

FACTORS ASSOCIATED WITH THE RETENTION OF NEW SECONDARY  
CAREER AND TECHNICAL EDUCATION TEACHERS

by

GREGORY JOHN WILSON

(Under the Direction of Jay Rojewski)

ABSTRACT

Retaining new teachers has long been an issue that has plagued K-12 education (Garcia & Weiss, 2019; Ingersoll, 2001; Kelchtermans, 2017). While there is significant literature on general K-12 teacher retention (Borman & Dowling, 2008; Chapman & Hutcheson, 1982; Hanushek et al., 2004; Whipp & Geronime, 2015), there has been little research, especially utilizing quantitative methods, to specifically examine the retention of new Career and Technical Education teachers. CTE should be studied separately from general the general K-12 teaching workforce due to unique differences between CTE and traditional academic programs. Key differences include competition with private industry for talent (i.e., CTE teachers must possess knowledge that is valuable in the private sector), declining enrollment in CTE teacher preparation programs combined with increasing student enrollment in CTE classes, and additional responsibilities (e.g., hosting advisory committee meetings, seeking industry certification, and advising career and technical student organizations (Bottoms et al., 2013; Brand et al., 2013; Fletcher & Gordon, 2017; Horne, 2010)).

This research employed teacher licensure data from the Georgia Professional Standards Commission and the Georgia Department of Education that included five years of records for new CTE teachers. A series of logistic regression models were built to examine the association between educational attainment, age, teaching in an in-demand field, geography, and school climate and retaining CTE teachers for the first five years of their career.

The analysis found statistically significant associations between CTE teacher retention and teaching in an in-demand field, geographic location of the teacher (i.e., urban/rural), and school climate. No statistically significant relationship between CTE teacher retention and age or educational attainment were detected. This project demonstrates the value of utilizing administrative data (i.e., state teacher licensure data) for analyzing CTE teacher retention. Future research efforts could pool additional cohorts of CTE teachers to expand the sample size and work with teacher licensure data owners to secure access to additional variables of interest, such as teacher preparation pathway.

INDEX WORDS: Teacher retention, Career and Technical Education, Logistic regression

FACTORS ASSOCIATED WITH THE RETENTION OF NEW SECONDARY  
CAREER AND TECHNICAL EDUCATION TEACHERS

by

GREGORY JOHN WILSON

AB, University of Georgia, 2011

MPA, University of Georgia, 2011

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial  
Fulfillment of the Requirements for the Degree

DOCTOR OF EDUCATION

ATHENS, GEORGIA

2022

© 2022

Gregory John Wilson

All Rights Reserved

FACTORS ASSOCIATED WITH THE RETENTION OF NEW SECONDARY  
CAREER AND TECHNICAL EDUCATION TEACHERS

by

GREGORY JOHN WILSON

Major Professor:	Jay W. Rojewski
Committee:	Elaine Adams
	Andrew Jackson
	John Mativo

Electronic Version Approved:

Ron Walcott  
Vice Provost for Graduate Education and Dean of the Graduate School  
The University of Georgia  
December 2022

## DEDICATION

I am thankful for my wife and best friend, Brittany Wilson, for motivating, supporting, and encouraging me throughout my graduate studies. She's been my #1 champion, proofreader extraordinaire, and sounding board during this journey. I would never have finished my studies without her. Thus, I dedicate this publication to her. I love Nolan and you so much!

## ACKNOWLEDGEMENTS

There have been many individuals who have supported me throughout my educational journey. Thank you to my parents, Keith and Jean Wilson, for inspiring a natural curiosity and love of learning. I acknowledge the support, patience, and mentorship of my committee chair, Dr. Jay Rojewski, over the past several years. Thank you to my committee members for pushing me to look at my research topics with new perspectives and helping to improve my work. I also want to acknowledge my employer, the Carl Vinson Institute of Government, and especially David Tanner, my long-time supervisor and mentor, for the flexibility and encouragement to complete my doctoral studies.

## TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS .....	v
LIST OF TABLES .....	viii
LIST OF FIGURES .....	ix
CHAPTER	
1 INTRODUCTION .....	1
Why CTE Teacher Retention Matters.....	5
Purpose of the Study .....	5
Research Questions .....	7
Theoretical Framework.....	7
Importance of the Study.....	10
2 REVIEW OF RELATED LITERATURE AND RESERCH .....	13
Relevant Theoretical Frameworks .....	13
Teacher Retention .....	19
CTE Teacher Preparation and Certification.....	30
CTE Teacher Workforce.....	37
3 METHOD .....	40
Research Design and Participants .....	40
Measures .....	44
Data Screening Procedures .....	48

	Data Analysis Methods .....	53
	Implications and Tradeoffs .....	56
4	Results.....	59
	Sample Overview .....	59
	Results.....	63
5	Discussion, Summary, and Conclusion .....	68
	Purpose.....	69
	Findings.....	70
	Limitations .....	73
	Implications.....	75
	Future Research Opportunities .....	76
	REFERENCES .....	79
	APPENDICES	
	A Variable Codebook .....	99
	B CTE Subject Codes by High Demand Factor .....	103

## LIST OF TABLES

	Page
Table 1: GPSC Data Elements .....	43
Table 2: School Climate Data Elements .....	44
Table 3: Proposed Independent Variables .....	47
Table 4: Sample Overview.....	63
Table 5: Logistic Regression Results Based on CTE Teacher Educational Attainment ...	65
Table 6: Logistics Regression Results Based on CTE Teacher Age .....	66
Table 7: Logistic Regression Results Based on Geography and School Climate.....	68
Table 8: Logistic Regression Based on CTE Subject Area .....	69

## LIST OF FIGURES

	Page
Figure 1: Chapman’s Conceptual Model of Teacher Retention .....	9
Figure 2: Missing Cells Per Variables .....	52
Figure 3: Pattern of Missingness Visualization .....	53
Figure 4: CTE Teacher Retention, 2014-2015 New Teacher Cohort .....	62

## CHAPTER 1

### INTRODUCTION

Retaining a sufficient number of qualified teachers in K-12 public education is a concern in the United States (Garcia & Weiss, 2019; Kelchtermans, 2017). The challenge facing K-12 education leaders and professionals is not necessarily a limited pipeline of teacher candidates but an inability to retain new teachers once they enter the profession (Dillon, 2009; Ingersoll, 2001). Nationally, an estimated one-half million public school teachers, 16% of the teaching workforce, either leave the profession entirely or change schools each year (Goldring et al., 2014). While both of these are sub-optimal outcomes, an estimated 8% of teachers leave the profession entirely, which contributes to teacher shortages. This turnover is about four times higher than the rate for all other occupations in the U.S. in the past decade (*Job Openings and Labor Turnover Survey*, 2020).

In Georgia, 44% of new teachers leave the profession within the first five years of service (Owens, 2015; Stephens et al., 2015). This is commonly called nonretention and means that the teacher has left the teaching profession (i.e., not just in a different district or role) (Boe et al., 1997). The level of nonretention varied by grade level, school characteristics, and location (Stephens et al., 2015). For example, high-school, high-poverty, and certain subjects (e.g., ESOL, mathematics, science) had higher non-retention rates than other groups. Teacher nonretention across K-12 public education results in increased costs to school districts (e.g., recruitment costs, increased wages, lost productivity), wasted resources (i.e., state investment into teaching training programs),

and diminished student learning (i.e., new teachers take several years to hit a teaching stride).

While the teacher retention issue is a challenge for K-12 education as a whole, Career and Technical Education (CTE) programs may face more acute workforce challenges. CTE refers to sequences of school-based courses “that provides individuals with rigorous academic content and relevant technical knowledge and skills needed to prepare for further education and careers in current or emerging professions” (Strengthening Career and Technical Education for the 21st Century Act, 2019, p. 4). Forty-four percent of school districts in the U.S. reported challenges “finding or keeping teachers for in-demand industries and occupations” (L. Gray & Lewis, 2018, p. 2) in CTE programs. The additional challenges associated with CTE teacher retention may be due to unique differences between CTE and traditional academic programs, such as competition with private industry for talent (i.e., a nurse can teach courses in an allied health pathway in high school or work as a registered nurse at a local hospital), declining enrollment in postsecondary CTE teacher preparation programs, and increasing student enrollment in CTE programs (Brand et al., 2013; Fletcher & Gordon, 2017; *Perkins Data Explorer*, n.d.; Song et al., 2011). CTE teachers also typically have more responsibilities than academic teachers (e.g., updating curriculum to match changing technology, hosting advisory committee meetings, seeking industry certification, advising CTE student organizations, engaging in local industry outreach) (Bottoms et al., 2013; Horne, 2010). The National Association of State Directors of Career Technical Education Consortium summarized the crisis facing CTE, “student demand requires more teachers, but teachers are leaving the profession and the opportunities to cultivate new educators are limited as

teacher programs are eliminated” (Conneely & Uy, 2009, p. 1). While this statement was released over a decade ago, the issues and challenges identified with CTE teacher recruitment and retention have not abated (Council of Chief State School Officers et al., 2016; Cross, 2016; Hasselquist & Graves, 2020)

A large body of literature has been produced over the past several decades that provides insight into the causes and potential strategies to solve teacher retention issues for K-12 education (Adams, 1996; Borman & Dowling, 2008; Chapman, 1983; Chapman & Hutcheson, 1982; Gritz & Theobald, 1996; Hanushek et al., 2004; Ingersoll, 2001; Kelchtermans, 2017; Lankford et al., 2002; Loeb et al., 2005; Scafidi et al., 2007; Shen, 1997; Theobald, 1990; Whipp & Geronime, 2015; Zhang & Zeller, 2016). Teachers are more likely to leave the profession if they teach in high poverty schools, work in schools and communities with a challenging school climate (e.g., poor school leadership, outdated facilities, unsupportive community), were not properly prepared for the position by their traditional or alternative preparation programs, or do not have access to mentoring and ongoing professional development. Generally, studies on teacher retention reflect one of two different emphases: a focus on (a) individual teacher characteristics or (b) organizational characteristics as reasons for leaving the profession (Ingersoll, 2001; Song et al., 2011).

Much of the existing literature has focused on retention and non-retention of the teaching workforce overall, raising questions about the applicability of these results to address the unique aspects and challenges of CTE teachers (Song et al., 2011). Prior studies that have examined CTE teacher retention have focused on the turnover of teachers in specific career clusters like agriculture education or family and consumer

sciences (Crawford Self, 2001; Dainty et al., 2011; Elliott et al., 2017; Su et al., 2011) or used small samples (Camp & Heath-Camp, 1989; Ruhland, 2001b). Career clusters are the framework used to organize the various career pathway programs taught in the United States. The National Career Cluster Framework has 16 clusters that each comprise several unique pathways (*Career Clusters*, 2020). The cluster studies represent nearly all of the CTE specific teacher retention literature, and there is not a clear consensus in the literature on the factors associated with teachers staying in the teaching profession (stayers) and those who leave the teaching profession (leavers). The variety of retention factors identified by previous CTE research include: (a) educational preparation (Dainty et al., 2011; Su et al., 2011), (b) job satisfaction (Crawford Self, 2001; Tippens et al., 2013), (c) teacher commitment (Dainty et al., 2011), (d) first-year experience (Dainty et al., 2011), (e) relationships with administrators and students (Camp & Heath-Camp, 1989; Dainty et al., 2011; Elliott et al., 2017; McCandless & Sauer, 2010; Su et al., 2011), (f) burnout (Solomonson, 2017; Tippens et al., 2013), and (g) adequate pay (Crawford Self, 2001; McCandless & Sauer, 2010). Some of the variance in retention factors may be related to the cluster or area the study focused on. For example, the two studies (Crawford Self, 2001; McCandless & Sauer, 2010) that found pay to be a significant factor were focused on industries where teachers could potentially make more in the private sector (construction and industrial arts). There has not been a comprehensive CTE research study that explores retention factors for all CTE teachers, regardless of specific cluster or teaching area. This study of CTE teacher retention used a quantitative approach will allow policy makers and researchers to better understand the

factors that influence CTE teacher retention decisions and potentially implement policy or practice changes to reduce turnover.

### **Why CTE Teacher Retention Matters**

Teachers play a critical role in delivering CTE programs. Research over the past several decades has detailed the important roles and impact of CTE programs in schools and communities by supporting students' career exploration, aiding in community or regional workforce development efforts, promoting overall student success, and supporting students with disabilities (Brand et al., 2013; Carnevale et al., 2012; Holzer et al., 2013; Levesque et al., 2008; Stone, 2011; Symonds et al., 2011). Without trained and qualified teachers, the various impacts of CTE may be diminished. One hallmark of high-quality and effective CTE programs is the presence of a qualified teacher (Holzer et al., 2013). Effective teachers have been identified as a key predictor for student success across all subjects in K-12 education (Auguste et al., 2010; Darling-Hammond, 1999; Harris & Sass, 2011; Rice, 2003; Rivkin et al., 2005).

### **Purpose of the Study**

The purpose of this study was to identify factors that are associated with Career and Technical Education (CTE) teachers' decisions to continue teaching (retention) or leave the teaching profession (nonretention). Retaining qualified teachers is critical to providing a quality education to students, preparing students for postgraduation success, and reducing the high costs of teacher turnover (Dillon, 2009; Hanushek et al., 2016; Henry & Redding, 2020; National Commission on Teaching and America's Future, 2007; Watlington et al., 2010). While teacher retention is a challenge throughout the K-12 education system currently (Kelchtermans, 2017; Owens, 2015), this study focused on the

challenges of retaining CTE teachers since the loss of CTE teachers presents school districts with unique challenges when compared to academic teachers. Many CTE teachers have skills that are financially lucrative in the private sector (e.g., nurse, engineer, computer programmer) and have additional responsibilities from academic teachers (e.g., updating curriculum to match changing technology, hosting advisory committee meetings, seeking industry certification, advising CTE student organizations, engaging in local industry outreach) (Bottoms et al., 2013; Fletcher & Gordon, 2017; Song et al., 2011). There is a paucity of research focused on CTE teacher retention, especially those utilizing quantitative approaches with larger datasets. This research will fill a void in our understanding of CTE teacher retention factors.

