with any questions about your participation and are clear on how to stop your participation in this study if you choose to do so.

End of Block: IRB

Start of Block: Introduction Block

Q91 Overview Information
Thank you for taking the time to complete this survey. Your responses are extremely valuable to your profession and your fellow technology and engineering teachers across the nation. Please complete each question as accurately as possible.

Do not click the back button/arrow on your internet browser, instead use the “Back” and “Next” buttons to navigate through the survey. A screen will appear upon completion of the survey.

End of Block: Introduction Block
Start of Block: Exclusion Criteria

Q92 Are you currently teaching one or more classes in the area of technology and/or engineering?
   ○ Yes (1)
   ○ No (2)

Skip To: End of Survey If Are you currently teaching one or more classes in the area of technology and/or engineering? = No

End of Block: Exclusion Criteria

Start of Block: Teacher Efficacy

Q104 To what extent do you agree with the following statements?

<table>
<thead>
<tr>
<th>I can motivate students who show low interest in school work. (1)</th>
<th>Strongly agree (12)</th>
<th>Agree (13)</th>
<th>Somewhat agree (14)</th>
<th>Somewhat disagree (16)</th>
<th>Disagree (17)</th>
<th>Strongly disagree (18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can respond to difficult questions from students. (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can help students think critically. (3)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can craft good questions/projects for my students. (4)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I know the content well enough to teach it effectively to my students. (5)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can demonstrate technical skills of the discipline effectively to my students. (6)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can effectively answer students questions about the content I teach. (7)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am comfortable with my knowledge to be able to teach what I teach. (8)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can get through to the most difficult students. (9)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly agree (1)</td>
<td>Agree (2)</td>
<td>Somewhat agree (3)</td>
<td>Somewhat disagree (4)</td>
<td>Disagree (5)</td>
<td>Strongly disagree (6)</td>
</tr>
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<td>------------------------</td>
</tr>
<tr>
<td>I can control disruptive behavior in the classroom. (10)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I can get students to believe they can do well in school work. (11)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I can establish routines to keep activities running smoothly. (12)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>For quality purposes, please select 'Strongly disagree' for this statement (13)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>End of Block: Teacher Efficacy</td>
<td></td>
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<td></td>
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<tr>
<td>Start of Block: Sense of Belonging</td>
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</tr>
<tr>
<td>Q95 To what extent do you agree with the following statements?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In my school, there is a great deal of cooperative effort among staff members. (1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In my school, teachers are supportive of me. (2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In my school, teachers are supportive of my program. (4)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In my school, teachers frequently consult with and help me with my teaching. (3)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In my school, teachers frequently consult with and help my program. (5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In my school, I can count on most staff to help out anywhere, anytime - even though it may not be part of their official assignment. (6)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In my school, most of my colleagues share my beliefs about what the central mission of the school should be. (7)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
In my school, teachers, including myself, take a major role in shaping the school's norms, values and practices. (8)

For quality purposes, please select 'Strongly disagree' for this statement (9)

---

**Start of Block: Persistence Intentions**

**Q101 To what extent do you agree with the following statements regarding your intentions to remain in the teaching profession?**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree (1)</th>
<th>Agree (2)</th>
<th>Somewhat agree (3)</th>
<th>Somewhat disagree (4)</th>
<th>Disagree (5)</th>
<th>Strongly disagree (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I plan to remain a TEE teacher until I retire. (5)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It would take something quite drastic for me to leave my position as a TEE teacher. (6)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I plan to remain teaching until I am physically no longer able to teach. (7)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I plan to leave the teaching profession sometime before I am eligible to retire. (8)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am preparing for the right opportunity to leave my teaching job. (9)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I plan to leave teaching as soon as I can. (13)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

---

**Start of Block: Job Satisfaction**

**Q126 Some jobs are more interesting and satisfying than others. We want to know how you feel about your job. For each statement below, use the following scale to indicate which is most descriptive of your current job:**
<table>
<thead>
<tr>
<th>I feel satisfied with my present job. (1)</th>
<th>Strongly agree (9)</th>
<th>Agree (10)</th>
<th>Somewhat agree (11)</th>
<th>Somewhat disagree (13)</th>
<th>Disagree (14)</th>
<th>Strongly disagree (15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most days I am enthusiastic about my work. (2)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>I find real enjoyment in my work. (4)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>I consider my job rather unpleasant. (5)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>I know of other jobs that I qualify for that pay more money. (12)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>I feel overworked for the amount of money I am paid. (13)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Each day of work seems like it will never end. (14)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

End of Block: Job Satisfaction

Start of Block: Institutional Factors

**Q118 Which of the following programs / supports exist in your school, district, or state to support technology and/or engineering teachers remaining in the profession?**

- Teacher Mentor Program (1)
- New Teacher Induction Program (2)
- Leadership Development Opportunities (3)
- Competitive pay (4)
- Professional Association Professional Development (6)
- State Professional Development Programs (7)
- District content area specific Professional Development (8)
- Other (please specify) (5)

Skip To: Q127 if Condition: Selected Count Is Less Than 1. Skip To: To what extent do you agree that the ....

Carry Forward Selected Choices - Entered Text from "Which of the following programs / supports exist in your school, district, or state to support technology and/or engineering teachers remaining in the profession?"
**Q124 How much do each of the below programs / supports influence you to remain as a technology and/or engineering teacher?**

<table>
<thead>
<tr>
<th>Program</th>
<th>None at all (49)</th>
<th>A little (50)</th>
<th>A moderate amount (51)</th>
<th>A lot (52)</th>
<th>A great deal (53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Mentor Program (x1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>New Teacher Induction Program (x2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Leadership Development Opportunities (x3)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Competitive pay (x4)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Professional Association Professional Development (x6)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>State Professional Development Programs (x7)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>District content area specific Professional Development (x8)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (please specify) (x5)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Q127 To what extent do you agree that the following items influence you to remain as a technology and/or engineering teacher?**

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly agree (12)</th>
<th>Agree (13)</th>
<th>Somewhat agree (14)</th>
<th>Somewhat disagree (16)</th>
<th>Disagree (17)</th>
<th>Strongly disagree (18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building administrative support for your CTE program. (1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>District administrative support for your CTE program. (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Community support for your CTE program. (3)</td>
<td></td>
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<td>--------------------------------------------</td>
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</tr>
<tr>
<td>Financial support for your CTE Program. (4)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Facilities support for your CTE program. (5)</td>
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</tbody>
</table>

**Q129 To what extent do you agree that the following items influence you to look for alternative employment outside of the teaching profession?**

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree (9)</th>
<th>Agree (10)</th>
<th>Somewhat agree (11)</th>
<th>Somewhat disagree (13)</th>
<th>Disagree (14)</th>
<th>Strongly disagree (15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The difficulty</td>
<td></td>
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<tr>
<td>associated with</td>
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<td>earning my</td>
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<tr>
<td>teaching license.</td>
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<td>(1)</td>
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<td>The extra</td>
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<td>paperwork that my</td>
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<td>school district</td>
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<td>requires me to fill</td>
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<td>out. (2)</td>
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<td>The intense focus</td>
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<td>on achieving high</td>
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<td></td>
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<td>test scores. (3)</td>
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<td>The requirement to</td>
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<td>earn extra</td>
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<td>education beyond</td>
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<td>what was required</td>
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<td>to enter the</td>
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<td>profession (such as</td>
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<td>an English as a</td>
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<td>Second Language</td>
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<td>endorsement). (4)</td>
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</tr>
</tbody>
</table>


Q130 If you could change your current job, what would be the reason you would? Respond "N/A" if there are no factors that would push you from your current job.

________________________________________________________________

Q132 What are some of the challenges you are dealing with that may drive you out of the profession early? Respond "N/A" if you don't have any challenges that would drive you out of the profession.

________________________________________________________________

End of Block: Institutional Factors

Start of Block: Professional Demographic Questions

Q128 Including the current year, how many years have you been teaching in the teaching profession? (Please include teaching of all subject areas, even those that are not in CTE)

___________________________________

Q18 Including the current year, how many years have you been teaching Technology and/or Engineering Education classes?

________________________________________________________________

Q19 Select the option that best represents how you earned your teaching license.

- State issued at the time of graduation from a teacher preparation program (1)
- State issued at the time of completion of an alternative licensing program (2)
- Emergency authorization for while licensing requirements are met (3)
- I don't have a teaching license (4)
- Other (please specify): (5)

________________________________________________________________

Q48 At what level do you primarily teach Technology and/or Engineering Education classes?

- Junior high / middle school (1)
- High school (2)

End of Block: Professional Demographic Questions
Start of Block: Personal Demographic

Q2 What is your gender?
   o Male  (4)
   o Female  (5)
   o Other  (8) ________________________________________________

Q77 In which state do you currently teach in?
   ▼ Alabama (1) ... I do not reside in the United States (53)

Q116 During the current school year, what is your gross annual teaching salary?
   o $30,000 and lower  (1)
   o $30,000 - $45,000  (2)
   o $45,000 - $60,000  (3)
   o $60,000 - $75,000  (4)
   o $75,000 - $90,000  (5)
   o $90,000 and up  (6)

End of Block: Personal Demographic
Appendix G
Qualitative Recruitment Questionnaire
Qualitative Follow-up

Survey Flow

| Standard: IRB (1 Question) |
| Block: Default Question Block (6 Questions) |

Start of Block: IRB

Q4 You are invited to participate in a research study by Dr. Tyson J. Sorensen, an Assistant Professor and Cory Ortiz, a Graduate Student in Applied Sciences, Technology & Education, at Utah State University. **The purpose of this research** is to identify the factors that predict TEE teachers’ persistence in teaching and to examine the teaching experiences of TEE teachers in relation to retention. Simply put, this study seeks to answer the question, “What keeps the Technology and Engineering Education teacher in the classroom?”

**Your participation in this study is voluntary** and you may withdraw your participation at any time for any reason prior to the researchers de-identifying the recorded video. After deidentification has occurred, you will not be able to withdraw from the study. If you want to skip one of the interview questions, you can do so by informing the interviewer at any point. You are also able to end the Zoom meeting during any portion of the interview.

If you take part in this study, you will be asked to participate in a 15-minute semi-structured recorded video interview inquiring about what keeps TEE teachers in the classroom. There is no cost to you except your time. You may answer some or none of the questions. **This is a minimal risk research study.** That means that the risks of participating are no more likely or serious than those you encounter in everyday activities. The foreseeable risks include the potential for the loss of confidentiality. However, confidentiality will be kept to the extent permitted by the technology being used. Although every precaution will be taken to ensure confidentiality, the security of information collected from you online cannot be guaranteed. Information collected online can be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. In order to minimize those risks and discomforts, the researchers will securely store data collected in a restricted-access folder on Box.com. **We will make every effort to ensure that the information you provide remains confidential.** We will not reveal your identity in any publications, presentations, or reports resulting from this research study.

We will collect your question responses via recorded Zoom interview. If you choose to take part in the interview for this portion of the study, your interview will be recorded. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This interview recording will be securely stored in a restricted-access folder on Box.com. All identifiers will be destroyed as soon as all data has been compiled in the electronic analysis program and quality confirmation
is complete.

**While you will not be compensated for your participation in this research study, your responses will greatly contribute** to the field of Technology and Engineering Education and our understanding of what factors contribute to the retention of teachers in the classroom.

You can decline to participate in any part of this study for any reason and can end your participation at any time. If you have any questions about this study, you can contact Tyson Sorensen, Ph.D. at tyson.sorensen@usu.edu or Cory Ortiz at cory.ortiz@usu.edu. Thank you again for your time and consideration. If you have any concerns about this study, please contact Utah State University’s Human Research Protection Office at (435) 797-0567 or irb@usu.edu and reference IRB Protocol #11981.

**Informed Consent**

By signing below, you agree to participate in this study. You indicate that you understand the risks and benefits of participation, and that you know what you will be asked to do. You also agree that you have asked any questions you might have, and are clear on how to stop your participation in the study if you choose to do so. Please be sure to retain a copy of this form for your records.

---

**Start of Block: Default Question Block**

Q3 What is your preferred email?

____________________________________________________________________

Q5 What is your name?

____________________________________________________________________

Q6 Including the current year, how many years have you been teaching Technology and/or Engineering Education classes?

____________________________________________________________________

Q7 What is your biological sex?

____________________________________________________________________
Q1 Select the option that best represents how you earned your teaching license.
   o State issued at the time of completion of an alternative licensing program (1)
   o Emergency authorization for while licensing requirements are met (2)
   o State issued at the time of graduation from a teacher preparation program (3)
   o I don't have a teaching license (4)
   o Other (5) ________________________________

Q8 What ACTE region do you live in?
   o Region I (1)
   o Region II (2)
   o Region III (3)
   o Region IV (4)
   o Region V (5)

End of Block: Default Question Block
Appendix H
Interview Protocol
Interview Protocol

General Procedures:

1. Set up zoom conference adhering to at the participants schedule using Calendly
2. Email questions ahead of time to the participants
3. After participants join zoom meeting, seek permission to record the interview
4. Verify the interview is being recorded
5. Ask one question at a time
6. Attempt to remain as neutral as possible
7. Encourage responses
8. Provide transition between major topics
9. Do not lose control of the interview
10. Use sound listening techniques
11. Follow the respondent. Follow up new information that they bring up without losing sense of where you are in the interview.
12. Follow post-interview procedures.

Notes to interviewee: Hello, as you know my name is Cory Ortiz, and I would like to thank you for agreeing to participate in this interview exploring teacher retention in Technology and Engineering Education. During this interview, I will be taking notes and would like to record the zoom meeting. “Do I have your permission to record this interview”?

First of all, I would like to thank you for participating in this interview. Throughout this study, I will take steps to protect your identity by using a pseudonym instead of your legal name. I will not mention anything identifiable in anything that is published. I will modify identifying factors that you choose to share with me. Your responses in part or in full, can, however, be published in this dissertation.

Please know that any time you feel uncomfortable during this interview and do not want to answer specific questions, that is fine. We can choose to skip the question or terminate the interview. If at any time you do not want to continue this interview, please let me know, and we will stop the interview. Do you understand?

Interview Questions:

1. What things keep you in the teaching profession?
   a. Why or how?
2. How does administration play a part in influencing you to remain or leave the profession?
3. How has salary / benefits influenced your decision to remain in the profession?
   a. Has industry ever attempted to recruit you for a higher paying position?
4. What specific parts of your job might influence you to leave the profession early?
5. Describe teacher professional development that your school district has offered that has been instrumental in keeping you invested in the profession.
   a. Describe the applicability of current professional development to CTE in your district.
   b. What professional development programs in your district exist that have increased your career satisfaction?

**Closure** This concludes our interview. Do you have any questions? I would like to thank you again for your participation. Please feel free to follow up with me at any time in regards to this interview and study results. Here is my contact information.

**Post Interview Procedures:**

1. Save video file in a password protected Box.com folder
2. Make digitize any written notes
3. Record any observations made during the interview
Appendix I
Data Analysis
Dissertation Data Analysis

Utah State University

Cory Ortiz

Spring 2022

Data Wrangling

Data Import

Main data set and Non-response data

Assessing who did not meet inclusion criteria in main data set

dissertation_phd_raw %>%
  furniture::tableF(teachTEE)

---

<table>
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<th>teachTEE</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
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</tr>
<tr>
<td>Yes</td>
<td>101</td>
<td>121</td>
<td>83.47%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

# Remove 'no' from sample size
dissertation_phd_clean <- dissertation_phd_raw %>%
  dplyr::filter(teachTEE == "Yes")

Reverse Coding
cols = c("pres4","pres5","pres6", "jobsat4","jobsat5","jobsat6", "jobsat7")
dissertation_phd_clean[ ,cols] = 7 - dissertation_phd_clean[ ,cols]
cols = c("pres4","pres5","pres6", "jobsat4","jobsat5","jobsat6", "jobsat7")
non_resp[ ,cols] = 7 - non_resp[ ,cols]

Data Wrangling - Mutating Variables, Creating Factors, and Averaging Constructs main data set
dissertation_phd_clean <- dissertation_phd_clean %>%
  dplyr::rename_all(tolower) %>%
  dplyr::mutate(genderF = factor(gender,
levels = c("M", "F"),
labels = c("Male", "Female"))) %>%
dplyr::mutate(diffteachlicF = factor(diffteachlic,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>%
dplyr::mutate(extrapaperworkF = factor(extrapaperwork,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>%
dplyr::mutate(testscoresF = factor(testscores,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>%
dplyr::mutate(extraeduF = factor(extraedu,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>%
dplyr::mutate(facilF = factor(facil,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>%
dplyr::mutate(finanF = factor(finan,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>%
dplyr::mutate(commsuppF = factor(commsupp,
levels = c("1","2","3","4","5","6"),
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
            "Somewhat Agree", "Agree","Strongly Agree"))) %>>
dplyr::mutate(disadminF = factor(disadmin, 
levels = c("1","2","3","4","5","6"), 
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
"Somewhat Agree", "Agree","Strongly Agree")))

%>>%

dplyr::mutate(buildsuppF = factor(buildsupp, 
levels = c("1","2","3","4","5","6"), 
labels = c("Strongly Disagree", "Disagree","Somewhat Disagree ",
"Somewhat Agree", "Agree","Strongly Agree")))

%>>%

dplyr::mutate(efficacy =
  (teachereff1 + teachereff2 + teachereff3 +
teachereff4 + teachereff5 + teachereff6 +
teachereff7 + teachereff8 + teachereff9 +
teachereff10 + teachereff11 + teachereff12)
  / 12 , na.rm = TRUE) %>>%

dplyr::mutate(efficacy = as.numeric(efficacy)) %>>%

dplyr::mutate(belong =
  (senseofbelong1 + senseofbelong2 + senseofbelong3 +
senseofbelong4 + senseofbelong5 + senseofbelong6 +
senseofbelong7 + senseofbelong8)
  / 8 , na.rm = TRUE) %>>%

dplyr::mutate(belong = as.numeric(belong)) %>>%

dplyr::mutate(persist =
  (pres1 + pres2 + pres3 +
pres4 + pres5 + pres6)
  / 6, na.rm = TRUE) %>>%

dplyr::mutate(persist = as.numeric(persist)) %>>%

dplyr::mutate(jobsat =
  (jobsat1 + jobsat2 + jobsat3 +
jobsat4 + jobsat5 + jobsat6 +
jobsat7)
  / 7, na.rm = TRUE) %>>%

dplyr::mutate(jobsat = as.numeric(jobsat)) %>>%
```r
dplyr::mutate(range = case_when(
  years.tee < 5 ~ 'early',
  years.tee < 20 ~ 'middle',
  years.tee > 21 ~ 'end'))

regionlist <- list(
  Region_II = c("Alabama", "Florida", "Georgia", "Kentucky", "North Carolina", "South Carolina", "Tennessee", "Virginia"),
  Region_III = c("Iowa", "Illinois", "Indiana", "Minnesota", "Missouri", "Wisconsin"),
  Region_IV = c("Arkansas", "Louisiana", "Mississippi", "New Mexico", "Oklahoma", "Texas"),
)

regionconvert <- function(x, lookup) {
  out <- x[NA]
  for (nm in names(lookup)) {
    ind <- x %in% lookup[[nm]]
    out[ind] <- nm
  }
  return(out)
}

dissertation_phd_clean <- dissertation_phd_clean %>%
  dplyr::mutate(region = regionconvert(state, regionlist))

Data Wrangling - Mutating Variables, Creating Factors, and Averaging Constructs non response

non_resp <- non_resp %>%
  dplyr::rename_all(tolower) %>%
  mutate_if(is.double, as.integer) %>%

  dplyr::mutate(efficacyNR =
    (teachereff1 + teachereff2 + teachereff3 + teachereff4 + teachereff5 + teachereff6 + teachereff7 + teachereff8 + teachereff9 + teachereff10 + teachereff11 + teachereff12) / 12 , na.rm = TRUE) %>%
```

This code snippet demonstrates data wrangling techniques using the `dplyr` package in R. It includes the following steps:

1. **Creating a range variable**: The `range` variable is created using the `case_when` function to categorize the `years.tee` values into 'early', 'middle', or 'end' categories.
2. **Defining the region list**: The `regionlist` is defined as a list of regions with different states.
3. **Function for region conversion**: The `regionconvert` function is defined to convert state names to region names.
4. **Applying region conversion**: The `dissertation_phd_clean` data frame is mutated with the `regionconvert` function.
5. **Data wrangling steps**: Additional data wrangling steps are shown, including:
   - Renaming columns to lowercase
   - Converting double columns to integers
   - Calculating a new variable `efficacyNR` by averaging several `teachereff` variables, with missing values removed using `na.rm = TRUE`.

These steps are essential for preparing data for analysis, making sure that the data is in a suitable format for further statistical analysis or modeling.
dplyr::mutate(belongNR = (senseofbelong1 + senseofbelong2 + senseofbelong3 + senseofbelong4 + senseofbelong5 + senseofbelong6 + senseofbelong7 + senseofbelong8) / 8, na.rm = TRUE) %>%
dplyr::mutate(persistNR = (pres1 + pres2 + pres3 + pres4 + pres5 + pres6) / 6, na.rm = TRUE) %>%
dplyr::mutate(jobsatNR = (jobsat1 + jobsat2 + jobsat3 + jobsat4 + jobsat5 + jobsat6 + jobsat7) / 7, na.rm = TRUE)

Descriptive Statistics non response data set

Model Constructs

non_resp %>%
dplyr::select(jobsatNR, persistNR, belongNR, efficacyNR) %>%
psych::describe(IQ = TRUE)

<table>
<thead>
<tr>
<th>vars</th>
<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
<th>mad</th>
<th>min</th>
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<td></td>
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<td></td>
</tr>
<tr>
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<td>0.64</td>
<td>4.43</td>
<td>4.28</td>
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<td>5.14</td>
<td>2.14</td>
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<td>5.83</td>
<td>4.83</td>
</tr>
<tr>
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<td>0.93</td>
<td>4.62</td>
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<tr>
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<td>6.00</td>
<td>2.00</td>
</tr>
<tr>
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<td></td>
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</tr>
</tbody>
</table>
## Descriptive Statistics main data set

Model Constructs

```r
dissertation_phd_clean %>%
dplyr::select(jobsat, persist, belong, efficacy) %>%
psych::describe(IQ = TRUE)
```

<table>
<thead>
<tr>
<th>vars</th>
<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
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<td>3.25</td>
<td>6.00</td>
<td>2.75</td>
<td>1.43</td>
</tr>
</tbody>
</table>

Descriptive statistics for additional variables in main data set

```r
dissertation_phd_clean %>%
dplyr::select(buildsupp, disadmin, commsupp, finan, facil, diffteachlic, extrapaperwork, testscores, extraedu) %>%
psych::describe(IQ = TRUE)
```

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<tr>
<th>vars</th>
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<th>sd</th>
<th>median</th>
<th>trimmed</th>
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</tbody>
</table>
Non Response bias testing

Visualizations

```r
p1 <- dissertation_phd_clean %>%
ggplot(aes(x = "jobsat Full Data",
y = jobsat)) +
geom_boxplot()+
   expand_limits(x = 0, y = 0)

p2 <- non_res %>%
ggplot(aes(x = "jobsat NR",
y = jobsatNR)) +
geom_boxplot()+
   expand_limits(x = 0, y = 0)

p3 <- dissertation_phd_clean %>%
ggplot(aes(x = "persist Full Data",
y = persist)) +
geom_boxplot()+
   expand_limits(x = 0, y = 0)

p4 <- non_res %>%
ggplot(aes(x = "persist NR",
y = persistNR)) +
geom_boxplot()+
   expand_limits(x = 0, y = 0)

p5 <- dissertation_phd_clean %>%
ggplot(aes(x = "belong Full Data",
y = belong)) +
geom_boxplot()+
   expand_limits(x = 0, y = 0)
```

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<tr>
<th></th>
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<th>se</th>
<th>IQR</th>
<th></th>
<th>mean</th>
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</table>

Kurtosis, se, IQR

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<td>3.00</td>
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</table>
\begin{verbatim}

y = belong()) +
geom_boxplot()+
expand_limits(x = 0, y = 0)

p6 <- non_res %>%
ggplot(aes(x = "belongNR NR",
    y = belongNR)) +
geom_boxplot()+
expand_limits(x = 0, y = 0)

p7 <- dissertation_phd_clean %>%
ggplot(aes(x = "efficacy Full Data",
    y = efficacy)) +
geom_boxplot()+
expand_limits(x = 0, y = 0)

p8 <- non_res %>%
ggplot(aes(x = "efficacy NR",
    y = efficacyNR)) +
geom_boxplot()+
expand_limits(x = 0, y = 0)

grid.arrange(p1, p2, ncol=2)

\end{verbatim}
grid.arrange(p7, p8, ncol=2)
Assumptions for T-Test - independent samples

Assumption 1: Are the two samples independent? Yes, since the samples from respondents and non-respondents are not related as per the design of the study.

Assumption 2: Are the data from each of the 2 groups follow a normal distribution?

Shapiro-Wilk normality test - Null hypothesis: the data are normally distributed - Alternative hypothesis: the data are not normally distributed.

THIS ASSUMPTION IS VIOLATED

```r
# Shapiro-Wilk normality test with non response data
with(non_resp, shapiro.test(jobsatNR))

Shapiro-Wilk normality test
data: jobsatNR
W = 0.92458, p-value = 0.1375

with(non_resp, shapiro.test(persistNR))

Shapiro-Wilk normality test
```
data:  persistNR
W = 0.92781, p-value = 0.1578
with(non_res, shapiro.test(belongNR))

    Shapiro-Wilk normality test
data:  belongNR
W = 0.96716, p-value = 0.7185
with(non_res, shapiro.test(efficacyNR))

    Shapiro-Wilk normality test
data:  efficacyNR
W = 0.96844, p-value = 0.7448

# Shapiro-Wilk normality test with main data set
with(dissertation_phd_clean, shapiro.test(jobsat))

    Shapiro-Wilk normality test
data:  jobsat
W = 0.97585, p-value = 0.107
with(dissertation_phd_clean, shapiro.test(persist)) # Not normal, 
p = 0.007139

    Shapiro-Wilk normality test
data:  persist
W = 0.95862, p-value = 0.007139
with(dissertation_phd_clean, shapiro.test(belong)) # Not normal, 
p = 0.001545

    Shapiro-Wilk normality test
data:  belong
W = 0.94676, p-value = 0.001545
with(dissertation_phd_clean, shapiro.test(efficacy)) # Not normal, 
p = 0.0002682
Shapiro-Wilk normality test

data:  efficacy
W = 0.93582, p-value = 0.0002682

P-values are at or around the significance level 0.05 implying that the distribution of the data are significantly different from the normal distribution.

Note the data are not normally distributed, so it’s recommended to use the non-parametric two-samples Wilcoxon rank test. The unpaired two-samples Wilcoxon test is a non-parametric alternative to the unpaired two-samples t-test, which can be used to compare two independent groups of samples. It’s used when your data are not normally distributed.