The study explored how individual factors (e.g., age, highest level of education completed, CTE pathway taught) and organizational factors (e.g., school climate, rural/urban) impact retention. Specifically, this study followed new CTE teachers who entered the profession in the 2014-2015 school year through the 2018-2019 school year. Teachers are most likely to leave early in their career or towards the end of their career (Grissmer & Kirby, 1987). Teacher licensure records maintained by the Georgia Professional Standards Commission (GPSC) were analyzed to follow teachers throughout their teaching career in Georgia and provide relevant data (e.g., demographics, education, subject, school, district, years of service).

These data were analyzed using logistic regression. Logistic regression is a statistical procedure that describes the relationship between a binary dependent variable and several independent variables (Hilbe, 2016). The study explored how individual

(e.g., age, highest level of education completed, career cluster) and organizational (e.g., school climate, rural/urban) variables impact retention.

### **Research Questions**

The following research questions guided data analysis:

1. Are there statistically significant differences in CTE teacher retention during the first five years based on educational attainment?
2. Are there statistically significant age differences between CTE teachers that stay five or more years and those who do not?
3. Are there statistically significant differences in the length of CTE teacher retention in the first five years of service based on district characteristics (e.g., school climate, urban/rural)?
4. Are there statistically significant differences in CTE teacher retention during the first five years based on high demand career clusters and not high demand career clusters?

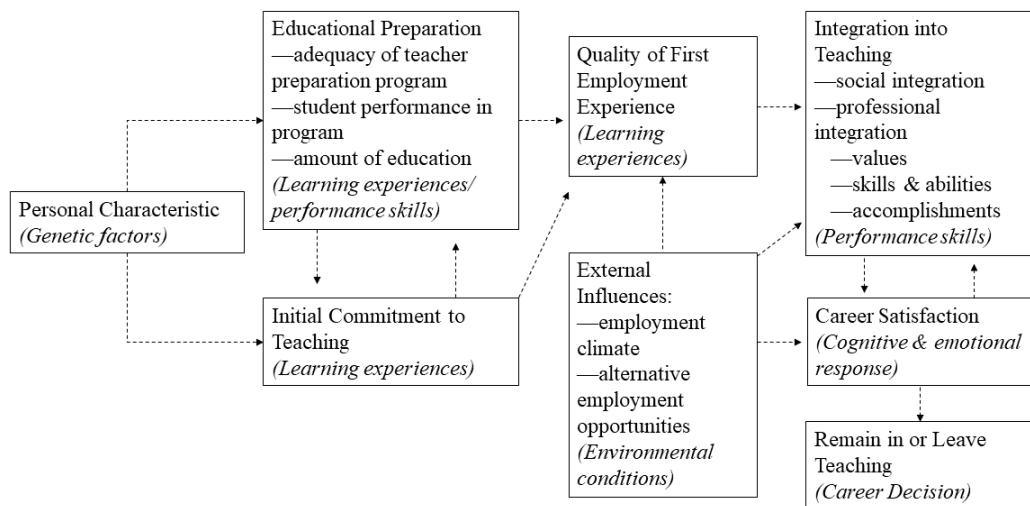
### **Theoretical Framework**

This study utilized Chapman's Conceptual Model (1983) on Teacher Retention to guide the development and implementation of the proposed study on CTE teacher retention. This selection was guided by several factors: (a) specific application to the teaching profession, (b) widespread use of the model in the teacher retention literature, (c) convergence with other key career development theories, and (d) a general high level of utility and ability to operationalize the model to support research design (Chapman, 1983; Chapman & Green, 1986; Dawis, 1994).

Chapman (1983) created a general conceptual model to aid in the studying of teacher retention. Chapman's model is based generally on Krumboltz's social learning theory, a commonly utilized and widely accepted career development theory (Chapman, 1983; Krumboltz et al., 1976; Krumboltz & Nichols, 1990). The model applied social learning theory to the unique occupational aspects of the teaching profession (Chapman & Green, 1986). Chapman identified four major categories that influence teacher retention decisions: (a) personal characteristics, (b) teaching training and early teaching experience, (c) integration into teaching, and (d) career satisfaction. Figure 1 provides a graphic representation of Chapman's model.

**Figure 1**

*Chapman's Conceptual Model of Teacher Retention*



Italicized words in parentheses indicate the relationship of components of the model to the more general tenets of social learning theory.

*Note.* Reprinted from “A Model of the Influences on Teacher Retention,” by D. Chapman, 1983, *Journal of Teacher Education*, 34(5), p. 47. Copyright [2021] by Sage Publishing. Reprinted with permission.

Personal characteristics variables identified as impacting teacher retention were sex (men and women differed in their assessment of career satisfaction), race, and socio-economic status (the lower the socio-economic status of the teacher's family, the more likely they were to stay in teaching). Teacher training and early experience variables influencing retention decisions included the amount of education completed, the initial commitment to teaching, adequacy of the teacher preparation program completed, student teaching experience, and the teacher's first teaching experience. Chapman (1983) argues that the amount of education influences retention, but it was not clear at the time of publication what the exact impact was (higher education might lead to more mobility or more conflict with principals and administrators). Teachers with a high-level of initial commitment to the profession were more likely to stay long-term. The teacher preparation methods and student teaching experiences influence retention decisions. Stronger student teaching programs better prepare new teachers and positively impacts retention. Finally, Chapman's model assumes that a positive first teaching experience will impact retention (i.e., happier teachers are more likely to stay in the profession).

The "integration into teaching" category is comprised of professional integration and social integration. Chapman (1983) defines integration in the context of teaching by noting: "the greater a teacher's involvement in the professional aspect of his or her career and the more social ties that person has to others in the school, the more likely that teacher will remain employed" (p. 45). Professional integration seeks to quantify a teachers' ties to their profession, including salary, individual views on the importance of professional success, individual views of achieving recognition by others, and individual assessments of skills and abilities. Social integration is how connected the individual

teacher is to other teachers in the school. Teachers that have close friends and feel an obligation to the institution are more likely to stay.

The final category is satisfaction with the teaching career and is very important as it may moderate the impact of other factors on retention decisions. The career satisfaction of teachers has a positive relationship with career persistence and retention.

The interaction of these categories ultimately results in the career decision of staying in the teaching profession or leaving the teaching profession. Chapman (1983) sought to identify the key factors that interact and influence staying or leaving the teaching profession. The model is longitudinal and is based on the assumption that a number of factors that occur at various times (e.g., pre-service, start of first year of teaching, subsequent school years) influence the retention decision. Some of the factors in the model directly influence other factors. Specifically, the educational preparation experience may positively or negatively impact the level of initial commitment to teaching and the integration into the teaching profession may positively or negatively impact the teacher's career satisfaction. Chapman's teacher retention model was developed with an eye towards understanding the factors that impact teacher retention decisions and then use the increased understanding to influence teacher development and support mechanisms.

### **Importance of Study**

Teacher retention is a challenge for K-12 education in the United States (Garcia & Weiss, 2019; Kelchtermans, 2017). CTE programs face a more difficult time recruiting and retaining CTE teachers (Conneely & Uy, 2009; L. Gray & Lewis, 2018) than other K-12 teaching roles due to unique factors evident only in CTE (e.g., competition from

industry, additional demands on CTE teacher's time, higher use of alternative teacher preparation and entry programs) (Cramer, 2004; *National Assessment of Career and Technical Education: Final Report to Congress*, 2014; Song et al., 2011) . This sought to understand the factors that are associated with the nonretention of early career CTE teachers.

The information developed from this study can be used by school district, state, and national CTE leaders to enhance programs and policies to support pre-service, first-year, and early career CTE teachers. The findings from the study can also be used to help influence the curriculum and resources provided in various teacher training programs. The findings can be used to shape additional support, training, mentorship, or resources for pathways that have a higher level of teacher nonretention. Another example of how this study can help influence CTE is by supporting policies (e.g., loan repayments, salary supplements, co-teaching model) to retain teachers that have skills that are in high-demand in the noneducation labor market. One of the research questions sought to understand if there are differences in retention based on the various career clusters. This can allow educational leaders to design retention strategies focused on supporting and retaining teachers in disciplines with a higher level of nonretention.

This research project filled a void in the CTE teacher retention literature by utilizing quantitative methods and a large dataset to identify the factors that are associated with retaining CTE teachers. These methods and datasets have been applied to K-12 education generally (Adams, 1996; Adams & Dial, 1993; Chapman & Hutcheson, 1982; Rots & Aelterman, 2008; Scafidi et al., 2007; Vagi et al., 2019) but have not been applied specifically to the CTE discipline. Additionally, there have been a number of

qualitative and individual discipline focused CTE studies (Crawford Self, 2001; Dainty et al., 2011; Elliott et al., 2017; McCandless & Sauer, 2010; Ruhland, 2001b; Su et al., 2011). This project is the first CTE focused retention study that will utilize quantitative methods to analyze a large dataset.

## CHAPTER 2

### REVIEW OF RELATED LITERATURE AND RESEARCH

#### **Relevant Theoretical Frameworks**

Theory plays an important role in the research process. Specifically, it may be used to help develop hypotheses, guide the research design (i.e., variable selection), and can help to explain the research findings (Creswell, 2014; Tuckman, 1999). In Career and Technical Education (CTE) focused research, Camp argued that “one must conclude that there is a general lack of agreement on what is meant by theoretical framework” (2001, p. 4) and sought to encourage CTE researchers to utilize theory (e.g., grand theory, theoretical frameworks, conceptual frameworks) in CTE research. Similarly, Kitchel and Ball (2014) argued that agricultural education research suffers from a lack of theory use and that strengthening the use of theory would improve the quality of research and allow it to address the key challenges faced by the discipline.

Schmidtke (2017) sought to quantify and analyze the various theories used in CTE research with an eye toward establishing a common theory base for the discipline. The analysis found that “there is no widespread agreement on foundational theories for CTE as a discipline, nor is there much discussion and debate in the literature on what a theory foundation might look like” (Schmidtke, 2017, p. 193). Researchers examined published research from 2006-2015 in three key CTE journals (*Journal of Career and Technical Education Research*, *Career and Technical Education Research Journal*, *Journal of Career and Technical Education*) and found that 76 distinct theories were

utilized. Most theory, according to the analysis, utilized in CTE research was in the social-cognitive theory group (e.g., super's life-space life-span theory, theory of self efficacy) and in the learning theory group (e.g., social cognitive learning theory, experiential learning theory). Only 45% of the articles published in the three CTE journals between 2006 and 2015 had an identified theory (Schmidtke, 2017).

Several career development research theories are potentially relevant to studying CTE teacher retention. These include Chapman's teacher retention conceptual model (detailed in chapter 1), vocational choice theory, social learning theory of career development, and the theory of work adjustment. Chapter 1 detailed that this research project will utilize Chapman's teacher retention conceptual model. The section details the additional relevant theories and why Chapman's model was selected for the research project.

### **Theory of Vocational Choice**

Holland (1959, 1973) developed a theory of vocational personalities and work environments. The core idea of Holland's theory of vocational choice was that individuals will search for and are best suited to careers that fit their personalities, skills, and preferences (Nauta, 2010). The theory identified six personality types: realistic, investigative, artistic, social, enterprising, and conventional. Most individuals exhibit several personality types. Holland argues that individuals will stay in a career if there is alignment between their personality type and the job's characteristics.

Holland's theory can be applied to studying teacher retention by comparing a teacher's personality type with the teaching work environment. Ruhland (2001a) suggested that Holland's theory of vocational choice could be operationalized in studying

retention, noting that “teachers who rate themselves higher in skills and abilities, values, and professional accomplishments should exhibit more satisfaction with their career” (p. 59).

### **Social Learning Theory of Career Development**

The social learning theory of career development (Krumboltz et al., 1976; Krumboltz & Nichols, 1990) helps to explain how individuals make career decisions. Specifically, the theory suggested that genetic factors, environmental conditions, learning experiences, cognitive and emotional responses, and performance skills help to influence career decisions and career paths (Chapman, 1984). Individuals make career decisions and navigate the workplace in light of these various factors, with the aim of achieving their career and life goals (Krumboltz & Worthington, 1999). Ruhland (2001a) summarized the applicability of this theory to CTE teacher retention by noting “understanding these factors can help answer the question of why individuals change occupations throughout their lives” (p. 60). Krumboltz’s theory is relevant to teacher retention discussion because those who chose to leave the profession may have been prompted by a misalignment of their preferences and expectations to the realities of the job (Krumboltz et al., 1976).

### **Theory of Work Adjustment**

Another theory used in teacher retention research is the theory of work adjustment (Dawis et al., 1968), which looks at the level of satisfaction between the individual and their work environment. It is based on four psychological concepts: (a) ability (i.e., aptitude), (b) reinforcement value (i.e., need for reinforcement or feedback from others), (c) satisfaction ( i.e., individuals satisfaction with their work environment), and (d)

person-environment correspondence (i.e., the fit between the individual and job factors) (Dawis, 1994). The theory examines the individual's work personality (their unique abilities and gifts) and how that aligns with the work environment. Specifically, the theory has two person-environment fits: (a) needs-supplies fit, which looks at the needs and values of the worker compared to what the job provides and (b) abilities-demand fit, which examines the knowledge and skills of the worker compared to the demand of the jobs (Dahling & Librizzi, 2015).