Wilcoxon test

wil1NS <- wilcox.test(dissertation_phd_clean$jobsat, non_resp$jobsatNR, conf.int=TRUE)
wil2NS <- wilcox.test(dissertation_phd_clean$persist, non_resp$persistNR, conf.int=TRUE)
wil3NS <- wilcox.test(dissertation_phd_clean$belong, non_resp$belongNR, conf.int=TRUE)
wil4NS <- wilcox.test(dissertation_phd_clean$efficacy, non_resp$efficacyNR, conf.int=TRUE)

wil1NS  ## significant differences between responders and non responders, p = 0.0323

Wilcoxon rank sum test with continuity correction

data:  dissertation_phd_clean$jobsat and non_resp$jobsatNR
W = 566, p-value = 0.03679
alternative hypothesis: true location shift is not equal to 0
95 percent confidence interval:
  -8.572025e-01  -6.467136e-05
sample estimates:
difference in location
  -0.4285768

wil2NS
Wilcoxon rank sum test with continuity correction

data: dissertation_phd_clean$persist and non_resp$persistNR
W = 738.5, p-value = 0.4707
alternative hypothesis: true location shift is not equal to 0
95 percent confidence interval:
-1.000046 0.333383
sample estimates:
difference in location
-0.3333053

wil3NS

Wilcoxon rank sum test with continuity correction

data: dissertation_phd_clean$belong and non_resp$belongNR
W = 741, p-value = 0.5782
alternative hypothesis: true location shift is not equal to 0
95 percent confidence interval:
-0.749970 0.374978
sample estimates:
difference in location
-0.1249701

wil4NS

Wilcoxon rank sum test with continuity correction

data: dissertation_phd_clean$efficacy and non_resp$efficacyNR
W = 1016.5, p-value = 0.1682
alternative hypothesis: true location shift is not equal to 0
95 percent confidence interval:
-0.08336487 0.49992129
sample estimates:
difference in location
0.1666999

Bonferroni correction - divide the original alpha level by the number of tests being performed.

(0.05)/4 new significant alpha level

[1] 0.0125
None of the above Wilcoxon tests are significant with the Bonferroni adjusted significance level of $p = 0.0125$

**Effect sizes and power**

```r
dissertation_phd_clean_non <- dissertation_phd_clean %>%
  dplyr::select(jobsat, persist, belong, efficacy) %>%
  mutate_if(is.double, as.integer)

non_resp <- non_resp %>%
  dplyr::select(jobsatNR, persistNR, belongNR, efficacyNR) %>%
  mutate_if(is.double, as.integer)

n1.1.1 = length(dissertation_phd_clean_non$jobsat)
n2.2.2 = length(non_resp$jobsatNR)

zstat1 <- qnorm(wil1NS$p.value/2)
zstat2 <- qnorm(wil2NS$p.value/2)
zstat3 <- qnorm(wil3NS$p.value/2)
zstat4 <- qnorm(wil4NS$p.value/2)

d1 <- abs(zstat1)/sqrt(n1.1.1+n2.2.2)# Standardized test statistic z by the square root of the number of pairs
d2 <- abs(zstat2)/sqrt(n1.1.1+n2.2.2)
d3 <- abs(zstat3)/sqrt(n1.1.1+n2.2.2)
d4 <- abs(zstat4)/sqrt(n1.1.1+n2.2.2)

s1.1 <- sd(dissertation_phd_clean_non$jobsat, na.rm=TRUE)
s1.4 <- sd(dissertation_phd_clean_non$persist, na.rm=TRUE)
s1.3 <- sd(dissertation_phd_clean_non$belong, na.rm=TRUE)
s1.2 <- sd(dissertation_phd_clean_non$efficacy, na.rm=TRUE)

s2.1 <- sd(non_resp$jobsatNR, na.rm=TRUE)
s2.4 <- sd(non_resp$persistNR, na.rm=TRUE)
s2.3 <- sd(non_resp$belongNR, na.rm=TRUE)
s2.2 <- sd(non_resp$efficacyNR, na.rm=TRUE)

n1.1 <- length(dissertation_phd_clean_non$jobsat)
n1.2 <- length(dissertation_phd_clean_non$persist)
n1.3 <- length(dissertation_phd_clean_non$belong)
n1.4 <- length(dissertation_phd_clean_non$efficacy)

n2.1 <- length(non_resp$jobsatNR)
n2.2 <- length(non_resp$persistNR)
n2.3 <- length(non_resp$belongNR)
n2.4 <- length(non_resp$efficacyNR)```
\[ m_{1.1} <- \text{mean(dissertation_phd_clean_non$jobsat, na.rm=TRUE)} \]
\[ m_{1.4} <- \text{mean(dissertation_phd_clean_non$persist, na.rm=TRUE)} \]
\[ m_{1.3} <- \text{mean(dissertation_phd_clean_non$belong, na.rm=TRUE)} \]
\[ m_{1.2} <- \text{mean(dissertation_phd_clean_non$efficacy, na.rm=TRUE)} \]

\[ m_{2.1} <- \text{mean(non_resp$jobsatNR, na.rm=TRUE)} \]
\[ m_{2.4} <- \text{mean(non_resp$persistNR, na.rm=TRUE)} \]
\[ m_{2.3} <- \text{mean(non_resp$belongNR, na.rm=TRUE)} \]
\[ m_{2.2} <- \text{mean(non_resp$efficacyNR, na.rm=TRUE)} \]

\[ \text{pwr.t2n.test(n1 = n1.1, n2 = n2.1, d = d1, sig.level = 0.05)} \]

\[ \text{t test power calculation} \]
\[ \hspace{1cm} n_1 = 101 \]
\[ \hspace{1cm} n_2 = 19 \]
\[ \hspace{1cm} d = 0.1906103 \]
\[ \hspace{1cm} \text{sig.level} = 0.05 \]
\[ \hspace{1cm} \text{power} = 0.1176158 \]
\[ \hspace{1cm} \text{alternative} = \text{two.sided} \]

\[ \text{pwr.t2n.test(n1 = n1.2, n2 = n2.2, d = d2, sig.level = 0.05)} \]

\[ \text{t test power calculation} \]
\[ \hspace{1cm} n_1 = 101 \]
\[ \hspace{1cm} n_2 = 19 \]
\[ \hspace{1cm} d = 0.06585076 \]
\[ \hspace{1cm} \text{sig.level} = 0.05 \]
\[ \hspace{1cm} \text{power} = 0.05785164 \]
\[ \hspace{1cm} \text{alternative} = \text{two.sided} \]

\[ \text{pwr.t2n.test(n1 = n1.3, n2 = n2.3, d = d3, sig.level = 0.05)} \]

\[ \text{t test power calculation} \]
\[ \hspace{1cm} n_1 = 101 \]
\[ \hspace{1cm} n_2 = 19 \]
\[ \hspace{1cm} d = 0.05076194 \]
\[ \hspace{1cm} \text{sig.level} = 0.05 \]
\[ \hspace{1cm} \text{power} = 0.05465701 \]
\[ \hspace{1cm} \text{alternative} = \text{two.sided} \]

\[ \text{pwr.t2n.test(n1 = n1.4, n2 = n2.4, d = d4, sig.level = 0.05)} \]
t test power calculation

n1 = 101
n2 = 19
d = 0.125805
sig.level = 0.05
power = 0.0789803
alternative = two.sided

Reliability and Validity of Survey Instrument

Chronbach’s Alpha Full Survey

chronJob <- dissertation_phd_clean %>%
dplyr::select(
  jobsat1,
  jobsat2,
  jobsat3,
  jobsat4,
  jobsat5,
  jobsat6,
  jobsat7
)
CronbachAlpha(chronJob, na.rm = TRUE, conf.level = 0.95, cond = FALSE)

Cronbach Alpha         lwr.ci         upr.ci
0.8515030      0.8326515      0.8689412

chronpersist <- dissertation_phd_clean %>%
dplyr::select(
  pres1,
  pres2,
  pres3,
  pres4,
  pres5,
  pres6
)
CronbachAlpha(chronpersist, na.rm = TRUE, conf.level = 0.95)

Cronbach Alpha         lwr.ci         upr.ci
0.8964065      0.8820073      0.9095913

chronbelong <- dissertation_phd_clean %>%
dplyr::select(
  senseofbelong1,
```r
cronbachAlpha(chronbelong, na.rm = TRUE, conf.level = 0.95)
Cronbach Alpha lwr.ci upr.ci
  0.9367911  0.9293472  0.9437283

cronefficacy <- dissertation_phd_clean %>%
dplyr::select(
  teachereff1, teachereff2, teachereff3, teachereff4, teachereff5, teachereff6, teachereff7, teachereff8, teachereff9, teachereff10, teachereff11, teachereff12
)
cronbachAlpha(cronefficacy, na.rm = TRUE, conf.level = 0.95)
Cronbach Alpha lwr.ci upr.ci
  0.8849780  0.8745219  0.8949123

Survey Correlations all variables
factorcor <- dissertation_phd_clean %>%
dplyr::select(persist, belong, jobsat, efficacy, diffteachlic, extrapaperwork,
  testscores, extraedu, facil, finan, commsupp, disadmin, buildsupp)
corrplot.mixed(cor(factorcor, use = "complete.obs"),
  is.corr = TRUE,
  order = "AOE",
  insig = "blank",
  lower = "shade",
```
```
dissertation_phd_clean %>%
  furniture::table(persist, belong, jobsat, efficacy, diffteachlc, extrapaperwork,
                  testscores, extraedu, facil, finan, commsupp, disadmin, buildsupp,
                  na.rm = TRUE,
                  output = "markdown")
```

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<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RQ 1: How do personal and professional characteristics impact TEE teachers' intended persistence in teaching?

Descriptives by categorical variable

Job Satisfaction

dissertation_phd_clean %>%
furniture::table1(jobsat, splitby = "range", output = "markdown")

<table>
<thead>
<tr>
<th></th>
<th>early</th>
<th>end</th>
<th>middle</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>25</td>
<td>16</td>
<td>41</td>
</tr>
</tbody>
</table>

.jobsat

3.6 (0.8) 4.3 (0.7) 3.6 (1.1)

dissertation_phd_clean %>%
furniture::table1(jobsat, splitby = "region", output = "markdown")

<table>
<thead>
<tr>
<th>Region_I</th>
<th>Region_II</th>
<th>Region_III</th>
<th>Region_IV</th>
<th>Region_V</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>26</td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

.jobsat

4.3 (0.7) 3.9 (0.9) 4.4 (0.7) 3.7 (0.9) 3.4 (1.2)
Furniture::table1(jobsat, splitby = "gender", output = "markdown")

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>2</td>
<td>38</td>
</tr>
<tr>
<td>jobsat</td>
<td>4.1 (0.1)</td>
<td>3.5 (0.9)</td>
</tr>
</tbody>
</table>

Furniture::table1(jobsat, splitby = "level")

<table>
<thead>
<tr>
<th></th>
<th>High school</th>
<th>Junior high / middle school</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>2</td>
<td>75</td>
</tr>
<tr>
<td>jobsat</td>
<td>4.1 (0.1)</td>
<td>3.7 (1.0)</td>
</tr>
</tbody>
</table>

Furniture::table1(jobsat, splitby = "license")

<table>
<thead>
<tr>
<th>license</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 2</td>
</tr>
<tr>
<td>jobsat</td>
</tr>
<tr>
<td>4.1 (0.1)</td>
</tr>
<tr>
<td>Emergency authorization for while licensing requirements are met</td>
</tr>
<tr>
<td>n = 9</td>
</tr>
<tr>
<td>3.7 (0.8)</td>
</tr>
<tr>
<td>Other (please specify):</td>
</tr>
<tr>
<td>n = 11</td>
</tr>
<tr>
<td>3.5 (1.0)</td>
</tr>
<tr>
<td>State issued at the time of completion of an alternative licensing program</td>
</tr>
<tr>
<td>n = 30</td>
</tr>
</tbody>
</table>
3.8 (0.9)
State issued at the time of graduation from a teacher preparation program
n = 34
3.8 (1.1)

<table>
<thead>
<tr>
<th>salary</th>
<th>$30,000 - $45,000</th>
<th>$45,000 - $60,000</th>
<th>$60,000 - $</th>
</tr>
</thead>
<tbody>
<tr>
<td>jobsat</td>
<td>n = 2</td>
<td>n = 7</td>
<td>n = 37</td>
</tr>
<tr>
<td>$75,000</td>
<td>4.1 (0.1)</td>
<td>3.4 (1.3)</td>
<td>3.7 (0.9)</td>
</tr>
<tr>
<td>$90,000 - $90,000</td>
<td>n = 9</td>
<td>$90,000 and up</td>
<td>n = 9</td>
</tr>
<tr>
<td></td>
<td>4.1 (0.9)</td>
<td>3.9 (1.7)</td>
<td></td>
</tr>
</tbody>
</table>

Sense of Belonging

<table>
<thead>
<tr>
<th>region</th>
<th>Region_I</th>
<th>Region_II</th>
<th>Region_III</th>
<th>Region_IV</th>
<th>Region_V</th>
</tr>
</thead>
<tbody>
<tr>
<td>belong</td>
<td>n = 6</td>
<td>n = 25</td>
<td>n = 4</td>
<td>n = 20</td>
<td>n = 27</td>
</tr>
<tr>
<td></td>
<td>4.5(1.1)</td>
<td>4.7(1.0)</td>
<td>4.1(1.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region_I</td>
<td>Region_II</td>
<td>Region_III</td>
<td>Region_IV</td>
<td>Region_V</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-----------</td>
<td>------------</td>
<td>-----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2 (1.3)</td>
<td>4.3 (1.2)</td>
<td>4.8 (0.3)</td>
<td>4.5 (1.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.3 (1.2)</td>
<td>4.8 (0.3)</td>
<td>4.5 (1.1)</td>
<td>4.2 (1.1)</td>
<td></td>
</tr>
</tbody>
</table>

```r
dissertation_phd_clean %>%
furniture::table1(belong, splitby = "gender", output = "markdown")
```

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>belong</td>
<td>n = 3</td>
<td>n = 36</td>
</tr>
<tr>
<td></td>
<td>3.8 (2.1)</td>
<td>4.2 (1.1)</td>
</tr>
</tbody>
</table>