The theory assumes that tenure in a workplace demonstrates a good alignment between the individual and the work environment. An individual chooses to leave a job when there is not a high level of satisfaction between their individual self and the work environment. The theory can be used to study the fit of the individual for a given work environment and also be used to predict employee turnover decisions (Dahling & Librizzi, 2015).

### **Theory Selection**

Based on a review and analysis of relevant theories, the study utilized Chapman's conceptual model on teacher retention. This selection was guided by several factors: (a) specific application to the teaching profession, (b) widespread use of the model in the teacher retention literature, (c) convergence with other key career development theories, and (d) a general high level of utility and ability to operationalize the model into a research framework.

One of the key strengths of Chapman's conceptual model is that it was designed specifically to examine the unique career development aspects of the teaching profession. While it is built on Krumboltz's social learning theory of career development, Chapman's

conceptual model crosswalks the various core concepts of the social learning theory and matches them to concepts that are pivotal to teacher development and retention (Chapman, 1983). For example, Chapman translates the learning experience construct in the social learning theory to a teacher specific concept in the conceptual model (initial commitment to teaching). Another example of the crosswalk from social learning theory to Chapman's model is the cognitive and emotional response construct is cross walked to a teaching specific content (teaching career satisfaction) in Chapman's model.

Chapman's model requires less work to be applied to specific teacher research projects and has relatively clear concepts that can be adopted by teacher retention researchers.

Chapman's conceptual model has been utilized to guide or influence a number of teacher retention focused research projects over the past three decades. The conceptual model still is regularly used and does not appear to be replaced by a new or improved teacher retention framework. Several examples of how the conceptual model has been used over the past three decades are detailed in the following paragraphs.

A test of Krumboltz's social learning theory and Chapman's conceptual model was conducted to explore if the frameworks could help to explain why some secondary agriculture teachers left the classroom and others stayed (Grady & Professor, 1990). Using a survey of secondary agriculture teachers (both stayers and leavers), the researchers sought to operationalize Chapman's conceptual model of teacher retention. The study used discriminant analysis to explore how the various model concepts (e.g., educational preparation, first year teaching experience, initial commitment to teaching, criteria for success, professional integration, and personal characteristics) potentially predict staying or leaving decisions. They found that variables guided by the proposed

frameworks helped to discriminate between stayers and leavers, especially educational preparation, grade point average, first year experience, professional integration, criteria for success, and attainment of the criteria for success.

Ruhland (2001a, 2001b) used Chapman's conceptual model to guide two studies looking at retention factors for secondary and post-secondary CTE teachers. The secondary CTE study surveyed graduates of a secondary teacher training program and sought responses from those both still teaching and those who were not in teaching. Chapman's model was used to guide the questions asked on the instrument. Ruhland (2001b) found a statistically significant difference between secondary CTE leavers and stayers on their perception of their commitment to teaching. Stayers were typically extremely committed to the teaching profession. Leavers cited burnout as the top reason for leaving the profession. The post-secondary study completed Ruhland (2001a) utilized Chapman's model to explore the retention factors for post-secondary technical college instructors. The research used surveys completed by individuals who completed a technical college instructor training program and found significant differences between post-secondary instructors who stayed in the profession or left the profession on measures of teaching commitment and their first year experience. Other variables focused on skills and willingness to continue teaching were not significantly different between stayers and leavers.

Another study used Chapman's conceptual model as the base for a study looking at the connection between teacher education programs and retention in the first several years of the teaching career (Rots et al., 2007). The research sought to build on the work of Chapman and other teacher retention researchers and specifically focused on

operationalizing multiple variables to better understand the influence of various teacher education programs on entrance (i.e., actually becoming a teacher after graduation) and retention decisions. They found that the level of preparation provided by the teacher education program, teaching commitment, feedback from mentors, and teaching training program type helped to best explain the decision to enter the teaching profession after completing a teacher education program.

The final strength of Chapman's model was highlighted briefly in the preceding section comparing various career development theories. Chapman's model, an application of Krumboltz's social learning theory, has a high level of convergence and similarity to other commonly accepted career development theories, including Holland's theory of vocational choice and Dawis's theory of work adjustment. While each of the theories has unique elements, they do not have large philosophical disagreements. Social learning theory, vocational choice, work adjustment, and Chapman's model could all be potentially utilized for the study. Chapman's model was selected due to its unique focus on the teaching profession, its common adoption in the teacher retention literature (likely due to its ease of use and potential to guide research), and its convergence with other commonly utilized career development theories.

### **Teacher Retention**

Teacher retention is a common and long studied facet of educational research. This section seeks to provide background on teacher retention data, discuss the primary teacher retention factors identified by general teacher retention research, and then detail the state of CTE teacher retention research.

Researchers are seeking to understand the reasons for why teachers stay or leave the teaching profession. Much of the research aims to influence educational policy, training programs (e.g., traditional teacher preparation programs, alternative certification programs), and support mechanisms provided for early career teachers (e.g., induction programs, mentoring relationships, peer learning community). Defining retention and other similar terminology is quite challenging (Billingsley, 1992). Generally, retention is focused on keeping teachers in the teaching profession, regardless of if they change schools or districts. There are additional facets to retention, such as smart retention, voluntary retention, and healthy attrition.

Jacob et al. (2012) argued for a subset of retention called smart retention where school districts focus their retention efforts on keeping high-quality teachers (called irreplaceables) in their schools and reduced efforts on retaining poor performers. Similarly, there is a differentiation between voluntary retention (i.e., the teacher chooses to leave) and involuntary retention (i.e., the teacher is fired or their contract is not renewed) (Guarino et al., 2006). Similar to the concept of smart retention previously described, Borman et al. (2008) attempted to differentiate between healthy attrition (i.e., low performers leave the school) and unhealthy attrition (i.e., the top performers leave while others stay) at the school level. When exploring teacher retention, it is critical to understand the current landscape of teacher retention data and the primary factors associated with teacher retention, both for all K-12 teachers and CTE specific research.

### **Teacher Retention Data**

The availability of easily accessible and comprehensive data are a key challenge for understanding both the overall K-12 teacher trends and analyzing the specific needs

of CTE. Accessing useful current or historical data are challenging due to data limitations, reliance on a variety of surveys (i.e., not comprehensive data), and a lack of standard definitions. There is also disagreement among educational researchers on the depth of the teaching shortages and nonretention issues (Aragon, 2016). For example, researchers from the National Center for Education Statistics (Raue & Gray, 2015) used the first five waves of the Beginning Teacher Longitudinal Study to calculate a national estimate of teacher turnover. They found that 77% of new public school teachers that started in the 2007-2008 school year remained in the teaching profession for all of the first five years (a 23% nonretention rate). Richard Ingersoll has long been one of the leading teacher retention researchers over the past several decades. In 2003, he estimated that teacher turnover in the first five years for new public and private school teachers was between 40% and 50% (2003). Ingersoll et al. (2018) updated this number recently with improved data and estimated that between 1993 and 2003 44% of public and private school teachers left the profession within the first five years. It is likely that the differences between the two estimates (Raue and Gray vs. Ingersoll) can be explained by when the data were collected, the specific definitions used, and the specific data source utilized. Ultimately, the data demonstrate that teacher retention is a challenge for K-12 education.

There are not easily accessible ongoing national estimates or a strong consensus on general teacher nonretention trends. Borman et al. (2008) summarized this challenge by noting “information on national attrition rates is sporadic and has been subject to some inconsistencies over time because of differences in data collection and sampling methods” (p. 400). Additionally, there is not an existing comprehensive dataset of teacher

nonretention data available at the state level (Thomsen, 2016). To help fill the data gap, many states issue teacher workforce reports (Collins & Schaaf, 2020; Tio, 2019), but they vary in definitions, procedures, and depth of analysis.

CTE specific retention data are not generally available. There appears to be little historical or current specific data to understand the retention issue facing CTE. Mordan (2012) utilized the Teacher Follow-up Survey and the Beginning Teacher Longitudinal Study (BTLS) datasets to develop a one-year retention rate estimate for CTE teachers. He found that 16.1% of CTE teachers did not return after their first year of teaching, which was nearly six percentage points higher than the overall teacher sample. It is important to also note that there were only 110 CTE teachers in the BTLS dataset, so it may not be fully representative of the national trend. While other sources indicate there are teacher retention issues and a general shortage of CTE teachers (Conneely & Uy, 2009; L. Gray & Lewis, 2018; Heath-Camp & Camp, 1990; National Association of State Directors of Career Technical Education Consortium, 2010), there are limited CTE teacher retention studies conducted with rigorous methods or approaches. This paucity of reliable data for CTE research demonstrates the importance of this project's data collection and analysis for increasing the understanding of factors associated with CTE teacher retention.

### **Primary Factors Associated with Teacher Retention**

The research on teacher retention relevant to the proposed study can generally be split into two groups. The first group focuses on the overall teaching workforce and seeks to understand macro retention factors for all teachers regardless of their specific discipline. The second group focuses on retention factors that are unique to CTE teachers.

### ***General Research on Teacher Retention and Nonretention***

Guarino et al. (2006) conducted a literature review of prior research on teacher recruitment and retention, looking to identify common findings among different research studies. Common findings on teacher retention from their study included: (a) turnover occurred early in a new teacher's career, (b) minority teachers had a lower turnover rate than white teachers, (c) science and math teachers left at a higher rate than other teachers, (d) academic ability is associated with turnover (i.e., teachers with higher test scores were more likely to turnover), and (e) female teachers had a higher turnover rate than male teachers.

Borman and Dowling (2008) conducted a meta-analysis of 34 studies that examined 63 variables related to teacher turnover using both individual teacher characteristics and organizational (i.e., school) characteristics. They found that teacher turnover was influenced by various personal and professional factors such as years of experience, leaving the profession to raise children, new teacher induction and support approaches, salaries, and pensions (i.e., ability to retire earlier than other professionals). Teacher turnover was moderated by characteristics of teachers' work conditions such as school climate, school location (i.e., urban vs. rural), leadership, quality of instructional support, and facilities (Borman & Dowling, 2008). The authors developed five groups of variables that prior studies identified as important to studying teacher retention and attrition. The five variable groups are: (a) teacher demographic characteristics (i.e., demographic and background characteristics of teachers such as gender, race, age, and marital status), (b) teacher qualifications (e.g., teacher training type, years of teaching experience, specialty training area), (c) school organizational characteristics (e.g., school

size, administrative support, level of bureaucracy, presence of a new teacher mentor program), (d) school resources (e.g., average class size, per-pupil spending, teacher salary), and (e) school student body characteristics (e.g., school's socioeconomic composition, student achievement levels, racial composition of the school).

Adams (1996) used a survival model to study teacher turnover in a large urban school district and found that race, certification type, education, and age helped to best explain teacher turnover. Specifically, Adams found that White teachers were 385% more likely to leave their district than African American teachers; traditionally certified teachers were 19% more likely to leave than those with an alternative certification; teachers who started at a younger age (less than 40) were 43% more likely to leave the district than those who started after 40; and teachers with only a bachelor's degree were 68% more likely to leave the district than those with a higher level of education.

Scafidi et al. (2007) used teacher certification data from Georgia to explore teacher retention through a linear probability model (a regression model where the outcome variable is binary, and the explanatory variables aim to predict or explain the outcome) and a competing risk model (a survival analysis type model that can accommodate studying multiple types of failure or end points). They found that “a one standard deviation increase in the proportion of black students in a school increases the probability that a median type [average] teacher will exit a particular school in a particular year by more than 20 percent” (Scafidi et al., 2007, p. 147).

Ingersoll (2001) used the School and Staffing Survey dataset to analyze how organizational factors impact teacher retention. Several variables were closely linked with nonretention, including poor support from school leaders, discipline problems,

limited teacher input into school decisions, and low salaries. Similarly, Loeb et al. (2005) analyzed how school characteristics impact teacher retention in California. They found that the strongest predictors for teacher turnover were school conditions, multitrack schedules (year-round school), class size, and beginning salary levels. Schools with poor facilities, numerous complex schedules, large classes, and low salaries are more likely to see teachers leave than schools that do not have those characteristics.

Other studies have looked at the impact of principals and school leadership on teacher turnover. Boyd et al. (2011) used a New York City School District dataset that combined survey data (teachers surveyed during their first and second years of teaching) and administrative data to explore how various factors (e.g., teacher influence, administrator effectiveness, school safety, facilities, student behavior, staff relations) impacted teacher retention decisions. Over 40% of both current and former teachers cited a lack of support from administrators as the most important aspect of the job that influenced their decision to leave teaching. This category was much larger than any other influence on the decision to leave.

There has been a large amount of teacher retention research conducted over the past decade. Teacher retention researchers like Guarino et al. (2006), Borman and Dowling (2008), and Ingersoll (2001) have found that individual (e.g., teacher demographics, teacher preparation), organizational (e.g., facilities, leadership effectiveness, support for new teacher), and student (e.g., behavior, economic need, student demographics) factors impact retention decisions for all K-12 teachers.

### *CTE Specific Research on Teacher Retention and Nonretention*

While there is a large body of literature looking at teacher retention issues across K-12 education, there has been a sparse amount of research looking specifically at CTE teachers. CTE teachers face the same issues and challenges as other K-12 teachers, but due to unique aspects of CTE there are likely additional factors influencing CTE teacher retention (Bottoms et al., 2013; Song et al., 2011). Most of the prior CTE research has been focused on certain clusters or pathways and cannot easily be generalized to the overall CTE discipline.