```r
dissertation_phd_clean %>%
furniture::table1(belong, splitby = "level")
```

<table>
<thead>
<tr>
<th>level</th>
<th>High school</th>
<th>Junior high / middle school</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 3</td>
<td>n = 73</td>
<td>n = 9</td>
</tr>
<tr>
<td>belong</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.8 (2.1)</td>
<td>4.3 (1.1)</td>
<td>4.5 (1.4)</td>
</tr>
</tbody>
</table>

```r
dissertation_phd_clean %>%
furniture::table1(belong, splitby = "license")
```

<table>
<thead>
<tr>
<th>license</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 3</td>
</tr>
<tr>
<td>belong</td>
</tr>
<tr>
<td>3.8 (2.1)</td>
</tr>
<tr>
<td>Emergency authorization for while licensing requirements are met</td>
</tr>
<tr>
<td>n = 9</td>
</tr>
<tr>
<td>3.6 (1.6)</td>
</tr>
<tr>
<td>Other (please specify):</td>
</tr>
<tr>
<td>n = 11</td>
</tr>
<tr>
<td>4.4 (1.1)</td>
</tr>
</tbody>
</table>
State issued at the time of completion of an alternative licensing program  
\( n = 29 \)  
4.4 (1.1)

State issued at the time of graduation from a teacher preparation program  
\( n = 33 \)  
4.5 (1.0)

---

```
dissertation_phd_clean %>%  
furniture::table1(belong, splitby = "salary")
```

<table>
<thead>
<tr>
<th>salary</th>
<th>$30,000 - $45,000</th>
<th>$45,000 - $60,000</th>
<th>$60,000 - $75,000</th>
<th>$75,000 - $90,000</th>
<th>$90,000 and up</th>
</tr>
</thead>
<tbody>
<tr>
<td>75,000</td>
<td>n = 3</td>
<td>n = 7</td>
<td>n = 36</td>
<td>n = 21</td>
<td></td>
</tr>
<tr>
<td>belong</td>
<td>3.8 (2.1)</td>
<td>4.6 (1.3)</td>
<td>4.2 (1.3)</td>
<td>4.4 (1.0)</td>
<td></td>
</tr>
<tr>
<td>$75,000 - $90,000</td>
<td>n = 9</td>
<td>$90,000 and up</td>
<td>n = 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3 (1.0)</td>
<td>4.5 (1.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Teacher Efficacy**

```
dissertation_phd_clean %>%  
furniture::table1(efficacy, splitby = "range", output = "markdown ")
```

<table>
<thead>
<tr>
<th></th>
<th>early</th>
<th>end</th>
<th>middle</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>25</td>
<td>16</td>
<td>41</td>
</tr>
<tr>
<td>efficacy</td>
<td>5.1 (0.4)</td>
<td>5.3 (0.4)</td>
<td>5.2 (0.6)</td>
</tr>
</tbody>
</table>
dissertation_phd_clean %>%
furniture::table1(efficacy, splitby = "region", output = "markdown")

<table>
<thead>
<tr>
<th>Region_I</th>
<th>Region_II</th>
<th>Region_III</th>
<th>Region_IV</th>
<th>Region_V</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 6</td>
<td>n = 26</td>
<td>n = 5</td>
<td>n = 20</td>
<td>n = 27</td>
</tr>
</tbody>
</table>

efficacy  
5.2 (0.6) 5.3 (0.5) 5.2 (0.5) 5.2 (0.5) 5.2 (0.6)

dissertation_phd_clean %>%
furniture::table1(efficacy, splitby = "gender", output = "markdown")

<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 5</td>
<td>n = 38</td>
</tr>
</tbody>
</table>

efficacy  
5.5 (0.3) 5.2 (0.5) 5.2 (0.6)

dissertation_phd_clean %>%
furniture::table1(efficacy, splitby = "level")

<table>
<thead>
<tr>
<th>level</th>
<th>High school</th>
<th>Junior high / middle school</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 5</td>
<td>n = 75</td>
<td>n = 9</td>
</tr>
</tbody>
</table>

efficacy
5.5 (0.3) 5.2 (0.5) 5.1 (0.5)

dissertation_phd_clean %>%
furniture::table1(efficacy, splitby = "license")

<table>
<thead>
<tr>
<th>license</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 5</td>
</tr>
</tbody>
</table>

efficacy
5.5 (0.3)

Emergency authorization for while licensing requirements are met
n = 9
4.8 (0.8)
Other (please specify): 
n = 11

5.3 (0.4)
State issued at the time of completion of an alternative licensing program 
n = 30

5.3 (0.4)
State issued at the time of graduation from a teacher preparation program 
n = 34

5.3 (0.6)
-----------------------------------------------------------------
---------------------------------------------------------
-----------------------------------------------------------------
dissertation_phd_clean %>%
furniture::table1(efficacy, splitby = "salary")

-----------------------------------------------------------------
---------------------------------------------------------
salary
$30,000 - $45,000 $45,000 - $60,000 $60,000 - $75,000
      n = 5     n = 7             n = 37            n = 22
efficacy
$75,000 - $90,000 $90,000 and up
      n = 9             n = 9

5.5 (0.3) 5.3 (0.5) 5.0 (0.6) 5.4 (0.4)
-----------------------------------------------------------------
---------------------------------------------------------

Frequency table for respondents by state 
dissertation_phd_clean %>%
  filter(state != "") %>%
furniture::tableF(state, n=50)

---------------------------------------------------------
state    Freq CumFreq Percent CumPerc
<table>
<thead>
<tr>
<th>State</th>
<th>Frequency</th>
<th>Cumulative Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>3</td>
<td>3</td>
<td>3.57%</td>
<td>3.57%</td>
</tr>
<tr>
<td>Arkansas</td>
<td>1</td>
<td>4</td>
<td>1.19%</td>
<td>4.76%</td>
</tr>
<tr>
<td>California</td>
<td>1</td>
<td>5</td>
<td>1.19%</td>
<td>5.95%</td>
</tr>
<tr>
<td>Colorado</td>
<td>2</td>
<td>7</td>
<td>2.38%</td>
<td>8.33%</td>
</tr>
<tr>
<td>Florida</td>
<td>1</td>
<td>8</td>
<td>1.19%</td>
<td>9.52%</td>
</tr>
<tr>
<td>Georgia</td>
<td>17</td>
<td>25</td>
<td>20.24%</td>
<td>29.76%</td>
</tr>
<tr>
<td>Hawaii</td>
<td>2</td>
<td>27</td>
<td>2.38%</td>
<td>32.14%</td>
</tr>
<tr>
<td>Illinois</td>
<td>2</td>
<td>29</td>
<td>2.38%</td>
<td>34.52%</td>
</tr>
<tr>
<td>Indiana</td>
<td>2</td>
<td>31</td>
<td>2.38%</td>
<td>36.90%</td>
</tr>
<tr>
<td>Kansas</td>
<td>1</td>
<td>32</td>
<td>1.19%</td>
<td>38.10%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>2</td>
<td>34</td>
<td>2.38%</td>
<td>40.48%</td>
</tr>
<tr>
<td>Michigan</td>
<td>1</td>
<td>35</td>
<td>1.19%</td>
<td>41.67%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>3</td>
<td>38</td>
<td>3.57%</td>
<td>45.24%</td>
</tr>
<tr>
<td>Missouri</td>
<td>1</td>
<td>39</td>
<td>1.19%</td>
<td>46.43%</td>
</tr>
<tr>
<td>Nebraska</td>
<td>1</td>
<td>40</td>
<td>1.19%</td>
<td>47.62%</td>
</tr>
<tr>
<td>Nevada</td>
<td>4</td>
<td>44</td>
<td>4.76%</td>
<td>52.38%</td>
</tr>
<tr>
<td>New Mexico</td>
<td>1</td>
<td>45</td>
<td>1.19%</td>
<td>53.57%</td>
</tr>
<tr>
<td>New York</td>
<td>1</td>
<td>46</td>
<td>1.19%</td>
<td>54.76%</td>
</tr>
<tr>
<td>North Carolina</td>
<td>5</td>
<td>51</td>
<td>5.95%</td>
<td>60.71%</td>
</tr>
<tr>
<td>North Dakota</td>
<td>1</td>
<td>52</td>
<td>1.19%</td>
<td>61.90%</td>
</tr>
<tr>
<td>Ohio</td>
<td>3</td>
<td>55</td>
<td>3.57%</td>
<td>65.48%</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>12</td>
<td>67</td>
<td>14.29%</td>
<td>79.76%</td>
</tr>
<tr>
<td>Oregon</td>
<td>1</td>
<td>68</td>
<td>1.19%</td>
<td>80.95%</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1</td>
<td>69</td>
<td>1.19%</td>
<td>82.14%</td>
</tr>
<tr>
<td>Texas</td>
<td>3</td>
<td>72</td>
<td>3.57%</td>
<td>85.71%</td>
</tr>
<tr>
<td>Utah</td>
<td>9</td>
<td>81</td>
<td>10.71%</td>
<td>96.43%</td>
</tr>
<tr>
<td>Virginia</td>
<td>1</td>
<td>82</td>
<td>1.19%</td>
<td>97.62%</td>
</tr>
<tr>
<td>Washington</td>
<td>1</td>
<td>83</td>
<td>1.19%</td>
<td>98.81%</td>
</tr>
<tr>
<td>Wyoming</td>
<td>1</td>
<td>84</td>
<td>1.19%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

**Frequency table for respondents by ACTE Region**

```r
dissertation_phd_clean %>%
  filter(region != "") %>%
  furniture::tableF(region)
```

<table>
<thead>
<tr>
<th>Region</th>
<th>Frequency</th>
<th>Cumulative Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region_I</td>
<td>6</td>
<td>6</td>
<td>7.14%</td>
<td>7.14%</td>
</tr>
<tr>
<td>Region_II</td>
<td>26</td>
<td>32</td>
<td>30.95%</td>
<td>38.10%</td>
</tr>
<tr>
<td>Region_III</td>
<td>5</td>
<td>37</td>
<td>5.95%</td>
<td>44.05%</td>
</tr>
<tr>
<td>Region_IV</td>
<td>20</td>
<td>57</td>
<td>23.81%</td>
<td>67.86%</td>
</tr>
<tr>
<td>Region_V</td>
<td>27</td>
<td>84</td>
<td>32.14%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
```r
dissertation_phd_clean %>%
  filter(region != "") %>%
  ggplot(aes(x = region)) +
  geom_bar() +
  theme_bw() +
  ylab("Count") +
  xlab(" ") +
  scale_x_discrete(guide = guide_axis(angle = 45))
```

```
dissertation_phd_clean %>%
  filter(range != "") %>%
  furniture::table1(persist, splitby = "region", output = "markdown")
```

<table>
<thead>
<tr>
<th>Region</th>
<th>n</th>
<th>persist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region_I</td>
<td>6</td>
<td>4.2 (1.3)</td>
</tr>
<tr>
<td>Region_II</td>
<td>25</td>
<td>4.1 (1.3)</td>
</tr>
<tr>
<td>Region_III</td>
<td>4</td>
<td>4.6 (1.5)</td>
</tr>
<tr>
<td>Region_IV</td>
<td>20</td>
<td>3.9 (1.7)</td>
</tr>
<tr>
<td>Region_V</td>
<td>27</td>
<td>3.7 (1.5)</td>
</tr>
</tbody>
</table>

T test / ANOVA - ACTE Region

NOT NORMAL, assumption violated

```r
with(dissertation_phd_clean, shapiro.test(persist))
```

Shapiro-Wilk normality test

data:  persist
W = 0.95862, p-value = 0.007139
t.test.rgn <- dissertation_phd_clean %>%
dplyr::select(region, persist) %>%
filter(!region == "")
kruskal.test(persist ~ region, t.test.rgn)

Kruskal-Wallis rank sum test

data:  persist by region
Kruskal-Wallis chi-squared = 2.5726, df = 4, p-value = 0.6317

Frequency Table and Visualization for Respondents Teaching Length

dissertation_phd_clean %>%
filter(range != "") %>%
furniture::tableF(range)

<table>
<thead>
<tr>
<th>range</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>early</td>
<td>25</td>
<td>25</td>
<td>30.49%</td>
<td>30.49%</td>
</tr>
<tr>
<td>end</td>
<td>16</td>
<td>41</td>
<td>19.51%</td>
<td>50.00%</td>
</tr>
<tr>
<td>middle</td>
<td>41</td>
<td>82</td>
<td>50.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>


dissertation_phd_clean %>%
dplyr::select(years.tee) %>%
psych::describe(IQ=TRUE)

vars  n  mean    sd median trimmed  mad min max range skew kur tosis  se IQR
X1    1 84 12.13 10.13      9   10.76 8.15   1  50    49 1.27  1.33 1.1  13


dissertation_phd_clean %>%
filter(range != "") %>%
furniture::table1(persist, splitby = "range", output = "markdown")

<table>
<thead>
<tr>
<th></th>
<th>early</th>
<th>end</th>
<th>middle</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>25</td>
<td>16</td>
<td>41</td>
</tr>
<tr>
<td>persist</td>
<td>3.8 (1.5)</td>
<td>4.6 (0.9)</td>
<td>3.7 (1.5)</td>
</tr>
</tbody>
</table>

ggplot(aes(x = factor(range, level= c('early', 'middle', 'end'))) +
```r
dissertation_phd_clean %>%
  filter(range != "") %>%
  ggplot(aes(x = factor(range, level = c('early', 'middle', 'end'), y = persist)) +
    xlab(" ") +
    geom_boxplot()
```