Ruhland (2001b) used a quantitative approach to explore how personal, professional, and school characteristics explain CTE teacher retention decision making. Through a survey of over 200 graduates from the University of Minnesota's CTE teacher training program, she tested out several concepts related to teacher retention or nonretention. Ruhland found a statistically significant difference between those who left and those who stayed regarding their evaluation of their first year teaching experience (e.g., positive, negative, feeling supported, not supported). The main reason for nonretention "was job-related stress with 31% of the participants selecting this reason" (Ruhland, 2001b, p. 41)

CTE teacher training and preparation may play an important role in teachers choosing to stay or leave the profession. If teachers are not properly prepared to enter the classroom, they may not be successful or have a positive experience, increasing the probability they will leave the profession. Ruhland and Bremer (2003) surveyed new CTE teachers that went through a traditional teacher preparation program or alternative teacher certification program and found differences regarding the adequacy of

preparation on pedagogy and knowledge of the subject matter. Teachers completing a traditional program reported that they felt a higher level of preparation in their pedagogical skills. Teachers going through an alternative preparation program reported a higher level of knowledge of their subject matter compared to traditionally prepared teachers. The survey design did not allow the researchers to capture individuals who had already left teaching, but they found no difference between teachers completing traditional and alternative certification programs in their planned likelihood to continue teaching.

Song et al. (2011) sought to explain teacher turnover by applying concepts and strategies from the human resources development field and utilize that framework to study CTE teacher retention. Much of the prior literature on CTE teacher retention focused on individual teacher factors and not the organization (i.e., school building level) as a whole. Specifically, they analyzed the following variables: supportive learning culture, innovative school climate, and the level of workforce job autonomy. Using structural equation modeling and a sample of current teachers, the researchers found that organizational culture significantly influences lower CTE teacher turnover intention.

The bulk of existing research on CTE teacher retention issues has been narrowly focused on a subset of CTE teachers to study the retention in various clusters or specific program areas. There have been a number of studies exploring the challenges of retaining agriculture education teachers in the US. Elliot et al. (2017) surveyed secondary agriculture education teachers in Kansas on their perception of factors influencing retention, including educational preparation, teacher commitment, first-year teaching experience, skills and abilities, social integration, and institutional factors. Survey

respondents reported the most important factor in new teacher retention was gaining the respect of students and the respect of building administrators. A similar study (Tippens et al., 2013) was conducted looking at Georgia secondary agriculture education teachers to explore factors associated with the likelihood of leaving early (i.e., before retirement). The researchers surveyed a sample of agricultural education teachers using questions exploring job satisfaction factors and demographics. They found that job satisfaction, number of years at the current school, number of years teaching prior to this position, number of teachers in the school's program, number of classes taught per day, and contract length were significant in explaining the likelihood of leaving their teaching role before retirement. The researchers generally found that job satisfaction and avoiding burnout were key factors in retaining agriculture education teachers.

Another study (Solomonson, 2017) sought to build on prior research on agricultural education teachers and address the gap of not getting feedback or responses from teachers who had already left the profession. The mixed-methods research (survey and interviews) reached similar conclusions to prior agricultural education teacher studies on job satisfaction but also identified new nonretention factors not detailed previously. Solomonson (2017) found that mid-career agricultural education teachers struggled to “balance their personal and professional lives due to changing family dynamics” (p. 67), especially with the success and growth of the CTE programs they have built during the initial years of their teaching careers. The survey of former agricultural education teachers found that personal factors were identified as the top construct, but that many of the individual factors identified as top reasons for leaving are tied to the job duties that

contribute to poor life balance, such as out-of-classroom expectations and the inability to feel caught up (Solomonson, 2017).

Su et al. (2011) also conducted a discipline specific study examining trade and industrial (T&I) education teachers in Kansas and the factors that influenced their retention decisions. Survey respondents reported that gaining the respect of students was important, managing behavior was difficult, that they felt that they had a good level of preparation, and most reported that they had the needed skills for their position. Several of these researchers from the T&I study conducted a similar research project (Dainty et al., 2011) to gather the perception of current family and consumer sciences (FACS) teachers on why FACS teachers might leave the profession. They reported that educational preparation, especially related to technology, student organizations, and teacher commitment were important to retaining teachers. They also found that the first-year teaching experience and teacher relationships with administrators and students were also important to retention. McCandless and Sauer (2010) examined the factors that potentially influenced nonretention of secondary construction teachers in Missouri. The mixed methods study identified four key reasons for nonretention of new construction teachers: (a) low pay compared to potential industry earnings, (b) challenges with student management, (c) poor student attitudes, and (d) lack of administrative support.

Crawford Self (2001) utilized a case study approach to understand the decision of 16 former T&I education teachers in a Midwestern state who left teaching. This approach allowed teachers who left the profession to share their reasons for not continuing. Former teachers reported leaving due to dissatisfaction with teaching (45% of cases), to pursue other career opportunities (33% of cases), better salary or benefits (17% of cases), and

family/personal (5% of cases). The former teachers identified issues or concerns that made them want to leave the profession, including lack of support from administrators, low pay, discipline challenges, politics, and internal school bureaucracy.

### **CTE Teacher Preparation and Certification**

While this study is focused on the retention of CTE teachers, teacher preparation methods play an important role in supporting teacher retention (Camp & Heath-Camp, 1989; Ruhland & Bremer, 2003). Additionally, teacher preparation is a key factor in Chapman's (1983) conceptual model for teacher retention. CTE has long had (for over 100 years) two general pathways to teaching in the US: (a) traditional university based degree program with classroom-based instruction and student teaching and (b) alternative pathways that rely on industry experience and specialized training and support systems (Zirkle et al., 2007). This section explores the current state of CTE teacher preparation programs (traditional and alternative) and how that may influence teacher retention decisions.

Regardless of the specific teacher preparation pathway, it is important to have a sufficient number of individuals interested in becoming a CTE teacher. This has been a difficult challenge for those involved in training and recruiting CTE teachers. The CTE teaching pipeline may be limited due to certain aspects related to recruitment for the positions. The American Institutes for Research examined CTE teacher workforce issues, finding that the complexity of certification requirements, preference for teachers with industry experience, a limited number of CTE training programs, and rapid industry changes may deter highly qualified individuals from seeking CTE teaching positions (Brand et al., 2013). Another challenge that impacts CTE teacher recruitment is the

growing role and expectations for CTE teachers (Bottoms et al., 2013; K. C. Gray & Walter, 2001; McCaslin & Parks, 2002; Zirkle et al., 2007). Specifically, there has been an increase in requirements for CTE teachers with additional duties, expectations, and skills required beyond just the traditional skill development role typically expected in the previous century. These new expectations include supporting the career development of students, integrating CTE with core academic courses, increased accountability standards, focus on literacy and numeracy in CTE, more diverse students, increased technology and changes in industries, and preparing students for work and postsecondary education (Bottoms et al., 2013).

CTE teacher training and preparation routes may play an important role in teachers choosing to stay or leave the profession. Ruhland and Bremer (2003) surveyed new CTE teachers that went through traditional preparation programs or alternative certification programs and found differences regarding the adequacy of preparation on pedagogy and knowledge of the subject matter. Teachers completing traditional programs reported that they felt a higher level of preparation in their pedagogical skills. Teachers going through alternative preparation programs reported a higher level of knowledge of their subject matter compared to traditionally prepared teachers. They found no difference between teachers completing traditional and alternative certification programs in their planned likelihood to continue teaching (Ruhland & Bremer, 2003).

A CTE teacher's first several years of teaching can also be highly influential on the retention decision. Camp and Heath-Camp (1989) studied the teacher induction period, defined as the first several years of teaching, by using a qualitative approach with domain analysis. Twelve teachers participated in the study, and they identified over 1,700

detractors (e.g., problems with their job, students, school, professional development). Participants were categorized as traditionally prepared or alternatively prepared. Overall, the top categories of detractors for CTE teachers, regardless of preparation methods, were students and the educational system. Alternatively prepared teachers were more likely to report detractors in the following areas: curriculum, pedagogy, peers, students, and systems. Traditionally prepared teachers were more likely to report detractors in the following areas: community, internal, and program. This indicates that traditionally prepared teachers likely possess more pedagogy and traditional teaching skills while they may have less industry and hands-on experience. Alternatively prepared teachers are less prepared on pedagogy, classroom management, and traditional teaching skills, while they are more likely to possess industry experience and community relationships.

### **Traditional University-Based Preparation Programs**

The traditional CTE teacher preparation pathway is offered by a college or university. It is a degree-granting program where the student completes coursework in the content specific area (e.g., business education, agriculture education, engineering education, family and consumer sciences) plus coursework on pedagogy and a student teaching or field experience (Hyde, 2007; Ruhland & Bremer, 2002; Schaffer, 2017). This could be at the bachelor's degree level or master's degree level. Entry requirements are not standardized for traditional CTE programs but typically require a minimum GPA (usually 2.75) and passing a basic skills exam (e.g., Georgia Assessments for the Certification of Educators, Praxis) (Asunda, 2011).

Traditional CTE teacher education programs have been facing a number of challenges, such as declining enrollment and difficulties keeping up with the changing

education landscape (Fletcher et al., 2015; Fletcher & Gordon, 2017; Lynch, 1996). Researchers found that 11% of CTE teacher preparation programs closed between 1990 and 2000 and that for every new program established, four were closed (Bruening et al., 2001). Fletcher et al. (2015) sought to replicate and update the Bruening study to explore the changing CTE teacher preparation landscape from 2000 to 2015. The research found a continued decline of CTE preparation programs, including 122 fewer higher education institutions offering undergraduate CTE preparation programs. A subsequent study that examined trends in CTE teacher preparation program enrollment and program offerings found that enrollment was relatively stable in the CTE teacher preparation programs that remained (Fletcher & Gordon, 2017). While that may look like a positive, the authors argue that the decline in the number of overall programs may have helped to stabilize enrollment in the programs that remained.

Another factor that has contributed to the decline of traditional programs over the past several decades is that CTE teacher education programs had historically received a portion of the state's Perkins funding to support their programs, but this funding was reduced with Perkins II in 1990. This cut in funding plus the K-12 student enrollment declines driven by a focus on academic courses (i.e., impact of No Child Left Behind) resulted in shrinking CTE teacher preparation programs (Camp & Heath-Camp, 2007).

Traditional CTE preparation programs have also faced criticism by school districts that employ their graduates. One researcher summarized this criticism of postsecondary CTE training programs by K-12 schools noting:

Commentary—often accusatory in nature—ranges from the nonresponsiveness of colleges and universities to reform initiatives in vocational and technical

education, low production of vocational and technical education teachers, inappropriate preparation of the few vocational and technical teachers that colleges and universities are producing, out-of-date professors, and on and on and on (Lynch, 1996, p. 2)

### **Alternative CTE Teacher Preparation Programs**

The declining student enrollment in and number of traditional CTE preparation programs has made alternative CTE teacher preparation programs a key entry point for CTE in the US. Alternative preparation programs are routes to entering the classroom not through a traditional degree-based university-based CTE teacher preparation program. These alternative routes generally rely on “occupational competency, professional experience, and completion of a baccalaureate degree in the subject area” (Ruhland & Bremer, 2003, p. 285). They aim to serve professionals with industry experience who want to transition to being a CTE teacher in the areas where they have specific experience. This industry experience component is a longstanding tenant of CTE. The Smith-Hughes Act, which acted as the foundation of formal vocation education in the US, required instructors to have practical work experience (Zirkle et al., 2007).

Alternative certification programs can be offered by universities, colleges, school districts, and other private organizations (Schaffer, 2017). One of the challenges of alternative certifications is that they encompass a variety of programs that differ in substance, length, rigor, and approach. They can be anything from an emergency certification with a short pedagogy bootcamp to post-baccalaureate certificate and master’s degree programs with strong classroom support and induction experiences. The decline in traditional CTE teacher preparation programs helped usher in the rise and

importance of alternative ways to prepare teachers. More CTE teachers will enter the profession through alternative means than traditional programs, but they will also likely have a bachelor's degree in a nonteaching degree program (K. C. Gray & Walter, 2001).

There are also outstanding questions about the readiness and impact of alternatively prepared teachers. Specifically, “a high and increasing share of career and technical education teachers qualify through alternative certification routes, but there is no evidence to suggest how this affects students” (Gordon & Schultz, 2020, p. 246). Additionally, alternative pathways, especially those that do not require a bachelor's degree, may contribute to CTE's image and perception problems (Asunda, 2011).

### **Evaluating Traditional and Alternative Programs**

With the decline of traditional preparation programs and increasing student demand, alternative preparation pathways will play an even larger role in training the CTE workforce. While there are certainly inconsistencies and challenges with alternative programs, traditional CTE programs are not without challenges or faults too (Lynch, 1996). The debate between traditional programs and alternative programs also lacks tangible evidence on student outcomes. Gordon and Schultz summarized this gap in CTE focused research by noting that:

There is currently little research to evaluate the relative or unique contributions of teacher certification and industry experience to career and technical education teaching. No rigorous evaluations have examined the relationship between the credentials of CTE teachers and the occupational and technical competencies of their students (Gordon & Schultz, 2020, p. 246)

Camp and Heath-Camp summarized the importance of preparing CTE teachers, regardless of method, by noting, “if CTE teacher education is nonexistent, the quality of instruction in CTE programs will decline. Potential teachers and existing teachers will not have the opportunity to receive the appropriate education they need to become qualified teachers and to stay qualified” (2007, p. 19). One of the biggest challenges to alternative certification programs is the lack of an adopted national standard for curriculum, delivery, and new teacher support. In fact, “as the need for CTE teachers increases, many states have lowered requirements in an attempt to fill their teacher shortage” (Devier, 2019, p. 48). Teachers entering through alternative pathways typically have strong technical skills and industry experience but may not develop the pedagogy and classroom management skills to succeed (Bowling & Ball, 2018). Similarly, traditionally trained teachers may have stronger pedagogical skills but be less confident in the specific CTE content area (Ruhland & Bremer, 2003).

The biggest challenge for traditional CTE programs is that they have been in serious decline over the past several decades (Bruening et al., 2001; Fletcher et al., 2015). While alternative programs are on the rise, many alternative certification programs are housed in university CTE departments and are reliant on university resources (e.g., faculty, administrative support, financial subsidy) to accomplish the program delivery. Alternative programs may be less viable (at least those that rely on university support) if traditional programs continue to decline. Asunda detailed a way to move forward with CTE teacher preparation when he argued that it is “essential for policymakers, stakeholders, educators, and those that are interested in CTE to work together to reinvent and position CTE teacher education as a program that is proactive and seeks to prepare

individuals for the world of work” (2011, p. 4). Regardless of the preparation method, Chapman’s (1983) conceptual model on teacher retention indicates that effective preparation is a key factor in retaining teachers.

### **CTE Teacher Workforce**

There are an estimated 74,520 secondary Career and Technical Education teachers in the United States, and they earn a mean wage of \$64,820 (Bureau of Labor Statistics, 2019). CTE teachers comprise an estimated 13% of the grades 9-12 teaching faculty in the US (*National Assessment of Career and Technical Education: Final Report to Congress*, 2014). CTE at the secondary level is a “large and complex system” (Gordon & Schultz, 2020, p. 221) and is primarily administered by states and school districts. This patchwork like approach to delivering CTE results in limited datasets to study and understand the characteristics and needs of secondary CTE teachers.

One way to better understand secondary CTE teachers is to compare them to academic teachers. The National Assessment of Career and Technical Education developed by the United States Department of Education (2014) provided a comprehensive comparison between CTE and academic teachers. CTE teachers are less likely than academic teachers to have a bachelor’s degree (82% vs. 97%) and master’s degree (46% vs. 59%). The bachelor’s degree attainment percentage varies by CTE program area, with the highest percentage (99%) being for business education teachers and the lowest percentage (26%) being repair and transportation teachers (*National Assessment of Career and Technical Education: Final Report to Congress*, 2014).

Another way to understand to compare CTE teachers to academic teachers is by utilizing data collected from the Praxis exam, which is an entrance requirement for many

teacher preparation programs. Cramer's (2004) analysis of Praxis data found that prospective CTE teachers were older (about 1.5 years), less likely to be female, and less likely to have a 3.0 grade point average or higher when compared to all secondary teachers. The analysis also found that CTE teachers' academic skills and pedagogical knowledge were lower when compared to other secondary and elementary teachers. The report found stark differences between CTE teachers and academic teachers. Specifically the author the noted that "it is not clear whether vocational candidates are prepared to support and reinforce students' acquisition of academic skills" but also moderates that statement by noting that it is also "not entirely clear whether academic skills, pedagogical knowledge or technical expertise is the most important factor in effective teaching practices in vocational education" (Cramer, 2004, p. 15).

Data from the 2011-2012 school year (*National Assessment of Career and Technical Education: Final Report to Congress*, 2014) indicate that CTE teachers may take a different route to the classroom. Eight-five percent of CTE teachers hold a regular state teaching license or certification compared to 91% of academic teachers. CTE teachers were also more likely to have a provisional permit (14% vs. 8%) and enter through an alternative program (33% vs. 19%).

Recruiting and retaining minority teachers is a challenge facing all of K-12 education (Carver-Thomas, 2018; Futrell, 1999; Ingersoll et al., 2019). There has been little research or analysis looking at minority teachers in CTE. Data from the 2007-2008 school year shows that the US CTE teaching workforce is not very diverse; 83% of CTE teachers were white, 7% black, 6% Hispanic, and 3% other (*Web Tables—Public High School Teachers of Career and Technical Education in 2007-08*, 2011). This is the most recent national data on race in CTE that are available. A lack of black teachers may be a

barrier to increasing black student enrollment in CTE (Waid, 2004). Little has been written about specifically recruiting or retaining minority CTE teachers. One researcher suggests that alternative teacher certification programs may be a viable strategy to increase the number of minority teachers in CTE (Sims, 2010).

## CHAPTER 3

### METHOD

This study identified factors associated with Career and Technical Education (CTE) teachers' decisions to continue teaching (retention) or leave the teaching profession (nonretention). While teacher retention is a challenge throughout the K-12 education system (Kelchtermans, 2017; Owens, 2015), this study focused on CTE teacher retention as this group often face unique challenges when compared to academic teachers (Song et al., 2011). Many CTE teachers have skills that are financially lucrative in the private sector (e.g., nurse, engineer, computer programmer) and have additional responsibilities not required of academic teachers (e.g., continually updating curriculum to match changing technologies, hosting advisory committee meetings, seeking industry certification, advising CTE student organizations, engaging in local industry outreach). There is a paucity of research on CTE teacher retention issues, especially those utilizing quantitative approaches with larger datasets that encompass all CTE clusters. This research addressed this gap and fills a void in our understanding of CTE teacher retention.

#### **Research Design and Participants**

The study accessed and analyzed archival (i.e., administrative) data maintained by state educational agencies in Georgia to study teacher retention. The main benefit of using an archival dataset is access to a larger number of records than traditional teacher surveys provide and also allows for compiling a longitudinal dataset by following

teachers over a number of years instead of just one point in time. This research design is not without tradeoffs, including potential measurement and selection error resulting from data being reported by 180 different school systems and limitations on variable selection (i.e., some desired data elements are not collected). While there are certainly challenges to utilizing administrative data, this data source was selected as it is the most comprehensive (e.g., every CTE teacher, longitudinal, not subject to sampling or nonresponse) and is an appropriate approach to answering the proposed research questions.

This quantitative study analyzed teacher licensure records maintained by the Georgia Professional Standards Commission (GPSC). These are existing administrative data (i.e., records collected in the normal course of operations for a state government education agency), so no original data collection is required for the proposed study. While data are collected for administrative purposes (e.g., ensuring teachers have a certificate, allocating budget dollars to school districts), these records can also be utilized for research studies. Administrative data are particularly useful for quantitative research projects as they “offer much larger sample sizes and have far fewer problems with attrition, nonresponse, and measurement error than traditional survey data sources” (Card et al., 2010, p. 1). Additional benefits include cost savings (traditional survey data collection can be resource intensive), population level information (i.e., data encompasses all CTE teachers in Georgia), and the ability to follow an individual over a period of time (i.e., longitudinal data) (Figlio et al., 2017).

The biggest challenge encountered when analyzing administrative data are that the elements collected were not designed with research in mind. Figlio et al. (2017)

described this challenge, “administrative datasets are collected for different reasons than research, and the types of variables that are captured in administrative data often do not comport with the types of variables that testing many educational and social science theories demands” (p. 133). Other challenges include technical issues (i.e., lack of proper documentation), attrition (i.e., people move from time to time), and data access and privacy considerations. While every dataset or data collection effort has challenges and limitations, this research project identified that administrative data was far superior to other potential datasets (i.e., National Teacher and Principal Survey) or data collection (i.e., conducting a survey of new CTE teachers). Additionally, identifying these issues early on will allow the researcher to guard against them in the study design, data processing, and analysis phases.

GPSC is responsible for managing the certification process and licensure records for all Georgia public K-12 teachers (*Georgia Professional Standards Commission Overview*, n.d.). GPSC is the exclusive teacher credential recordkeeper for K-12 public education in Georgia and provides data on individuals throughout their teaching career in Georgia. GPSC uses the data to administer the teacher licensure process. The GPSC database also contains detailed contextual information on teachers (e.g., personal demographics, education levels, subjects taught, school, district, years of service) that can be useful in understanding retention-related issues. Data are delivered in a spreadsheet format where each row is a unique individual record and each column represents a data element. It is possible that individual teachers will have more than one record (row) since the scope of this study encompasses five fiscal years and some teachers serve as instructors multiple subjects, change schools/districts, or perform more than one job.

GPSC provides a codebook for the dataset that details the meaning of each response code. Table 1 presents the data elements available in the GPSC data that will be accessed for this study. Appendix A provides a detailed codebook for all proposed study elements.

**Table 1**

*GPSC Data Elements*

<b>Available Data Element</b>	<b>Description</b>
Unique identifier	GAPSC generated identifier that is consistent over the teaching career
Job code	Jobs codes assigned by the Georgia Department of Education to indicate the teaching or administrative role
Fiscal year	State fiscal year
Data cycle	Data collection point (October or March)
District code	District identifier
School ID (Matching Field)	School identifier
Subject matter code	Subject taught by teacher
Percent of time	% of time reported on Certified/Classified Personnel Information (CPI) report for row
Age	Age of teacher at collection point
Certificate type	The type of certificate (teaching, permit, adjunct)
Certificate field	Teacher's field of certification
Years of teaching experience	# of years of Georgia teaching experience
Highest degree achieved (certificate level)	Highest degree reported in the certification record
Gender	Gender of the teacher
Race	Race/ethnicity of the teacher

While the GPSC database contains a number of data fields on each public school teacher in Georgia, it does not contain school and district level data that would be helpful in research on teacher retention, such as school climate, financial resources available to schools or communities, and students' socioeconomic status. Thus, additional data are required. The GPSC dataset will be linked to other Georgia state government administrative records using a common data element. Specifically, linked administrative

data will come from the school climate rating in the College and Career Ready Index published by the Georgia Department of Education (GaDOE). Table 2 presents the available data elements in the Georgia Department of Education School Climate report.

**Table 2**

*School Climate Data Elements*

<b>Available Data Elements</b>	<b>Description</b>
Year	The school year for the data collection
System ID	The three digit system identification code assigned by the Georgia Department of Education facilities division
System Name	The name of the school system
School ID (Matching Field)	The four digit school identification code assigned by the Georgia Department of Education facilities division
School Name	The name of the school
College and Career Ready Performance Index Single Score	This is a continuous variable that details the numerical score based on the various components of index
School Climate Star Rating	This is a 1-5 rating that details the school's climate for learning.

Both datasets include the school code managed by GaDOE, which facilitated matching records across datasets. Additional information on the data linking procedure is detailed later (see Data Screening section). Linking one dataset to other dataset is common when utilizing administrative data (Figlio et al., 2017). For example, Clotfelter et al. (2007a, 2007b) studied the impact of teacher credentials on student achievement by linking together separate datasets containing information on teacher licensure and student performance (i.e., student test scores).

### **Measures**

This CTE teacher retention study used a number of variables. The dependent variable, teacher retention status, was measured by determining if teachers remained in the teaching profession more than five years or if they left the profession before the five

year mark. Five years was selected due to nearly half of all teachers leave the teaching profession within the first five years of their career (Ingersoll et al., 2018). This status is calculated using longitudinal teacher licensure data available from the GPSC.

Specifically, the absence of the teacher from the dataset in the fifth year will indicate that they are no longer a CTE classroom teacher in Georgia. Those that are not found in the data could have left the profession entirely, moved to another state to teach CTE, or stayed in Georgia K-12 education but changed positions (i.e., administrative role) or subjects (i.e., non-CTE).

Independent variables are based on Chapman's conceptual model of teacher retention (1983) and a review of teacher retention literature. These variables include teacher age at the first year of their teaching career, a measure of if the primary subject taught by the teacher has a high labor market demand (see Appendix B), school climate rating, geography (rural and non-rural), and highest education level completed by teacher (as recorded during their first year of their teaching career). Table 3 provides additional details on the independent variables that will be utilized in the research study and also what Chapman model elements that each selected variables sought to best represent. Appendix A contains the codebook for dependent and independent variables.

**Table 3***Independent Variables*

<b>Independent Variable</b>	<b>Description</b>	<b>Data Source</b>	<b>Selection Rationale</b>	<b>Theory Element</b>
Beginning age	The age of new CTE teachers during the initial year of teaching. This will be a categorical variable (under 40 and 40+)	GPSC teacher dataset	Commonly used demographic variable. May potentially indicate first career versus career changer. See Adams (1996) and Scafidi (2010).	Personal characteristic
Labor market demand of CTE subject taught	The subject area that the teacher spends a majority of their time teaching. See Appendix A for information on the recode and Appendix B for the list of in-demand programs.	GPSC teacher dataset	Teachers in some CTE subjects may have skills and knowledge that are in-demand in the larger labor market. See Song et al. (2011).	External influence (alternative employment opportunities)
School climate rating	A 1-5 categorical variable (1=weakest school climate and 5= strongest school climate) that details the school climate as measured by a Georgia Department of Education criteria. The school climate measure is a calculation that weights data collected from several sources (e.g., student survey, parent survey, staff attendance data, discipline data) to approximate the school's climate for learning (Georgia Department of Education, 2018).	GaDOE College and Career Ready Performance Index	This variable would serve as a proxy for the first year teaching experience. A school with a higher school climate rating would likely offer a more positive first-year teaching experience. See Chapman (1984).	Quality of first employment experience
Highest education level	The highest level of education completed by new CTE teachers	GPSC teacher dataset	This variable would serve as a proxy for educational preparation. The highest education level may best capture the educational preparation for the teaching role. See Chapman	Educational preparation

Independent Variable	Description	Data Source	Selection Rationale	Theory Element
miller and Non-Rural	A 1-9 scale developed by the US Department of Agriculture that classifies each county on a 1-9 scale of rural and urban based on population and being adjacent to a metropolitan area.	USDA County RUC Code List	(1983, 1984) and Borman and Dowling (2008).  This variable would serve as a proxy to the approximate financial resources available in a school (e.g., salary, materials, academic support, new teacher induction) and outside employment opportunities. The assumption is that generally more rural counties would have less financial resources and fewer outside employment opportunities.	Quality of first employment experience and external influences

### **Data Screening Procedures**

There are no perfect archival datasets. While administrative data can be more accurate and comprehensive than data gathered by other collection techniques such as surveys (Card et al., 2010), administrative data still require review, cleaning, and preparation before use. These steps are necessary since these data are not usually collected or designed for social sciences research. Therefore, it must be prepared and transformed for empirical analysis (Goerge & Lee, 2002).