```r
ggplot2::geom_bar() +
  ggplot2::theme_bw() +
  ggplot2::ggtitle("Teacher career length") +
  ggplot2::ylab("Count") +
  ggplot2::xlab(" ") +
  ggplot2::scale_x_discrete(guide = guide_axis(angle = 45))
```
T test / ANOVA YEARS IN TEE

NOT NORMAL, assumption violated

with(dissertation_phd_clean, shapiro.test(persist))

    Shapiro-Wilk normality test

data:  persist
W = 0.95862, p-value = 0.007139

t.test.rng <- dissertation_phd_clean %>%
  dplyr::select(range, persist) %>%
  filter(!range == "")

kruskal.test(persist ~ range, t.test.rng)

    Kruskal-Wallis rank sum test

data:  persist by range
Kruskal-Wallis chi-squared = 4.2745, df = 2, p-value = 0.118

t.test.yrs <- dissertation_phd_clean %>%
  dplyr::select(years.tee, persist) %>%
  filter(!years.tee == "")

t.test.yrs %>%
furniture::table1(years.tee)

-----------------------------------------------
  Mean/Count (SD/%)  
n = 84
  years tee  
  12.1 (10.1)
-----------------------------------------------

z_scores <- as.data.frame(sapply(t.test.yrs, function(t.test.yrs) (abs(t.test.yrs-mean(t.test.yrs))/sd(t.test.yrs))))
no_outliers <- z_scores[!rowSums(z_scores>3), ]

wilcox.test(no_outliers$persist, no_outliers$years.tee)

   Wilcoxon rank sum test with continuity correction

data:  no_outliers$persist and no_outliers$years.tee
\( W = 3772, p\text{-value} = 0.2907 \)

alternative hypothesis: true location shift is not equal to 0

**Frequency Table and Visualization for Respondents Gender**

dissertation_phd_clean %>%
  filter(gender != "") %>%
  furniture::tableF(gender)

<table>
<thead>
<tr>
<th>gender</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>38</td>
<td>38</td>
<td>45.24%</td>
<td>45.24%</td>
</tr>
<tr>
<td>Male</td>
<td>46</td>
<td>84</td>
<td>54.76%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

dissertation_phd_clean %>%
  filter(gender != "") %>%
  furniture::table1(persist, splitby = "gender", output = "markdown")

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>38</td>
<td>46</td>
</tr>
</tbody>
</table>

persist

3.8 (1.5) 4.0 (1.4)

dissertation_phd_clean %>%
  filter(gender != "") %>%
  ggplot(aes(gender)) +
  geom_bar() +
  theme_bw() +
  ggtitle("Teacher Gender") +
  ylab("Count") +
  xlab(" ") +
  scale_x_discrete(guide = guide_axis(angle = 45))
dissertation_phd_clean %>%
  filter(gender != "") %>%
  ggplot(aes(x = gender, y = persist)) +
  geom_boxplot()

T test / ANOVA GENDER

NOT NORMAL, assumption violated

with(dissertation_phd_clean, shapiro.test(persist))

Shapiro-Wilk normality test
data:  persist
W = 0.95862, p-value = 0.007139

t.test.gen <- dissertation_phd_clean %>%
  dplyr::select(gender, persist) %>%
  filter(!gender == "")
t.test(persist ~ gender, t.test.gen)

Welch Two Sample t-test

data:  persist by gender
t = -0.60639, df = 77.316, p-value = 0.546
alternative hypothesis: true difference in means between group Female and group Male is not equal to 0
95 percent confidence interval:
  -0.8193048  0.4367724
sample estimates:
mean in group Female  mean in group Male
  3.837719          4.028986

t.test.gen <- dissertation_phd_clean %>%
  dplyr::select(gender, persist) %>%
  filter(!gender == "")
wilcox.test(t.test.gen$persist ~ t.test.gen$gender)

Wilcoxon rank sum test with continuity correction

data:  t.test.gen$persist by t.test.gen$gender
W = 793.5, p-value = 0.4717
alternative hypothesis: true location shift is not equal to 0

Frequency table and Visualization for Respondents licensure type
dissertation_phd_clean %>%
  filter(license != "") %>%
ggplot(aes(x=factor(license)))+
  geom_bar()+
  theme_bw()+
  ggtitle("Teacher License") +
  ylab("Count") +
  xlab(" ") +
  scale_x_discrete(guide = guide_axis(angle = 45), labels =
      function(x) stringr::str_wrap(x, width = 15))
dissertation_phd_clean %>%
  filter(license !="") %>%
  furniture::tableF(license)

---

**license**
- Emergency authorization for while licensing requirements are met
- Other (please specify):
- State issued at the time of completion of an alternative licensing program
- State issued at the time of graduation from a teacher preparation program

<table>
<thead>
<tr>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>9</td>
<td>10.71%</td>
<td>10.71%</td>
</tr>
<tr>
<td>11</td>
<td>20</td>
<td>13.10%</td>
<td>23.81%</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>35.71%</td>
<td>59.52%</td>
</tr>
<tr>
<td>34</td>
<td>84</td>
<td>40.48%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

---

dissertation_phd_clean %>%
  filter(license !="") %>%
  furniture::table1(persist, splitby = "license", output = "markdown")
Emergency authorization for while licensing requirements are met | Other (please specify): | State issued at the time of completion of an alternative licensing program | State issued at the time of graduation from a teacher preparation program
---|---|---|---
n = 9 | n = 11 | n = 30 | n = 34

Persist

4.1 (1.4) | 4.1 (1.8) | 4.2 (1.3) | 3.6 (1.4)

dissertation_phd_clean %>%
  filter(license != "") %>%
  ggplot(aes(x = license, y = persist)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 45), labels =
  function(x) stringr::str_wrap(x, width = 15))

T test / ANOVA LICENSE

NOT NORMAL, assumption violated

with(dissertation_phd_clean, shapiro.test(persist))

Shapiro-Wilk normality test

data:  persist
W = 0.95862, p-value = 0.007139
t.test.lic <- dissertation_phd_clean %>%
dplyr::select(license, persist) %>%
filter(!license == "")
kruskal.test(persist ~ license, t.test.lic)

Kruskal-Wallis rank sum test

data: persist by license
Kruskal-Wallis chi-squared = 3.5676, df = 3, p-value = 0.3121

Frequency Table and Visualization for Respondents salary

dissertation_phd_clean %>%
filter(salary != "") %>%
furniture::tableF(salary)

------------------------------------------------
salary            Freq CumFreq Percent CumPerc
$30,000 - $45,000 7    7       8.33%   8.33%
$45,000 - $60,000 37   44      44.05%  52.38%
$60,000 - $75,000 22   66      26.19%  78.57%
$75,000 - $90,000 9    75      10.71%  89.29%
$90,000 and up    9    84      10.71%  100.00%
------------------------------------------------

dissertation_phd_clean %>%
filter(salary != "") %>%
furniture::table1(persist, splitby = "salary", output = "markd own")

<table>
<thead>
<tr>
<th></th>
<th>$30,000 - $45,000</th>
<th>$45,000 - $60,000</th>
<th>$60,000 - $75,000</th>
<th>$75,000 - $90,000</th>
<th>$90,000 and up</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>7</td>
<td>37</td>
<td>22</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>persist</td>
<td>4.1 (1.8)</td>
<td>3.9 (1.4)</td>
<td>3.9 (1.2)</td>
<td>4.0 (1.7)</td>
<td>3.8 (1.9)</td>
</tr>
</tbody>
</table>

dissertation_phd_clean %>%
filter(salary != "") %>%
ggplot(aes(x=factor(salary)))+
  geom_bar()+
  theme_bw() +
  ggtitle("Salary") +
  ylab("Count") +
  xlab(" ") +
  scale_x_discrete(guide = guide_axis(angle = 45))
T test / ANOVA SALARY

NOT NORMAL, assumption violated

with(dissertation_phd_clean, shapiro.test(persist))

Shapiro-Wilk normality test
data:  persist
W = 0.95862, p-value = 0.007139

t.test.sal <- dissertation_phd_clean %>%
dplyr::select(salary, persist) %>%
filter(!salary == "")
kruskal.test(persist ~ salary, t.test.sal)

Kruskal-Wallis rank sum test
data:  persist by salary
Kruskal-Wallis chi-squared = 0.31898, df = 4, p-value = 0.9886

Frequency Table and Visualization for Level of Teaching Respondents Served
dissertation_phd_clean %>%
filter(level != "") %>%
furniture::tableF(level)

----------------------------------------------------------
<table>
<thead>
<tr>
<th>level</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school</td>
<td>75</td>
<td>75</td>
<td>89.29%</td>
<td>89.29%</td>
</tr>
<tr>
<td>Junior high / middle school</td>
<td>9</td>
<td>84</td>
<td>10.71%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
----------------------------------------------------------

dissertation_phd_clean %>%
filter(level != "") %>%
furniture::table1(persist, splitby = "level", output = "markdown")

<table>
<thead>
<tr>
<th></th>
<th>High school</th>
<th>Junior high / middle school</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>75</td>
<td>9</td>
</tr>
<tr>
<td>persist</td>
<td>4.0 (1.4)</td>
<td>3.9 (1.4)</td>
</tr>
</tbody>
</table>

dissertation_phd_clean %>%
filter(level != "") %>%
ggplot(aes(x=factor(level)))+
  geom_bar()+
  theme_bw()+
  ggtitle("Level Taught at") +
  ylab("Count") +
  xlab("") +
  scale_x_discrete(guide = guide_axis(angle = 45))
dissertation_phd_clean %>%
  filter(level != "") %>%
  ggplot(aes(x = level, y = persist)) +
  geom_boxplot() +
  scale_x_discrete(guide = guide_axis(angle = 45))

T test / ANOVA LEVEL TAUGHT

NOT NORMAL, assumption violated

with(dissertation_phd_clean, shapiro.test(persist))

Shapiro-Wilk normality test
data: persist
W = 0.95862, p-value = 0.007139

t.test.lvl <- dissertation_phd_clean %>%
  dplyr::select(level, persist) %>%
  filter(!level == "")
t.test(persist ~ level, t.test.lvl)

Welch Two Sample t-test

data: persist by level
t = 0.20171, df = 10.05, p-value = 0.8442
alternative hypothesis: true difference in means between group High school and group Junior high / middle school is not equal to 0
95 percent confidence interval:
  -1.018766  1.221729
sample estimates:
  mean in group High school
        3.953333
  mean in group Junior high / middle school
        3.851852

t.test.lvl <- dissertation_phd_clean %>%
  dplyr::select(level, persist) %>%
  filter(!level == "")
wilcox.test(t.test.lvl$persist ~ t.test.lvl$level)

Wilcoxon rank sum test with continuity correction

data: t.test.lvl$persist by t.test.lvl$level
W = 345.5, p-value = 0.9135
alternative hypothesis: true location shift is not equal to 0

RQ 2, 3, and 4

Correlations
factorcor2 <- dissertation_phd_clean %>%
  dplyr::select(efficacy, belong, persist, jobsat)
corrplot.mixed(cor(factorcor2, use = "complete.obs"),
               is.corr = TRUE,
               insig = "blank",
               cormethod = "pearson")
Regression Model

```r
dissertation_phd_clean_no_na <- dissertation_phd_clean %>%
dplyr::select(persist, belong, jobsat, efficacy, diffteachlic, extrapaperwork, testscores, extraedu, facil, finan, commsupp, disadmin, buildsupp, salary, gender) %>%
dplyr::filter(complete.cases(persist, belong, jobsat, efficacy, diffteachlic, extrapaperwork, testscores, extraedu, facil, finan, commsupp, disadmin, buildsupp, salary, gender))
```

---

```
dissertation_phd_clean %>%
furniture::tableC(efficacy, belong, persist, jobsat, na.rm = TRUE, output = "markdown")
```

<table>
<thead>
<tr>
<th></th>
<th>[1]</th>
<th>[2]</th>
<th>[3]</th>
<th>[4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]efficacy</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[2]belong</td>
<td>0.384 (&lt;.001)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[3]persist</td>
<td>0.195 (0.076)</td>
<td>0.363 (&lt;.001)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>[4]jobsat</td>
<td>0.229 (0.036)</td>
<td>0.486 (&lt;.001)</td>
<td>0.681 (&lt;.001)</td>
<td>1.00</td>
</tr>
</tbody>
</table>
```r
# Analysis of data from dissertation_phd_clean_no_na

# Table 1
furniture::table1(persist, belong, jobsat, efficacy, output = "markdown")

### Mean/Count (SD/%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>persist</td>
<td>3.9 (1.4)</td>
</tr>
<tr>
<td>belong</td>
<td>4.3 (1.1)</td>
</tr>
<tr>
<td>jobsat</td>
<td>3.7 (1.0)</td>
</tr>
<tr>
<td>efficacy</td>
<td>5.2 (0.5)</td>
</tr>
</tbody>
</table>

# Regression Analysis

modmultiple <- dissertation_phd_clean_no_na %>%
  lm(persist ~ efficacy + jobsat + belong, data = .)

summary(modmultiple)