The first step in data screening and preparation is to create the subset of data required for analysis. The study examined CTE teachers starting their teaching career in Georgia and follows them for five years, starting with the 2014-2015 school year and concluding with the 2018-2019 school year (latest complete dataset available). The initial dataset provided by the Georgia Professional Standards Commission contained 787 cases of new CTE teachers starting in 2014-2015. All other records except for the new teachers (i.e., 2014-2015 experience = zero) were removed from the dataset. This winnowing increased the processing speed of statistical procedures and make the dataset easier to manage.

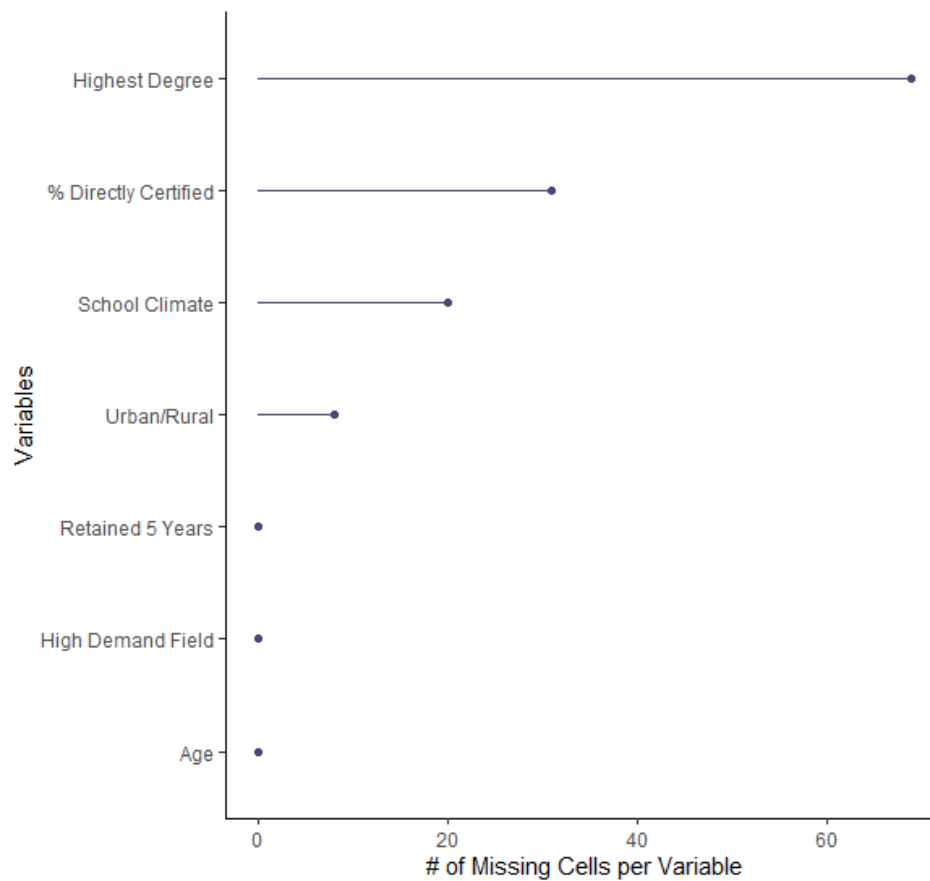
Next, records from various datasets (GPSC and GaDOE) will be linked (Figlio et al., 2017). This step is both a data development and cleaning procedure. School identifiers used in the GPSC dataset will be used to append additional data to the database. The data link procedure will use a common data element to connect data from GPSC and GaDOE, viz., unique school codes. These seven-digit codes are managed by the Georgia Department of Education as part of their facilities management process (*School Codes*, n.d.). The first three digits of school codes indicate the school district,

while the last four digits identify specific schools within the district. The seven-digit number uniquely identifies the school. For example, school code 6010103 contains the district code 601 indicating Appling County, and 0103 indicating Appling County High School. This unique school identifier was utilized in a matching procedure in the statistical package. Both datasets included this data element. This data linking procedure also functioned as a data cleaning procedure, as data errors (i.e., unmatched records) that require additional review, correction, or deletion from the final data pool can be identified (Goerge & Lee, 2002). A manual validation check of the linking procedure was performed after the data linkage to ensure it executed properly. This entailed reviewing a sample of 5% of all records and comparing the data in the database to the source records.

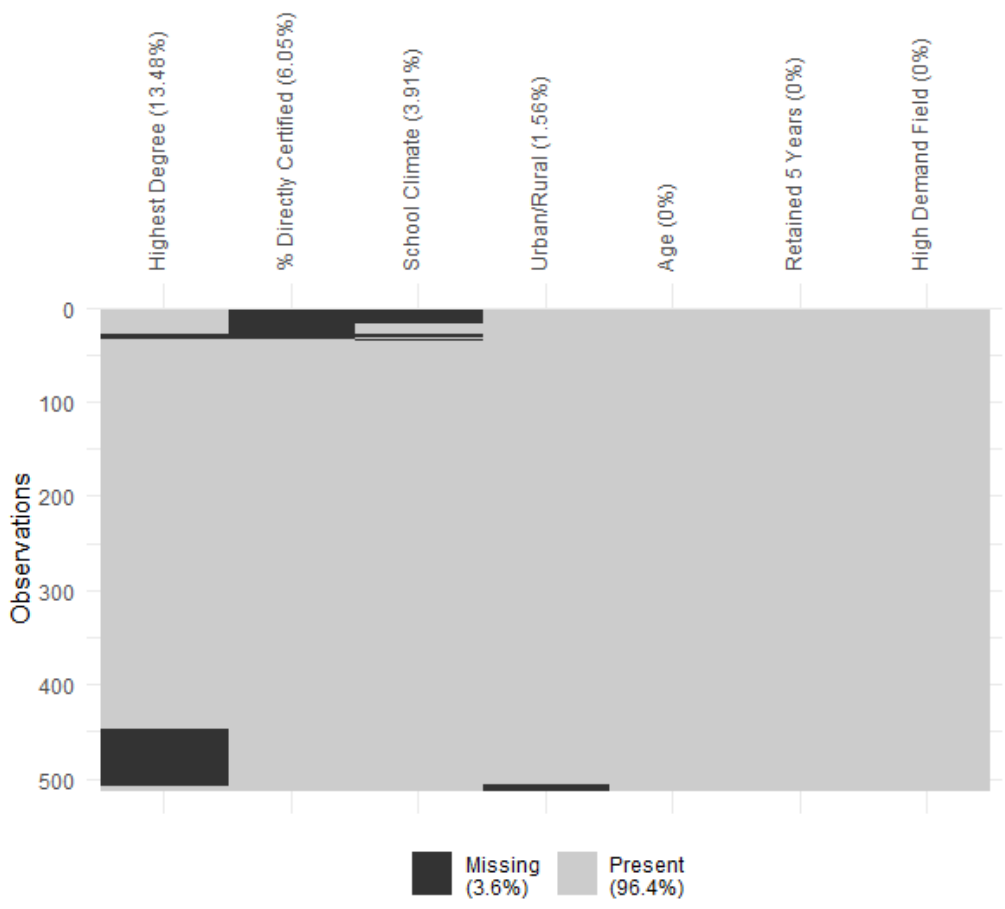
After creating and linking data, a series of data cleaning steps and checks were applied to the resulting dataset that includes checking for missing data (i.e., identifying each record that contains missing data) and exploring potential data errors (e.g., outliers, inconsistencies over time). The first step in the data cleaning process was to examine the 787 records for inconsistent experience. This is a critical step in the data cleaning process as the study sought to only examine CTE teachers who are new to the profession. A total of 275 records were dropped due to inconsistent experience. Examples of dropped records include changes in experience from semester to semester (i.e., 0 years of teaching experience in the fall semester and eight years of teaching experience in the spring semester), inconsistent experience over time (i.e., 0 years of teaching experience in the 2014-2015 school year and six years of teaching experience in the 2015-2016 school year), and teaching records prior to the 2014-2015 school year (i.e., zero years of teaching experience in the 2014-2015 school year and two years of teaching experience

in the 2013-2014 school year). The 275 records with inconsistent experience comprised 35% of the initial dataset. The experience data are self-reported by each individual school district during each data collection cycle (Georgia Department of Education, 2021) so it is likely that data entry and inconsistent application of policy contributed to the high rate of errors.

Missing data was a key consideration. Even though these are administrative data, it is highly probable that there are fields where no data are reported (Folsom et al., 2014). The initial data review and analysis process sought to quantify the size of missing data and determine if the data are missing completely at random (no discernable pattern to the missingness), missing at random (there is a discernible pattern of the missingness but the missing data are randomly distributed), or not missing at random (the missing data are not randomly distributed but only apparent in a subset of the data) (McKnight, 2007). Of the 512 remaining records 411 records were complete (i.e., all data elements were non-missing). Ultimately, 411 or 52% of the original 787 records were completed and passed the data screening procedures. Figure 2 details the number of missing cells for each variable. The highest degree earned was the variable most likely to be missing in the 101 incomplete records. Figure 3 details the pattern of the missingness (i.e., number of missing elements in each case). Cells in grey indicates that data are present for that records and cells in black indicated missing data for that records. The figure shows that most of the missing records were only missing the highest degree data while a smaller number were missing only directly certified data, and both directly certified and school climate data.

**Figure 2***Missing Cells Per Variables*

**Figure 3**  
*Pattern of Missingness Visualization*



Missing data was managed by dropping records with missing data (i.e., listwise deletion) (Allison, 2001; Tuckman, 1999). After the inconsistent data and missing data checks were completed 411 cases remained. The large number of remaining cases in the dataset reduced some of the potential issues with deleting records with missing data, such as creating a sample too small for some statistical tests and result in decreased statistical power (Lodder, 2013).

### **Data Analysis Method**

Data were analyzed using logistic regression. This method was selected based on their ability to answer the proposed research questions and fit with the variable formats and types. Logistic regression is a statistical procedure that seeks to analyze the relationship between a binary dependent variable (i.e., retention or non retention) and several independent variables (Agresti, 2007; Hilbe, 2016). Logistic regression was utilized to identify relationships of variables for teachers who are retained for the five-year period and those who leave before the end of the five-year period (e.g., highest educational attainment, impact of various CTE clusters, and age).

Logistic regression is a statistical technique that models the relationship between a binary response (dependent) variable and one or more predictor (independent) variables (Allison, 1999; Menard, 1995). A logistic regression model “predicts the probability that the response has a value of one given a specific set of predictor variables” (Hilbe, 2016, p. 4). For example, a logistic regression model could be used to identify the probability of a teacher leaving the profession within five years when the teacher is male, entered the profession after the age of 40, and teaches in a high-growth CTE career cluster.

Equation 1 details a simple form of the logistic regression model (Allison, 1999; Menard, 1995; Osborne, 2015).

$$\log \left[ \frac{p_i}{1-p_i} \right] = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_k X_{ik} \quad (1)$$

The left side of the equation is the natural log of the odds of Y dependent variable being 1 (also called the logit). The odds are calculated as the probability of Y being 1 divided by the probability of Y not being 1. The right side of the equation includes an

alpha term which is the intercept and several beta terms which are the slope for X independent variable/s for each individual case ( $i=1, \dots, n$  cases).

There are several assumptions that must be met to effectively fit a logistic regression model (Hilbe, 2016). First, predictor (independent) variables must not be correlated with each other (i.e., avoiding multicollinearity). Second, predictor variables must be related to the response (dependent) variable and no extraneous variables are included. Finally, individual predictor observations (cases) must be independent. Logistic regression does not require a normal distribution for the independent variables (Osborne, 2015).

Logistic regression differs from linear regression in several ways (Allison, 1999; Osborne, 2015). First, linear regression analyzes a continuous dependent variable, while logistic regression is applied for binary dependent variables. Second, the two models utilize different approaches for estimating the relationship between dependent and independent variables. Linear regression seeks to fit a line that best captures all data points (viz., least squares methods). Logistic regression seeks to fit a line that best separates the two binary responses (viz., maximum likelihood). Put simply, linear regression fits a straight line and logistic regression utilizes an s-shaped curve. The s-shaped curve allows the model to best fit dependent binary data (0 or 1). Binary dependent data in a linear regression model will violate at least two of the model assumptions: (a) homoscedasticity and (b) residuals are normally distributed. Due to the violation of the assumptions for linear regression, binary dependent data are best analyzed utilizing a logistic regression model (Allison, 1999; Menard, 1995).

Logistic regression and discriminant analysis (also called linear discriminant analysis) can be used to answer similar questions. Logistic regression seeks to understand the relationship between a binary response variable and independent variables, whereas discriminant analysis is used to form classifications or groups from quantitative data that reflect links between multiple independent variables and a dependent variable (Huberty & Olejnik, 2006; Klecka, 1980; Weiss, 1976). Discriminant analysis has more assumptions and requirements for effectively fitting a model (Huberty, 1975). Logistic regression was selected for this analysis because it is able to accommodate categorical independent variables and nonnormal distributions for independent variables.

Interpreting logistic regression results is not nearly as straightforward as linear regression (Allison, 1999; Osborne, 2012). Specifically, a .5 coefficient for X independent variable results in a .5 increase in the log-odds of a 1 unit increase in Y. Interpreting this directly is difficult and likely not very meaningful (Allison, 1999). Instead logistic regression results are typically interpreted using the odds ratio, which is the odds of the event occurring over the odds of it not occurring. For example, if a teacher retention logistic regression model returned a 1.52 odds ratio for new teachers over age 40 it can be interpreted as teachers starting at age 40+ have a 52% higher odds of staying in the profession than younger teachers (Osborne, 2006, 2012). Odds ratio can be difficult to interpret (Osborne, 2012), especially when many research consumers may be more comfortable with conditional probability. Odds ratios can be converted in a conditional probability (Osborne, 2012, 2015).

### **Implications and Tradeoffs**

Like any research project, there are issues of internal and external validity, tradeoffs, assumptions, and other limitations in this proposed research project (Creswell, 2002). Using administrative data to conduct this research study led to various tradeoffs. First, there is the potential for selection error and measurement error, as the researcher is reliant on other sources to correctly report the data (H. Jacob, 1984; Smith, 2008). These data are collected by the Georgia Professional Standards Commission but rely on all 180 school districts to properly report their data, ensure they are utilizing the right codes, and capture the correct measures. As demonstrated during the data cleaning process, the data used for this study presented some data quality issues.

Second, utilizing administrative data constricts the ability to collect unique variables that precisely match the desired construct and may lead to construct validity challenges (Card et al., 2010; Figlio et al., 2017; H. Jacob, 1984). Quantitative data collection (i.e., survey) or qualitative data collection (e.g., interviews, case studies, focus groups) would allow the researcher to design and collect variables that best represent the construct (though with other tradeoffs). Utilizing administrative data requires the researcher to develop proxy variables to best capture the desired effect. For example, prior research tells us the importance of the quality of the first year teaching experience (Chapman, 1983). This variable does not exist in the administrative data, but one could select an available proxy variable like school climate that best approximates the item being measured (Frost, 1979). One researcher summarized this challenge by noting “one problem that may occur when administrative data are used for research or statistics is that the concepts measured do not correspond to the desired concepts. In other words, the

validity of the measurement leaves much to be desired” (Bakker, 2012, p. 9). While this is certainly a large tradeoff, by utilizing administrative data researchers have access to a larger longitudinal dataset that is likely much more complete than traditional survey approaches (especially with declining survey response rates) utilized for many CTE teacher retention studies (Dainty et al., 2011; Elliott et al., 2017; Ruhland, 2001a, 2001b).

The third tradeoff is that the dataset did not allow for detailed study on the particular teacher preparation pathways. With the rise in alternative certification pathways in CTE and the decline in traditional preparation programs (Fletcher et al., 2015; Gordon & Schultz, 2020), one might hypothesize that some alternative pathways prepare and support teachers better than other programs. This level of granular data does not exist in any GPSC administrative data sets. The final tradeoff with utilizing administrative data and a quantitative data approach is that it somewhat limited the depth of insights allowed by a qualitative approach (Creswell, 2002). For example, a quantitative approach may indicate that an independent variable has a significant association with the dependent variable, but the research may not clearly tell us why the association exists or what it means. A qualitative approach may allow for a higher level of detail and explanation on how something potentially impacts something else (though there are other concerns such as limited generalizability).

Potential sources of internal validity issues in this research project (and administrative data based research in general) included measurement errors, missing data, and data quality errors. Since the data are collected originally by other parties, the researchers have limited ability to directly guard against these data related issues, though data cleaning and review steps can be applied as preventive measures. Administrative

data typically have a high level of external validity (Harron et al., 2017). The research project has a high level of external validity to the wider CTE teacher population across the US. This assumes that Georgia's results are representative of the experiences of CTE teachers in other states. This research design also guardedZ against another threat to external validity related to sampling bias, since the dataset acts as a de facto census of all new Georgia CTE teachers.

## CHAPTER 4

### RESULTS

The purpose of this quantitative study was to examine the factors associated with the nonretention of new CTE teachers in Georgia. This chapter details the findings of the data analysis for the research questions. Specifically, this study examined four research questions.

1. Are there statistically significant differences in CTE teacher retention during the first five years based on educational attainment?
2. Are there statistically significant age differences between CTE teachers that stay five or more years and those who do not?
3. Are there statistically significant differences in the length of CTE teacher retention in the first five years of service based on district characteristics (e.g., school climate, urban/rural)?
4. Are there statistically significant differences in CTE teacher retention during the first five years based on high demand career clusters and not high demand career clusters?

#### **Sample Overview**

The sample of this study included 411 new CTE teachers in Georgia starting in the 2014-2015 school year. The dataset included five years of teacher records to allow for examination over time. Figure 4 details the retention of the sample over the five-year study period. Nearly 40% of the 2014-2015 new CTE teacher cohort had left by the end

of the second year. CTE teachers continued to leave the profession during subsequent years but at a slower pace. By the end of the fifth year over 60% of the 411 new CTE teachers starting in 2014 had left the profession. Table 4 provides an overview of the 411 CTE teachers in the sample. Most new CTE teachers were younger than age 40, in non-rural communities, female, white, taught at a 3- or 4-climate star rated school, taught in a non-high demand subject, and had a bachelor's degree.

Table 4 also breaks down each of these variables by fifth-year retention status (i.e., remained in teaching for all five years or left the profession). On some factors there were large differences between the various categories and others there were not. Specifically, 63% of younger teachers were not retained while a slightly smaller group of older teachers (55%) were not retained. Teachers in urban parts (65%) of Georgia were much more likely to not be retained than teachers in rural Georgia (38%). Schools with lower school climates were less likely to retain teachers than those with a higher school climate (1 star school 83% not retained, 5 star school 60% not retained).

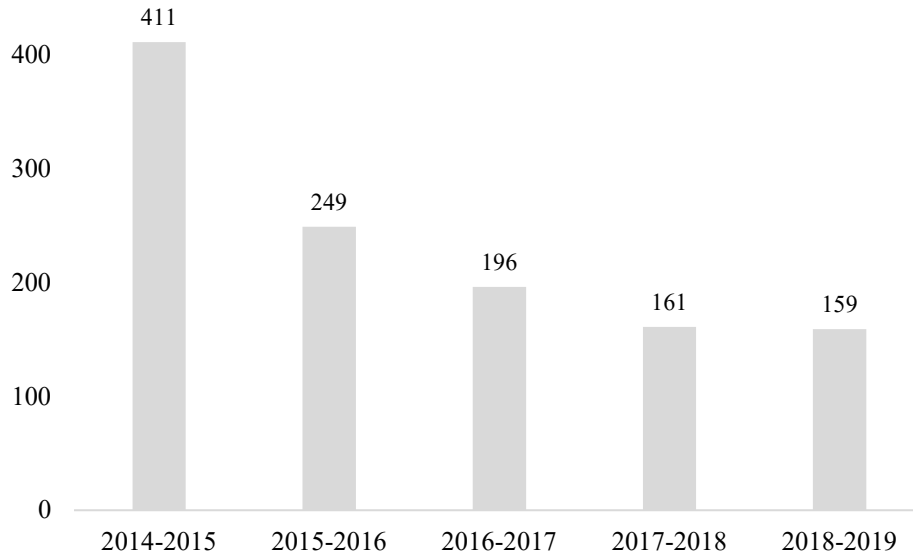
There were large differences in non-retention for the demand level of the cluster taught by teachers. Teachers in not high demand subject areas were not retained in 63% of cases, while only 32% of teachers in high demand subjects were not retained. There was virtually no difference in retention for teachers with a masters degree (63%) or greater and teacher's with a bachelor's degree (62%).

Another consideration when examining teacher retention is movement from one school to another school (Boe et al., 1997). Out of the 159 teachers who were retained for five years, 129 or 81% were in the same school district at year one and year five. Of the

129 who stayed in the same school district, 113 of those teachers remained at the same school.

**Figure 4**

*CTE Teacher Retention of 2014-2015 New Teacher Cohort.*



*Note:* This visualization only includes the 411 2014-2015 new teacher records with complete data.

**Table 4***Sample Overview*

Variable	Not retained at 5 years (N=252)	Retained at 5 years (N=159)	Overall (N=411)
<b>Age</b>			
Less than 40 years old	183 (72.6%)	103 (64.8%)	286 (69.6%)
40 years of age or older	69 (27.4%)	56 (35.2%)	125 (30.4%)
<b>Location</b>			
Rural	24 (9.5%)	38 (23.9%)	62 (15.1%)
Urban	228 (90.5%)	121 (76.1%)	349 (84.9%)
<b>Sex</b>			
Male	66 (26.2%)	65 (40.9%)	131 (31.9%)
Female	186 (73.8%)	94 (59.1%)	280 (68.1%)
<b>Race/Ethnicity</b>			
Nonwhite	109 (43.3%)	72 (45.3%)	181 (44.0%)
White	143 (56.7%)	87 (54.7%)	230 (56.0%)
<b>School Climate Rating</b>			
1 Star	25 (9.9%)	5 (3.1%)	30 (7.3%)
2 Star	47 (18.7%)	21 (13.2%)	68 (16.5%)
3 Star	83 (32.9%)	69 (43.4%)	152 (37.0%)
4 Star	80 (31.7%)	53 (33.3%)	133 (32.4%)
5 Star	17 (6.7%)	11 (6.9%)	28 (6.8%)
<b>Cluster Taught Demand Level</b>			
Not high demand subject	244 (96.8%)	142 (89.3%)	386 (93.9%)
High demand subject	8 (3.2%)	17 (10.7%)	25 (6.1%)
<b>Highest Degree Earned</b>			
Less than Bachelor's degree	7 (2.8%)	9 (5.7%)	16 (3.9%)
Bachelor's degree	153 (60.7%)	95 (59.7%)	248 (60.3%)
Master's degree or higher	92 (36.5%)	55 (34.6%)	147 (35.8%)

## Results

### Research Question One

The first research question asked, are there statistically significant differences in CTE teacher retention during the first five years based on educational attainment? Table 5 presents the results of the logistic regression. Educational attainment as a predictor for CTE teacher retention was analyzed using less than Bachelor's degree as the reference category. The odds ratio for Bachelor's degree .48 and .46 for master's degree or higher, indicating that teachers at both of these educational attainment levels are about 50% less likely than teachers' with less than a Bachelor's degree to be retained. These predictors were not found to be statistically significant. The interpretation of these results should must consider the relatively small sample size of 16 teachers with less than a bachelor's degree in the sample. The pseudo R<sup>2</sup> of .005 indicates that the educational attainment model does a poor job of explaining the dependent outcome.

**Table 5**

*Logistic Regression Results Based on CTE Teacher Educational Attainment*

<i>Predictors</i>	<i>Odds Ratios</i>	<i>95% Confidence Interval</i>
(Intercept)	1.29	0.48 – 3.60
Less than Bachelor's degree	<i>Reference</i>	
Bachelor's degree	0.48	0.17 – 1.34
Master's degree or higher	0.46	0.16 – 1.32
Pseudo R <sup>2</sup> (Tjur Coefficient of Determination)	0.005	
Model $\chi^2$	2.13	

\*  $p < 0.05$     \*\*  $p < 0.01$     \*\*\*  $p < 0.001$

## Research Question Two

The second research question asks, are there statistically significant age differences between CTE teachers that stay five or more years and those who do not? The model sought to analyze the retention of new CTE teachers based on their age. The model used teachers as less than 40 as the reference category. Teachers 40+ had an odds ratio of 1.44 meaning that they were 44% more likely to stay in the teaching profession than those less than age 40. This variable was not found to be statistically significant. The pseudo  $R^2$  of .007 indicates that the educational attainment model does a poor job of explaining the dependent outcome.

**Table 6**

*Logistics Regression Results Based on CTE Teacher Age*

<i>Predictors</i>	<i>Odds Ratios</i>	<i>95% Confidence Interval</i>
(Intercept)	0.56 ***	0.44 – 0.71
Less than age 40	<i>Reference</i>	
Age 40 or older	1.44	0.94 – 2.21
Pseudo $R^2$ (Tjur Coefficients of Determination)	0.007	
Model $\chi^2$	2.81	

\*  $p < 0.05$    \*\*  $p < 0.01$    \*\*\*  $p < 0.001$

### **Research Question Three**

The third research question asks, are there statistically significant differences in the length of CTE teacher retention in the first five years of service based on district characteristics (e.g., school climate, geographic location)? This question sought to understand how external or organization factors (i.e., not related to the teacher) were associated with staying or leaving. The model utilized two sets of predictors to assess this question. The first factor was location (i.e., did they teach in a rural school district or urban school district). The model used rural as the reference. New CTE teachers in urban school districts are about 65% more likely to not be retained than new CTE teachers in rural school districts. This was statistically significant. The second factor was the school's climate rating. The model used the 1 star climate rating category as the reference. The logistic regression model found that new CTE teachers in 2, 3, 4, and 5 star schools were much more likely to be retained than in schools with the lowest climate rating at 250%, 400%, 343%, and 332%, respectively. The 3 star and 4 star school climate results were statistically significant. The pseudo  $R^2$  of .058 indicates that the educational attainment model does an okay job of explaining the dependent outcome (significantly higher than any of the other three models).

**Table 7***Logistic Regression Results Based on Geography and School Climate*

<i>Predictors</i>	<i>Odds Ratios</i>	<i>95% Confidence Interval</i>
(Intercept)	0.47	0.15 – 1.30
<b>Location</b>		
Rural	<i>Reference</i>	
Urban	0.35 ***	0.20 – 0.62
<b>School Climate Rating</b>		
1 star	<i>Reference</i>	
2 star	2.50	0.88 – 8.33
3 star	4.01 **	1.54 – 12.52
4 star	3.43 *	1.31 – 10.81
5 star	3.32	1.00 – 12.40
Pseudo R <sup>2</sup> (Tjur Coefficients of Determination)	0.058	
Model $\chi^2$	24.99***	

\*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$

**Research Question 4:**

The final research question asks, are there statistically significant differences in CTE teacher retention during the first five years based on high demand career clusters and not high demand career clusters? This question sought to understand if the subject taught by the CTE teacher had an impact on retention, especially those that are in high-demand in the larger economy. The model used not high demand clusters as the reference category. Teachers in high demand clusters were 365% more likely to be retained than teachers in not high demand clusters. These results were statistically significant. Analysis of these results should take into account that only 25 teachers in the dataset were in high demand clusters impacting the validity of the findings. The small sample size limits the ability to draw wider conclusions about high demand clusters and retention.