# Variation in the outcome explained by the predictors (R^2).

# Analysis of residuals

summary(modmultiple)
```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.043 on 77 degrees of freedom
Multiple R-squared:  0.4867,    Adjusted R-squared:  0.4667
F-statistic: 24.34 on 3 and 77 DF,  p-value: 3.535e-11

texreg::knitreg(modmultiple,
custom.model.names = "Constructs",
ci.force = TRUE,
quest 95% conf interv
caption = "Constructs",
single.row = TRUE)

<table>
<thead>
<tr>
<th>Constructs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-0.16</td>
</tr>
<tr>
<td>efficacy</td>
<td>0.07</td>
</tr>
<tr>
<td>jobsat</td>
<td>0.98</td>
</tr>
<tr>
<td>belong</td>
<td>0.02</td>
</tr>
<tr>
<td>R^2</td>
<td>0.49</td>
</tr>
<tr>
<td>Adj. R^2</td>
<td>0.47</td>
</tr>
<tr>
<td>Num. obs.</td>
<td>81</td>
</tr>
</tbody>
</table>

library(GGally)
dissertation_phd_clean_no_na %>%
dplyr::select(persist, belong, jobsat, efficacy) %>%
ggpairs()

Power Analysis (Persistence intentions)
\[ f^{2.4} = \frac{(0.4667)}{(1-0.4667)} \]

\[
pwr.f2.test(u=3, \# Number of Predictors
v=77, \# DF
f2=f2.4, \# r^2/(1-R^2)
sig.level=.01,
\]

\[
\text{Multiple regression power calculation}
\]

\[
u = 3 \\
v = 77 \\
f2 = 0.8751172 \\
sig.level = 0.01 \\
power = 0.9999996
\]

This model does contain sufficient power.

**Testing Regression Assumptions Multiple Regression (Persistence Intentions)**

\[
\text{ols_vif_tol(modmultiple)}
\]

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>efficacy</td>
<td>0.8558745</td>
</tr>
<tr>
<td>2</td>
<td>jobsat</td>
<td>0.7583078</td>
</tr>
<tr>
<td>3</td>
<td>belong</td>
<td>0.6866439</td>
</tr>
</tbody>
</table>

\[
\text{ols_eigen_cindex(modmultiple)}
\]

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Condition Index</th>
<th>intercept</th>
<th>efficacy</th>
<th>jobsat</th>
<th>belong</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.91711290</td>
<td>1.000000</td>
<td>0.0006454758</td>
<td>0.0005701454</td>
<td>0.00318811</td>
</tr>
<tr>
<td>0</td>
<td>0.002801192</td>
<td>9.353759</td>
<td>0.0606099705</td>
<td>0.0419596298</td>
<td>0.42892287</td>
</tr>
<tr>
<td>1</td>
<td>0.135050368</td>
<td>10.867175</td>
<td>0.0059759143</td>
<td>0.0002529606</td>
<td>0.56326492</td>
</tr>
<tr>
<td>0</td>
<td>0.810006873</td>
<td>28.138141</td>
<td>0.9327686394</td>
<td>0.9572172643</td>
<td>0.00462409</td>
</tr>
<tr>
<td>7</td>
<td>0.052141566</td>
<td>0.9572172643</td>
<td>0.00462409</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{ols_coll_diag(modmultiple)}
\]

<table>
<thead>
<tr>
<th>Tolerance and Variance Inflation Factor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>efficacy</td>
<td>0.8558745</td>
</tr>
<tr>
<td>2</td>
<td>jobsat</td>
<td>0.7583078</td>
</tr>
<tr>
<td>3</td>
<td>belong</td>
<td>0.6866439</td>
</tr>
</tbody>
</table>
### Eigenvalue and Condition Index

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Condition Index</th>
<th>intercept</th>
<th>efficacy</th>
<th>jobsa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.91711290</td>
<td>1.000000</td>
<td>0.0006454758</td>
<td>0.0005701454</td>
</tr>
<tr>
<td>2</td>
<td>0.04477069</td>
<td>9.353759</td>
<td>0.0606099705</td>
<td>0.0419596298</td>
</tr>
<tr>
<td>3</td>
<td>0.03316903</td>
<td>10.867175</td>
<td>0.0059759143</td>
<td>0.002529606</td>
</tr>
<tr>
<td>4</td>
<td>0.00494738</td>
<td>28.138141</td>
<td>0.9327686394</td>
<td>0.9572172643</td>
</tr>
</tbody>
</table>

### Residual diagnostics Persistence Intentions

```r
resid(modmultiple) %>%
  head()
```

```
1  2  3  4  5  6
1.2944217 0.3125361 -0.9249736 -0.6301950 1.3992959 1.0070352
```

```r
ols_plot_resid_fit_spread(modmultiple)
```

![Fit - Mean](image1)

![Residual](image2)

```r
plot(modmultiple)
```
Residuals vs Fitted

Fitted values
lm(persist ~ efficacy + jobsat + belong)

Normal Q-Q

Theoretical Quantiles
lm(persist ~ efficacy + jobsat + belong)
# Cooks D is influence
# Hat value is leverage
# Residuals are distance - look for large when screening out bad values

Regression with Job satisfaction as Outcome
modmultiple_jobsat <- dissertation_phd_clean_no_na %>%
lm(jobsat ~ efficacy + jobsat + belong, data = .)
summary(modmultiple_jobsat)$coefficient

|            | Estimate | Std. Error | t value | Pr(>|t|) |
|------------|----------|------------|---------|----------|
| (Intercept)| 1.44464  | 0.96301    | 1.500   | 1.376e-01|

Scale-Location
Fitted values
lm(persist ~ efficacy + jobsat + belong)

Residuals vs Leverage
lm(persist ~ efficacy + jobsat + belong)

Cook’s distance
Leverage
efficacy  0.0954355 0.1985661  0.4806235 6.321294e-01 
belong   0.41171280 0.09320627  4.4172223 3.182674e-05 

#variation in the outcome explained by the predictors (R^2).

summary(modmultiple_jobsat)

Call:
  lm(formula = jobsat ~ efficacy + belong, data = .)

Residuals:
   Min       1Q   Median       3Q      Max
-2.49381 -0.48181 -0.02031  0.63607  1.67353

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.44464    0.96301   1.500    0.138
efficacy     0.09544    0.19857   0.481    0.632
belong       0.41171    0.09321   4.417 3.18e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8815 on 78 degrees of freedom
Multiple R-squared:  0.2417,    Adjusted R-squared:  0.2222
F-statistic: 12.43 on 2 and 78 DF,  p-value: 2.061e-05

texreg::knitreg(modmultiple_jobsat, 
  custom.model.names = "Constructs", 
  ci.force = TRUE,              # request 95% conf interv
  caption = "Constructs", 
  single.row = TRUE)

Constructs

|            | Estimate | Std. Error | t value | Pr(>|t|) |
|------------|----------|------------|---------|---------|
| (Intercept)| 1.44     | 0.963      | 1.500   | 0.138   |
| efficacy   | 0.10     | 0.29       | 0.48    | 0.632   |
| belong     | 0.41     | 0.23       | 0.59    | *       |

R^2         | 0.24     |
Adj. R^2    | 0.22     |
Num. obs.   | 81       |

Power Analysis (Job Satisfaction)
f2.4.1=(0.222)/(1-0.222)
pwr.f2.test(u=2, # Number of Predictors
v=78, #DF
f2=f2.4.1, #r^2/(1-R^2)
sig.level=.001,
power = NULL)

Multiple regression power calculation

\[ u = 2 \\
v = 78 \\
f2 = 0.285347 \\
sig.level = 0.001 \\
power = 0.8415061 \]

This model does contain sufficient power. ## Testing Regression Assumptions Multiple Regression (job satisfaction)

ols_vif_tol(modmultiple_jobsat)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>efficacy</td>
<td>0.8584092</td>
<td>1.164946</td>
</tr>
<tr>
<td>belong</td>
<td>0.8584092</td>
<td>1.164946</td>
</tr>
</tbody>
</table>

ols_eigen_cindex(modmultiple_jobsat)

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Condition Index</th>
<th>intercept</th>
<th>efficacy</th>
<th>belong</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2.956144748</td>
<td>1.000000</td>
<td>0.001171345</td>
<td>0.001008887</td>
<td>0.006151415</td>
</tr>
<tr>
<td>2 0.038887946</td>
<td>8.718772</td>
<td>0.056628491</td>
<td>0.027638303</td>
<td>0.945308659</td>
</tr>
<tr>
<td>3 0.004967306</td>
<td>24.395088</td>
<td>0.942200163</td>
<td>0.971352809</td>
<td>0.048539926</td>
</tr>
</tbody>
</table>

ols_coll_diag(modmultiple_jobsat)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>efficacy</td>
<td>0.8584092</td>
<td>1.164946</td>
</tr>
<tr>
<td>belong</td>
<td>0.8584092</td>
<td>1.164946</td>
</tr>
</tbody>
</table>

Residual diagnostics Job Satisfaction
```r
resid(modmultiple_jobsat) %>%
  head()

   1         2         3         4      5
6 -0.01219742 -0.48181462 0.17680036 -2.02435701 0.77645858 0.30095795

ols_plot_resid_fit_spread(modmultiple_jobsat)
```

![Fit - Mean](image1)

![Residual](image2)

```r
plot(modmultiple_jobsat)
```
Fitted values
\( \text{lm(jobsat} \sim \text{efficacy + belong)} \)

Normal Q-Q

Theoretical Quantiles
\( \text{lm(jobsat} \sim \text{efficacy + belong)} \)
# Cooks D is influence
# Hat value is leverage
# Residuals are distance - look for large when screening out bad values

Mediation Analysis
library(DiagrammeR)
library(DiagrammeRsvg)
library(rsvg)
library(pander)
library(broom)

knit_gv <- function(code, filename=NULL, width=NULL, height=800){
assetpath <- "assets"
dir.create(assetpath, showWarnings = F)

if (!is.character(knitr::current_input())){
  format <- "png"
} else {
  if (stringr::str_detect(
    knitr::opts_knit$get("rmarkdown.pandoc.to"), "beamer|latex|pdf") ){
    format <- "pdf"
  } else {
    format <- "png"
  }
}
if (!is.character(filename)){
  filename <- file.path(assetpath, paste0(sample(1e6:1e7, 1), ".", format))
} else {
  filename = paste0(filename, ".", format)
}

library('rsvg')
outfun <- get(paste0("rsvg_, format))
capture.output({
  g <- grViz(paste("digraph{", code, "}"))) 
  DiagrammeRsvg::export_svg(g) %>% charToRaw %>% outfun(filename, 
    width=width, height=height)
  }, file='NUL')
  knitr::include_graphics(filename)
}

knit_gv("Belonging -> Persistence[label=0.45]
Belonging -> Job_Satisfaction[label=0.42]
Job_Satisfaction -> Persistence[label=0.97]
")
Mediation Steps

Step 1 (check distal variable predicts mediator) That is, show Belong predicts persistence

```r
step1 <- lm(persist ~ belong, data=dissertation_phd_clean_no_na)
tidy(step1) %>% pander()
```

<table>
<thead>
<tr>
<th>term</th>
<th>estimate</th>
<th>std.error</th>
<th>statistic</th>
<th>p.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1.967</td>
<td>0.5875</td>
<td>3.349</td>
<td>0.001247</td>
</tr>
<tr>
<td>belong</td>
<td>0.4498</td>
<td>0.1313</td>
<td>3.425</td>
<td>0.0009772</td>
</tr>
</tbody>
</table>

Step 2 (check distal variable predict mediator) That is, show belong predicts jobsat
Step 2 (check for mediation) That is, show jobsat predicts persistence, controlling for belong:

```r
step2 <- lm(jobsat ~ belong, data=dissertation_phd_clean_no_na)
tidy(step2) %>% pander()
```

<table>
<thead>
<tr>
<th>term</th>
<th>estimate</th>
<th>std.error</th>
<th>statistic</th>
<th>p.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1.869</td>
<td>0.3844</td>
<td>4.861</td>
<td>5.827e-06</td>
</tr>
<tr>
<td>belong</td>
<td>0.4286</td>
<td>0.08593</td>
<td>4.987</td>
<td>3.557e-06</td>
</tr>
</tbody>
</table>

Step 3 (check for mediation) That is, show jobsat predicts persistence, controlling for belong:

```r
step3 <- lm(persist ~ jobsat+belong, data=dissertation_phd_clean_no_na)
tidy(step3) %>% pander()
```

<table>
<thead>
<tr>
<th>term</th>
<th>estimate</th>
<th>std.error</th>
<th>statistic</th>
<th>p.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.1391</td>
<td>0.5177</td>
<td>0.2687</td>
<td>0.7889</td>
</tr>
<tr>
<td>jobsat</td>
<td>0.9783</td>
<td>0.1329</td>
<td>7.359</td>
<td>1.621e-10</td>
</tr>
<tr>
<td>belong</td>
<td>0.03055</td>
<td>0.1164</td>
<td>0.2624</td>
<td>0.7937</td>
</tr>
</tbody>
</table>

An additional step, which allows us to test whether the effect is completely mediated, also uses the final regression model:

Step 4 (check for total mediation) That is, check if Belong still predicts persistence, controlling for belong:

```r
step4 <- lm(persist ~ belong+belong, data=dissertation_phd_clean_no_na)
tidy(step4) %>% pander()
```

<table>
<thead>
<tr>
<th>term</th>
<th>estimate</th>
<th>std.error</th>
<th>statistic</th>
<th>p.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1.967</td>
<td>0.5875</td>
<td>3.349</td>
<td>0.001247</td>
</tr>
<tr>
<td>belong</td>
<td>0.4498</td>
<td>0.1313</td>
<td>3.425</td>
<td>0.0009772</td>
</tr>
</tbody>
</table>

```r
library(mediation)
test.mediation <- mediation::mediate(step2, step3, treat = "belong", mediator = "jobsat", boot = TRUE)
summary(test.mediation)
```

Causal Mediation Analysis

Nonparametric Bootstrap Confidence Intervals with the Percentile Method
<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACME</td>
<td>0.4193</td>
<td>0.2809</td>
<td>0.58</td>
<td>&lt;2e-16   ***</td>
</tr>
<tr>
<td>ADE</td>
<td>0.0306</td>
<td>-0.2003</td>
<td>0.22</td>
<td>0.79</td>
</tr>
<tr>
<td>Total Effect</td>
<td>0.4498</td>
<td>0.2370</td>
<td>0.66</td>
<td>&lt;2e-16   ***</td>
</tr>
<tr>
<td>Prop. Mediated</td>
<td>0.9321</td>
<td>0.5966</td>
<td>1.81</td>
<td>&lt;2e-16   ***</td>
</tr>
</tbody>
</table>

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sample Size Used: 81

Simulations: 1000

**RQ 5: What institutional-related programs exist for TEE teacher intended persistence?**

**Frequency Table and Visualization for Respondents Support Programs**

```r
RQ5 <- read_excel("RQ5.xlsx")
RQ5_clean <- RQ5 %>%
  dplyr::rename_all(tolower)
RQ5_clean %>%
  furniture::tableF(prog)
```

<table>
<thead>
<tr>
<th>prog</th>
<th>Freq</th>
<th>Cum</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Competitive pay</em></td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>District content area specific Professional Development</td>
<td>41</td>
<td>59</td>
</tr>
<tr>
<td>Leadership Development Opportunities</td>
<td>44</td>
<td>103</td>
</tr>
<tr>
<td>New Teacher Induction Program</td>
<td>62</td>
<td>165</td>
</tr>
<tr>
<td>Professional Association Professional Development</td>
<td>55</td>
<td>220</td>
</tr>
<tr>
<td>State Professional Development Programs</td>
<td>57</td>
<td>277</td>
</tr>
<tr>
<td>Teacher Mentor Program</td>
<td>52</td>
<td>329</td>
</tr>
</tbody>
</table>

CumPerc
5.47%
17.93%
31.31%
50.15%
66.87%
84.19%
100.00%

---
dissertation_phd_clean %>%
dplyr::select(mentor, induct, lead, compsala, profass, stateass, distcon) %>%
psych::describe()

<table>
<thead>
<tr>
<th>vars</th>
<th>se</th>
<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
<th>mad</th>
<th>min</th>
<th>max</th>
<th>range</th>
<th>skew</th>
<th>kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>mentor</td>
<td>1</td>
<td>50</td>
<td>0.94</td>
<td>1.27</td>
<td>0</td>
<td>0.70</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>1.23</td>
<td>0.33</td>
<td>0.18</td>
</tr>
<tr>
<td>induct</td>
<td>2</td>
<td>61</td>
<td>0.59</td>
<td>1.12</td>
<td>0</td>
<td>0.31</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>1.90</td>
<td>2.53</td>
<td>0.14</td>
</tr>
<tr>
<td>lead</td>
<td>3</td>
<td>43</td>
<td>1.51</td>
<td>1.26</td>
<td>2</td>
<td>1.40</td>
<td>1.48</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0.39</td>
<td>-0.82</td>
</tr>
<tr>
<td>compsala</td>
<td>4</td>
<td>17</td>
<td>2.53</td>
<td>0.94</td>
<td>2</td>
<td>2.53</td>
<td>1.48</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>0.13</td>
<td>-1.09</td>
</tr>
<tr>
<td>profass</td>
<td>5</td>
<td>54</td>
<td>1.52</td>
<td>1.27</td>
<td>1</td>
<td>1.45</td>
<td>1.48</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0.28</td>
<td>-1.20</td>
</tr>
<tr>
<td>stateass</td>
<td>6</td>
<td>55</td>
<td>1.31</td>
<td>1.15</td>
<td>1</td>
<td>1.22</td>
<td>1.48</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0.53</td>
<td>-0.73</td>
</tr>
<tr>
<td>distcon</td>
<td>7</td>
<td>41</td>
<td>1.76</td>
<td>1.36</td>
<td>2</td>
<td>1.70</td>
<td>1.48</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0.14</td>
<td>-1.24</td>
</tr>
</tbody>
</table>

---

Teacher Mentor Program

dissertation_phd_clean %>%
filter(admin1 != "") %>%
furniture::tableF(admin1)

<table>
<thead>
<tr>
<th>admin1</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>4</td>
<td>4</td>
<td>8.00%</td>
<td>8.00%</td>
</tr>
<tr>
<td>A little</td>
<td>12</td>
<td>16</td>
<td>24.00%</td>
<td>32.00%</td>
</tr>
<tr>
<td>A lot</td>
<td>3</td>
<td>19</td>
<td>6.00%</td>
<td>38.00%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>5</td>
<td>24</td>
<td>10.00%</td>
<td>48.00%</td>
</tr>
<tr>
<td>None at all</td>
<td>26</td>
<td>50</td>
<td>52.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
New Teacher Induction

dissertation_phd_clean %>%
  filter(admin2 != "") %>%
furniture::tableF(admin2)

<table>
<thead>
<tr>
<th>admin2</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>3</td>
<td>3</td>
<td>4.92%</td>
<td>4.92%</td>
</tr>
<tr>
<td>A little</td>
<td>9</td>
<td>12</td>
<td>14.75%</td>
<td>19.67%</td>
</tr>
<tr>
<td>A lot</td>
<td>3</td>
<td>15</td>
<td>4.92%</td>
<td>24.59%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>3</td>
<td>18</td>
<td>4.92%</td>
<td>29.51%</td>
</tr>
<tr>
<td>None at all</td>
<td>43</td>
<td>61</td>
<td>70.49%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Leadership Development Opportunities

dissertation_phd_clean %>%
  filter(admin3 != "") %>%
furniture::tableF(admin3)

<table>
<thead>
<tr>
<th>admin3</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>4</td>
<td>4</td>
<td>9.30%</td>
<td>9.30%</td>
</tr>
<tr>
<td>A little</td>
<td>9</td>
<td>13</td>
<td>20.93%</td>
<td>30.23%</td>
</tr>
<tr>
<td>A lot</td>
<td>4</td>
<td>17</td>
<td>9.30%</td>
<td>39.53%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>14</td>
<td>31</td>
<td>32.56%</td>
<td>72.09%</td>
</tr>
<tr>
<td>None at all</td>
<td>12</td>
<td>43</td>
<td>27.91%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Competitive Pay

dissertation_phd_clean %>%
  filter(admin4 != "") %>%
furniture::tableF(admin4)

<table>
<thead>
<tr>
<th>admin4</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>3</td>
<td>3</td>
<td>17.65%</td>
<td>17.65%</td>
</tr>
<tr>
<td>A little</td>
<td>2</td>
<td>5</td>
<td>11.76%</td>
<td>29.41%</td>
</tr>
<tr>
<td>A lot</td>
<td>5</td>
<td>10</td>
<td>29.41%</td>
<td>58.82%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>7</td>
<td>17</td>
<td>41.18%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Professional Association Professional Development
```r
library(tidyverse)

dissertation_phd_clean %>% 
  filter(admin5 != "") %>% 
furniture::tableF(admin5)

dissertation_phd_clean %>% 
  filter(admin6 != "") %>% 
furniture::tableF(admin6)

dissertation_phd_clean %>% 
  filter(admin7 != "") %>% 
furniture::tableF(admin7)
```

<table>
<thead>
<tr>
<th>admin5</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>3</td>
<td>3</td>
<td>5.56%</td>
<td>5.56%</td>
</tr>
<tr>
<td>A little</td>
<td>14</td>
<td>17</td>
<td>25.93%</td>
<td>31.48%</td>
</tr>
<tr>
<td>A lot</td>
<td>12</td>
<td>29</td>
<td>22.22%</td>
<td>53.70%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>10</td>
<td>39</td>
<td>18.52%</td>
<td>72.22%</td>
</tr>
<tr>
<td>None at all</td>
<td>15</td>
<td>54</td>
<td>27.78%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

**State Professional Development Programs**

<table>
<thead>
<tr>
<th>admin6</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>2</td>
<td>2</td>
<td>3.64%</td>
<td>3.64%</td>
</tr>
<tr>
<td>A little</td>
<td>18</td>
<td>20</td>
<td>32.73%</td>
<td>36.36%</td>
</tr>
<tr>
<td>A lot</td>
<td>8</td>
<td>28</td>
<td>14.55%</td>
<td>50.91%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>11</td>
<td>39</td>
<td>20.00%</td>
<td>70.91%</td>
</tr>
<tr>
<td>None at all</td>
<td>16</td>
<td>55</td>
<td>29.09%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

**District Content Area Specific Professional Development**

<table>
<thead>
<tr>
<th>admin7</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>A great deal</td>
<td>5</td>
<td>5</td>
<td>12.20%</td>
<td>12.20%</td>
</tr>
<tr>
<td>A little</td>
<td>8</td>
<td>13</td>
<td>19.51%</td>
<td>31.71%</td>
</tr>
<tr>
<td>A lot</td>
<td>8</td>
<td>21</td>
<td>19.51%</td>
<td>51.22%</td>
</tr>
<tr>
<td>A moderate amount</td>
<td>10</td>
<td>31</td>
<td>24.39%</td>
<td>75.61%</td>
</tr>
<tr>
<td>None at all</td>
<td>10</td>
<td>41</td>
<td>24.39%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
Frequency Table and Visualization for Preceptons of Extra Paperwork on Teaching persistence

dissertation_phd_clean %>%
  filter(extrapaperwork != "") %>%
ggplot(aes(x=factor(extrapaperwork)))+
  geom_bar()+
  theme_bw() +
  ggtitle("Preceptions of the effects of Extra Paperwork") +
  ylab("Count") +
  xlab("") +
  scale_x_discrete(guide = guide_axis(angle = 45), breaks=1:6,
    labels=c("Strongly Disagree", "Disagree","Somewhat Disagree",
    "Somewhat Agree", " Agree","Strongly Agree"))

<table>
<thead>
<tr>
<th>extrapaperworkF</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>6</td>
<td>6</td>
<td>7.14%</td>
<td>7.14%</td>
</tr>
<tr>
<td>Disagree</td>
<td>12</td>
<td>18</td>
<td>14.29%</td>
<td>21.43%</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>13</td>
<td>31</td>
<td>15.48%</td>
<td>36.90%</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>12</td>
<td>43</td>
<td>14.29%</td>
<td>51.19%</td>
</tr>
<tr>
<td>Agree</td>
<td>13</td>
<td>56</td>
<td>15.48%</td>
<td>66.67%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>28</td>
<td>84</td>
<td>33.33%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
Frequency Table and Visualization for Preceptons of the Focus on Test Scores on Teaching persistence

dissertation_phd_clean  %>%
  filter(testscores != "")  %>%
ggplot(aes(x=factor(testscores)))+
geom_bar()+
theme_bw()+
ggtitle("Preceptions of the effects of Testscores") +
ylab("Count") +
xlab(" ") +
scale_x_discrete(guide = guide_axis(angle = 45), breaks=1:6,
  labels=c("Strongly Disagree", "Disagree","Somewhat Disagree",
  "Somewhat Agree", "Agree","Strongly Agree"))

<table>
<thead>
<tr>
<th></th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>9</td>
<td>9</td>
<td>10.71%</td>
<td>10.71%</td>
</tr>
<tr>
<td>Disagree</td>
<td>12</td>
<td>21</td>
<td>14.29%</td>
<td>25.00%</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>9</td>
<td>30</td>
<td>10.71%</td>
<td>35.71%</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>22</td>
<td>52</td>
<td>26.19%</td>
<td>61.90%</td>
</tr>
<tr>
<td>Agree</td>
<td>13</td>
<td>65</td>
<td>15.48%</td>
<td>77.38%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>19</td>
<td>84</td>
<td>22.62%</td>
<td>100.00%</td>
</tr>
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</table>
Frequency Table and Visualization for Preceptors of Teaching Facilities on Teaching Persistence

dissertation_phd_clean %>%
  filter(facil !="" ) %>%
ggplot(aes(x=factor(facil))) +
  geom_bar() +
  theme_bw() +
  ggtitle("Preceptions of the Importance of Facilities Support")
+  ylab("Count") +
  xlab("") +
  scale_x_discrete(guide = guide_axis(angle = 45), breaks=1:6,
                   labels=c("Strongly Disagree", "Disagree", "Somewhat Disagree",
                            "Somewhat Agree", "Agree", "Strongly Agree"))

<table>
<thead>
<tr>
<th></th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
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</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>5</td>
<td>5</td>
<td>6.02%</td>
<td>6.02%</td>
</tr>
<tr>
<td>Disagree</td>
<td>3</td>
<td>8</td>
<td>3.61%</td>
<td>9.64%</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>6</td>
<td>14</td>
<td>7.23%</td>
<td>16.87%</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>17</td>
<td>31</td>
<td>20.48%</td>
<td>37.35%</td>
</tr>
<tr>
<td>Agree</td>
<td>24</td>
<td>55</td>
<td>28.92%</td>
<td>66.27%</td>
</tr>
</tbody>
</table>
Frequency Table and Visualization for Preceptons of Financial Support on Teaching persistence

dissertation_phd_clean %>%
  filter(finan != "") %>%
ggplot(aes(x=factor(finan))) +
  geom_bar() +
  theme_bw() +
  ggtitle("Preceptions of the Importance of Financial Support") +
  ylab("Count") +
  xlab("") +
  scale_x_discrete(guide = guide_axis(angle = 45), breaks=1:6,
      labels=c("Strongly Disagree", "Disagree","Somewhat Disagree",
      "Somewhat Agree", "Agree","Strongly Agree"))

<table>
<thead>
<tr>
<th>finanF</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>5</td>
<td>5</td>
<td>6.02%</td>
<td>6.02%</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>6</td>
<td>1.20%</td>
<td>7.23%</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>5</td>
<td>11</td>
<td>6.02%</td>
<td>13.25%</td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td>18</td>
<td>29</td>
<td>21.69%</td>
<td>34.94%</td>
</tr>
</tbody>
</table>
Agree             23   52    27.71%  62.65%
Strongly Agree    31   83    37.35%  100.00%

Frequency Table and Visualization for Preceptons of Community Support on Teaching persistence
dissertation_phd_clean %>%
  filter(commsuppF != "") %>%
  ggplot(aes(x=factor(commsuppF)))+
  geom_bar()+
  theme_bw()+
  ggtitle("Preceptions of the Importance of Community Support") +
  ylab("Count") +
  xlab(" ") +
  scale_x_discrete(guide = guide_axis(angle = 45), breaks=1:6, labels=c("Strongly Disagree", "Disagree", "Somewhat Disagree", "Somewhat Agree", "Agree", "Strongly Agree"))

dissertation_phd_clean %>%
  filter(commsuppF != "") %>%
  furniture::tableF(commsuppF)

<table>
<thead>
<tr>
<th>commsuppF</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
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<tbody>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>2</td>
<td>2.41%</td>
<td>2.41%</td>
</tr>
<tr>
<td>Disagree</td>
<td>4</td>
<td>6</td>
<td>4.82%</td>
<td>7.23%</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>6</td>
<td>12</td>
<td>7.23%</td>
<td>14.46%</td>
</tr>
<tr>
<td>Opinion</td>
<td>Freq</td>
<td>CumFreq</td>
<td>Percent</td>
<td>CumPerc</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>6</td>
<td>6</td>
<td>7.23%</td>
<td>7.23%</td>
</tr>
<tr>
<td>Disagree</td>
<td>7</td>
<td>13</td>
<td>8.43%</td>
<td>15.66%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>6</td>
<td>16</td>
<td>7.23%</td>
<td>15.66%</td>
</tr>
</tbody>
</table>

Frequency Table and Visualization for Preceptions of District Support on Teaching Persistence

dissertation_phd_clean %>%
  filter(disadminF != "") %>%
ggplot(aes(x=factor(disadmin)))+
  geom_bar()+
  theme_bw()+
  ggtitle("Preceptions of the Importance of Building Support") +
  ylab("Count") +
  xlab("") +
  scale_x_discrete(guide = guide_axis(angle = 45), breaks=1:6,
<table>
<thead>
<tr>
<th>Somewhat Disagree</th>
<th>7</th>
<th>20</th>
<th>8.43%</th>
<th>24.10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somewhat Agree</td>
<td>14</td>
<td>34</td>
<td>16.87%</td>
<td>40.96%</td>
</tr>
<tr>
<td>Agree</td>
<td>22</td>
<td>56</td>
<td>26.51%</td>
<td>67.47%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>27</td>
<td>83</td>
<td>32.53%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

```
dissertation_phd_clean %>%
  filter(diffteachlicF != "") %>%
  furniture::tableF(diffteachlicF)
```

<table>
<thead>
<tr>
<th>diffteachlicF</th>
<th>Freq</th>
<th>CumFreq</th>
<th>Percent</th>
<th>CumPerc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>25</td>
<td>25</td>
<td>29.76%</td>
<td>29.76%</td>
</tr>
<tr>
<td>Disagree</td>
<td>22</td>
<td>47</td>
<td>26.19%</td>
<td>55.95%</td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td>6</td>
<td>53</td>
<td>7.14%</td>
<td>63.10%</td>
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<tr>
<td>Somewhat Agree</td>
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<td>68</td>
<td>17.86%</td>
<td>80.95%</td>
</tr>
<tr>
<td>Agree</td>
<td>11</td>
<td>79</td>
<td>13.10%</td>
<td>94.05%</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>5</td>
<td>84</td>
<td>5.95%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
CURRICULUM VITAE

CORY J. ORTIZ, Ph.D.

Utah State University
Department of Aviation, and Technical Education
6000 Old Main Hill,
Logan, UT 84322-6000

Phone (Cell): 801-879-0789
Email: Cory.ortiz@usu.edu

EDUCATION

2022  Doctor of Philosophy. Utah State University – Logan, UT
      Major: Career and Technical Education
      Dissertation Title:  What Keeps Technology and Engineering Teachers in The Classroom? A National Mixed Methods Study
                        Major Professor: Dr. Tyson Sorensen

2018  Master of Science. Utah State University – Logan, UT
      Major: Technology and Engineering Education
      Thesis Title: An Experimental Comparison of Student Motivation Between Two Computational Thinking Based Stem Activities, Vex Based Automation and Robotics and a Quadcopter Activity
                        Major Professor: Dr. Gary Stewardson

2015  Bachelors of Science. Utah State University – Logan, UT
      Major: Technology and Engineering Education
      GPA: 3.7/4.0 Graduated Cum Laude

2012  Associate’s Degree. Salt Lake Community College – Salt Lake City, UT
      Major: General Education
      GPA: 3.6/4.0 Graduated on the Dean’s List
EDUCATIONAL WORK EXPERIENCE

Utah State University, Brigham City UT 2021 – Present
Assistant Professor of Practice, Aviation and Technical Education

Courses Taught*:

- TEE 1200 - Computer-Aided Drafting and Design (Online)
- TESY 4500 – Quality Systems Management I
- TESY 4540 – Quality Systems Management II
- TESY 3020 – Technology Enterprise (Online)
- TESY 4330 – Product Innovation Processes Tools, and Strategies
  * Course reviews available on request

Ogden School District, Ogden UT 2020 – 2021
Work-Based Learning Coordinator & STEM Specialist

Responsibilities:

- Coordinated student internships district wide.
- Worked to establish new and maintain existing industry partnerships.
- Worked with Talent Ready Utah and Consortium pathway committees to create meaningful Work-Based Learning experiences for students.
- Coordinated district wide CTE initiatives with CTE and Curriculum Directors
- Supported newly hired teachers in the area of Technology and Engineering Education
- Wrote grants aligned with district initiatives in personalized and competency-based education, career and technical education, and computer science education

Committees served on:

- Utah Architecture, Engineering, & Construction
- Utah Aerospace Pathway
- Utah Technical Sales Pathway
- Utah Diesel Tech Pathway

Boards served on

- Utah State Board of Education, Work Based Learning Advisory Board
- Utah Association of Career and Technical Education, Work-Based Learning
Utah State University, Logan, UT 2017 – 2020
Graduate Teaching Assistant, Agricultural Systems, Technology, and Education

Courses Taught*:
- TEE 1200 - Computer-Aided Drafting and Design (face-to-face and online)
- TEE 2300 – Electronic Fundamentals
- TEE 3050 – Computer Systems and Networking
  * Course reviews available on request

Other Responsibilities:
- Managed ROAVcopters.usu.edu, MailChimp Listserv, developed and ran challenges, wrote grants to fund ROAVcopter competition events.

Ogden School District, Ogden UT 2015 – 2017
Engineering Teacher, Highland Jr. High/Mount Ogden Junior High

Courses Taught:
- Manufacturing Technology (9th grade)
- Exploring Technology (8th grade)
- Project Lead the Way – Introduction to Engineering Design (9th grade)
- Project Lead the Way – Design and Modeling (8th grade)
- Project Lead the Way – Automation and robotics (8th grade)

District Responsibilities:
- Technology and Engineering content area PLC Leader
- Created monthly agendas aligned to content area common goals, led content area PLCs, and reported on common interim assessments.
- Attended monthly STEM industry advisory committee PLC. Attended Multi-tiered systems of support (MTSS) training and acted on Positive Behavior Intervention and Supports (PBIS) team.

Logan School District, Logan, UT
2015 Student Teacher, Mount Logan Middle School

Courses Taught:
- CTE Tech Introduction (8th grade)
- Exploring Technology (7th grade)

Other Responsibilities:
- Developed curriculum for new VEX Robotics course offered Fall of 2015. Curriculum was organized and shared on Canvas.
- AmeriCorps Scholar - worked with Student Council to organize St. Baldrick’s head shaving event
OTHER RELATED WORK

**Orbital ATK, Corinne, UT**

**Teacher Extern** Developmental Flight Instrumentation (DFI) Group
Supervisor – Mont Johnson, Ph.D.

Primary Responsibilities
- Worked with DFI on testing and validating flight critical hardware in preparation for NASA’s Space Launch System (SLS) Qualifying Motor static fire (QM-2).
- Verified sensor channels, analyzed test data

**Utah State University, Logan UT**

**Metals Lab Teachers Assistant**, Agricultural Systems, Technology, and Education

Primary Responsibilities
- Laboratory maintenance, plasma cutting, welding, and cutting stock in preparation for class

OTHER RESEARCH ACTIVITIES

Participated in Summer NSF funded Research Experience for Undergraduates (REU) Program at Utah State University – Summer 2014
- Developed a survey instrument measuring three constructs, problem interest, task interpretation, and planning strategies, of self-regulated learning in engineering education

Soils Lab Assistant Utah State University Fall 2012 – Fall 2013
- Conducted microbiology research dealing with biodiversity specifically urease genes in soils. Duties consisted of laboratory maintenance, irrigation of research plot, as well as sampling.

SERVICE AND VOLUNTEER WORK

2008 – Present, St. Baldrick’s Foundation

- 2021 - $17,377 – National Ability Center, Park City UT †*
- 2020 - $918 - McMullan’s Irish Pub, Las Vegas NV *
- 2019 - $635 - Copper Hills High School, West Jordan UT †*
- 2018 - $610 - virtual shavee*
- 2017 - $2,403 - Highland Jr. High School, Ogden UT †*
- 2016 - $7,512 - Highland Jr. High School, Ogden UT †*
- 2015 - $8,112 - Mount Logan Middle School, Logan UT †*
- 2014 - $1,838 - Smithfield Recreation Center, Smithfield UT †*
- 2012 - $4,650 - Salt Lake Community College, SLC UT †*

* Shavee
† Lead Volunteer Event Organizer
2014, College of Agriculture and Applied Sciences Ambassador

- Recruited students at state high schools for majors within the College of Agriculture
- Represented the College of Agriculture at university events

2013 – 2014, Technology Engineering Education Club President

- Organized socials, worked closely with faculty advisor, marketing for fundraising
- Worked with officers to revitalize the club
- Coordinated community Science Technology Engineering Mathematics (STEM) outreach

PROFESSIONAL PRESENTATIONS

**Ortiz, C., & Wray, J.** (2021). *Step 4: Specialized / Focused Marketing in the Junior High*. Oral Presentation at the 2021 USBE Work-Based Learning Summer Conference, Online

**Robinson, T. & Ortiz, C.** (2020). *Teaching project-based electronics as an online course*. Oral Presentation at the 82th Annual International Technology and Engineering Educators Association Conference, Baltimore City, MD.*


* Conference or talk Canceled due to COVID-19

### EXTERNAL FUNDING

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Award Amount</th>
<th>Award Period</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>Computer Science Implementation Grant</td>
<td>Awarded $1,000,000</td>
<td>July 1, 2021 – June 30, 2025</td>
<td>Funded the hiring of a teacher specialist to oversee the development of PCBL in Ogden School District</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Project Lead, funded by the Utah State Board of Education</td>
</tr>
<tr>
<td>2021</td>
<td>FY22 – FY23 Utah State Board of Education Application for Competency Based Education Implementation Grant - (PCBL)</td>
<td>Awarded $400,000</td>
<td>July 1, 2021 – June 30, 2023</td>
<td>Funded the hiring of a teacher specialist to oversee the development of PCBL in Ogden School District</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Project Lead, funded by the Utah State Board of Education</td>
</tr>
<tr>
<td>2020</td>
<td>FY21 Perkins Special Project Grant</td>
<td>Awarded $29,199.60</td>
<td>July 1, 2021 – June 30, 2022</td>
<td>Funded computer science curriculum for all junior high schools in Ogden, funded by the Utah State Board of Education</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Project Lead</td>
</tr>
<tr>
<td>2019</td>
<td>Utah STEM Action Center Organization Grant</td>
<td>Awarded $3,000</td>
<td>October 25, 2019 – May 15 2020</td>
<td>Funded four schools to participate at the elementary school level ROAVcopter competition</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Co-principle lead</td>
</tr>
<tr>
<td>2018</td>
<td>Utah STEM Action Center Organization Grant</td>
<td>Awarded $5,581.16</td>
<td>10/17/2018 – 5/30/2019</td>
<td>Funded six schools to participate at the high school level ROAVcopter competition</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Co-principle lead</td>
</tr>
</tbody>
</table>
2018  Utah NASA Space Grant Consortium Higher Education Grant. **Awarded $4,789**
- Award Period – 4/10/2018 – 4/9/2019
- Partially funded eight NIFA affiliated schools to compete in the 2018 NIFA regional ROAVcopter Challenge in Billings, MT.
  - Co-principle lead

2017  Utah STEM Action Center Organization Grant. **Awarded $6,837**
- Award Period – 10/20/2017 – 6/30/2018
- Funded eight schools to participate in ROAVcopter Mini
  - Co-principle lead

**INTERNAL FUNDING**

2015  Ogden School District Foundation School Impact Grant. **Awarded $7,728**
- Funded 3D printers for all junior high schools in Ogden School District
- Received 1:1 match from private source to expand grants impact

2015  Logan School Foundation Grant. **Awarded $1,000**
- Funded VEX robotics equipment

2013  Summer Undergraduate Research and Creative Opportunities (SURCO)
- Project title: *Survey of Genes Encoding Nitrogen Mineralization Enzymes in Agricultural Soils*

**PROFESSIONAL AFFILIATIONS**

Association for Career and Technical Education (ACTE)
- National Engineering and Technology Education Division Policy Committee member (2021 – Present)
- Utah Work Based Learning Section Board Member (2020 – 2021)

Society for Advancement of Chicanos and Native Americans in Science (SACNAS)
International Technology and Engineering Educators Association (ITEEA)

**PROFESSIONAL TRAININGS AND CERTIFICATES**

Project Lead the Way – Gateway Design and Modeling
Project Lead the Way – Automation and Robotics
Project Lead the Way – Introduction to Engineering Design
Utah Professional Teaching certificate
  - Endorsements: Technology and Engineering Education

**AWARDS AND HONORS**

2021  – ACTE, 2021 National Leadership Fellow, New professional Class*
  *Postponed to 2022 due to COVID-19

2020  – ITEEA, Maley Outstanding Graduate Student Citation

2017  – Ogden School District, February Achieving Higher Award

2014  – SACNAS, Outstanding Research Presentation Award Winner