**Table 8**

*Logistic Regression Based on CTE Subject Area*

<i>Predictors</i>	<i>Odds Ratios</i>	<i>95% Confidence Interval</i>
(Intercept)	0.58 ***	0.47 – 0.71
CTE Subject Area		
Not High Demand Cluster	<i>Reference</i>	
High Demand Cluster	3.65 **	1.58 – 9.15
Pseudo R <sup>2</sup> (Tjur Coefficients of Determination)	0.023	
Model $\chi^2$	9.36 ***	

\*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$

## CHAPTER 5

### DISCUSSION, SUMMARY, AND CONCLUSION

Retaining teachers in K-12 education is a long-standing issue facing public education (Ingersoll, 2001; Kelchtermans, 2017), with an estimated one-half million public school teachers, 16% of the teaching workforce, either leaving the profession entirely or changing schools each year (Goldring et al., 2014). The nonretention statistics in Georgia are worse than the national average, with an estimated 44% of new teachers in Georgia leaving the profession within the first five years of service, which is more than double the US average (Owens, 2015). While this is certainly a challenge for K-12, this is also a topic that has generally been well analyzed in the academic literature (Adams, 1996; Borman & Dowling, 2008; Guarino et al., 2006; Loeb et al., 2005; Scafidi et al., 2007).

An area that has received scant attention in the teacher retention literature is research focused on CTE teachers. Nearly half of school districts in the US report challenges recruiting or retaining CTE teachers for in demand occupations (L. Gray & Lewis, 2018). Issues concerning the retention of CTE teachers requires additional study separate from general K-12 teacher retention literature for several reasons: (1) CTE has a much higher level of labor market competition with private industry (i.e., an engineering technology teacher could also work in a variety of engineering related private sector positions), (2) steep declines in enrollment in postsecondary CTE teacher training programs, (3) growing enrollment in secondary CTE programs creating an increased

demand for CTE teachers, and (4) additional demands placed on CTE teachers (e.g., managing advisory committee, industry certification, career and technical student organization supervision) compared to other K-12 teachers (Bottoms et al., 2013; Brand et al., 2013; Fletcher & Gordon, 2017; Horne, 2010; *Perkins Data Explorer*, n.d.; Song et al., 2011). Little research on CTE teacher retention, especially looking at CTE as a whole (as opposed to a certain pathway or cluster), has been conducted.

### **Purpose**

The purpose of this study was to understand the factors associated with the nonretention of CTE teachers in Georgia. The study aimed to identify common nonretention patterns, trends, and findings that could help recruitment and retention efforts. Since this is the first time this analysis has been conducted in Georgia, it aimed to examine the entire CTE teacher workforce. This project aimed to show the proof of concept of using administrative data to study CTE teacher nonretention and future studies can focus on specific subdisciplines in CTE.

The secondary purpose of this study was to demonstrate the efficacy of utilizing administrative data (i.e., records collected in the normal course of operations for a state government education agency) to study CTE teachers. Administrative data have long been used for answering general K-12 teacher retention questions (Adams, 1996; Boyd et al., 2011; Scafidi, 2010). While there is an existing body of research on CTE teacher retention (Elliott et al., 2017; Ruhland, 2001a, 2001b; Solomonson, 2017; Song et al., 2011; Tippens et al., 2013), these previously cited studies on CTE teacher retention studies largely has been reliant on small scale convenience samples (i.e., 50 teachers going through a new teacher induction program) and qualitative research techniques.

Administrative data have not been commonly employed for studying CTE teacher retention.

### **Findings**

The study examined four research questions related to new CTE teacher retention in Georgia using administrative data. A series of logistic regression models were developed to answer the research questions.

#### **Educational Preparation**

Question 1 sought to examine if differences in highest degree completed level was associated with new teacher retention. No statistically significant difference in retention between a teacher with a master's degree or higher and a teacher with a lower level of education (e.g., bachelor's degree, associate's degree, high school diploma) was detected. The logistic regression model used three groups (less than bachelor's degree, bachelor's degree, and master's degree or greater). The groups were designed to best test for educational preparation of teachers, but splitting into three groups may have limited the model variance and ability to detect differences between the groups.

This was a somewhat surprising finding, especially when considered using Chapman's (1983) conceptual model, where educational preparation is a key factor in increasing teacher retention (i.e., teachers with a higher level of educational preparation are more likely to be retained). This finding may be moderated somewhat by data limitations. The administrative data I used did not detail the type of degree earned or how teachers entered the teaching workforce (i.e., traditional or alternative preparation program). Chapman's conceptual model sought to take into account the adequacy of the teacher preparation program, but this model could not account for that concept fully due

to data limitations. In the future, researchers interested in this question could work directly with one or more school districts that have a more detailed set of administrative data on degree earned and teacher preparation pathway.

### **Age of CTE Teachers**

Question two aimed to determine if an association existed between the age of new CTE teachers and retention. Again, no statistically significant difference in retention between new teachers (i.e., those in their first year of teaching in Georgia) under age 40 and over age 40. This was somewhat surprising as there was some prior research (Adams, 1996; Scafidi, 2010) that found that career switchers were more likely to stay in the teaching profession than those who entered initially after post-secondary education graduation. Age was utilized as a rough proxy for first career or career switcher. It is possible that age is not an effective proxy for career switcher, or potentially, that I selected an incorrect age cut that would best capture first career or career switcher. Age was initially a continuous variable, but had to be transformed into a categorical variable to allow to for the analysis of first career (i.e., age under 40) or career switcher (age 40+).

### **Location and School Climate**

Question 3 sought to understand what school specific factors were associated with new CTE teacher retention. Location (i.e., urban vs. rural) and school climate rating (1-5 scale) were analyzed using a logistic regression model. Results indicated significant relationships between both location and school climate with teacher retention.

Specifically, new CTE teachers were more likely to be retained if they were in a rural school district compared to an urban district. In fact, new CTE teachers in urban districts are 65% less likely to be retained in the first five years than teachers in rural

districts. Most existing teacher retention literature in recent decades has found a similar trend of increased retention in rural districts (Baugh & Stone, 1982; Collins & Schaaf, 2020; Moore et al., 2018; Simon et al., 2015). This finding could be further explained in part that CTE teachers in rural districts likely have decreased non-teaching labor market options for their unique skills than CTE teachers in more urban areas. For example, a computer science teacher in Atlanta likely has access to more competing job opportunities compared to a computer science teacher in rural Bacon County.

An association between school climate rating and CTE teacher retention was also detected. The Georgia Department of Education (2018) has a 5 level rating system for school climate with 1 being the weakest school climate and 5 being the strongest school climate. All levels of school climate above the one star level (the reference category) showed a positive relationship with retention. The association between three star and four star climate ratings and retention were statistically significant while the two star and five star climate ratings were not statistically significant. Teachers at schools with a three star school climate rating were four times more likely to be retained than teachers at a one star school; teachers at school with a four star school climate rating were 3.4 times more likely to be retained than teachers at a one star school. This model helped to demonstrate that new CTE teachers are more likely to be retained in a school that has a positive school climate. This result is supported by teacher retention literature that found schools with a stronger school climates are more likely to retain teachers than schools with a poor school climate (Borman & Dowling, 2008).

## **High Demand Subjects**

The final research question aimed to understand if the CTE subject area taught by the teacher was associated with retention. I sought to identify teachers in high demand career clusters based on faculty shortage areas identified by Advance CTE, the national association of state CTE directors (*CTE Teacher and Faculty Shortages*, 2018). Specific clusters identified by Advance CTE as high demand include: manufacturing, information technology, health sciences, and science, technology, engineering, and mathematics. A statistically significant relationship was found between CTE subject area and teacher retention.

The results indicate that teachers in high demand clusters were more likely to be retained than teachers in clusters that were not deemed high demand. Specifically, high demand cluster teachers were 3.6 times more likely to be retained than other CTE teachers. These results are surprising and do not necessarily track with the expectation that teachers in high demand clusters may have increased noneducation labor market outcomes (Song et al., 2011). While the results were significant at the .01 level, with only 25 of the 411 teachers in the sample teaching in a high demand cluster area the results do not lend themselves to a high level of reliability or validity due to the small number of interested outcome in the sample (i.e., teachers in a high demand subject).

## **Limitations**

Administrative data were used to examine selected factors associated with new CTE teacher retention. Three major limitations were encountered in this study. First, the study faced some data quality issues. While employing administrative data allowed access to a large amount of comprehensive Georgia CTE teacher data, there were still

issues with missing data and inconsistent data. The largest data quality issues were that a number of records had missing educational attainment data and other records had inconsistent experience data. Data cleaning resulted in about half of the records being dropped from the dataset. While half the dataset was dropped due to data quality issues, the remaining dataset still included over 400 unique teachers allowing for a large sample size for the statistical tests employed. The data were examined to see if there were any problematic missingness patterns that may indicate that that they data should not be analyzed. No problematic missingness patterns were detected.

A second limitation was the limited variables available in the administrative dataset. Data from the Georgia Professional Standards Commission is collected to aid in the teacher licensure process and not with the education researcher in mind. The challenge aligning available variables to theory and research goals is a common challenge with administrative data (Card et al., 2010; Figlio et al., 2017; H. Jacob, 1984). Based on a review of the existing literature and Chapman's theory (1983) the most glaring missing variable was teacher preparation pathway. Were these new CTE teachers prepared through a traditional teacher preparation program, alternative preparation program, or another entrance method (e.g., emergency licensure, uncertified teacher)? The limited variables available in the administrative dataset reduced the potential questions that could be analyzed and also required using proxy variables instead of the desired variable (i.e., using educational attainment as a proxy for teacher preparedness). While administrative data limited the potential questions that could be answered, it also allowed the project to follow over 400 new CTE for five years, something that would be challenging and expensive with surveys or other data collection techniques (Card et al., 2010).

The final limitation of this study was a lack of information about reasons for nonretention. Variables were identified that were associated with the nonretention of CTE teachers, but I lacked information about the specific reasons for departing. There are a variety of work and nonwork related reasons for leaving the teaching profession (Gonzalez et al., 2015; Ryan et al., 2017). The expanded data collection on reasons for leaving could capture those leaving for family reasons (e.g., spouse took new job out of state, starting a family, leaving to care for a sick family member), career reasons (e.g., took job in private industry, returning to school for further education outside education, moved to administration), preparation reasons (e.g., teacher did not have the skills to succeed, insufficient content knowledge), or building level reasons (e.g., poor school climate, limited school resources).

### **Implications**

This research study identified a number of implications for both school, district, and state CTE leaders. At the most basic level, this study helped to gather, clean, and analyze Georgia CTE retention data to provide state leaders with statistics on the retention of new CTE teachers (see table four). While the Georgia Department of Education and the Governor's Office of Student Achievement publish research and dashboards on K-12 teacher retention, no state entity or research partner has developed statistics focused on CTE retention. State CTE leaders should track retention and nonretention at the state and district level and utilize it for more programmatic, problem solving, and policymaking actions.

Another general finding is the need for more complete and enhanced administrative data. Many records in this study had to be dropped due to missing or

inconsistent data. To increase the usefulness of the data for future research and practice strategy projects, more complete data would be required. Additionally, one of the shortcomings of this research was the lack of data on the new CTE teacher preparation route (e.g., traditional, alternative, provider, length, curriculum) for each record. To allow for research to assess the impact of various CTE teacher preparation pathways, state leaders should explore collecting data on the teacher preparation process, potentially maintained as part of the teacher's certification record.

The research study found three teacher retention factors that had statistically significant associations. Each of these associations may have implications on policy and practice. Specifically, the research identified that being in a rural district, improved school climate, and high-demand subject were associated with improved new CTE teacher retention. While this study validated the use of administrative data to study CTE nonretention, state leaders should consider commissioning an additional study of the state's new CTE teachers. The additional study should pool several classes of new teachers to increase the sample size and potentially overcome some of the challenges of limited sample size for some categories. Additionally, the study could potentially employ a mixed methods approach to combine qualitative and quantitative research approaches to best answer the research questions (Leech & Onwuegbuzie, 2009). These study design changes would allow for increased reliability and confidence.

### **Future Research Opportunities**

This research study demonstrated the utility of using administrative data to study retention factors for Georgia CTE teachers. There are more opportunities to mine the administrative data to answer retention questions and to also inform other CTE research

topics. The first research opportunity would be to pool several years of new teacher data to increase the sample size, address missing data concerns, and increase the utility of some statistical tests. For example, a future study could look at five year retention data for a pooled group of CTE teachers starting in 2014, 2015, and 2016. The second research opportunity would be to conduct cluster specific studies such as examining agriculture teachers, health care science teachers, or family and consumer science teachers. These would somewhat mirror prior CTE studies (Bennett et al., 2004; Crawford Self, 2001; Dainty et al., 2011; Elliott et al., 2017; Su et al., 2011) that used small-sample surveys to understand cluster retention issues but would instead employ administrative data to understand the question. The third future research opportunity would combine the learning from this study with an additional focus on teacher preparation pathways (e.g., traditional v. alternative, efficacy of various alternative preparation models). This is an unsettled question in CTE (Asunda, 2011; Camp & Heath-Camp, 1989; Gordon & Schultz, 2020; Lynch, 1996; Ruhland & Bremer, 2002, 2003) and deserves further empirical research. This would likely either involve working with GPSC to assist with additional data collection or a mixed-methods approach, potentially meshing administrative data and survey data.

Finally, there is an opportunity for an applied research project to benefit state and district CTE leaders. The administrative data could be leveraged in a beneficial way to assist with ongoing policy and practice decisions by CTE leaders. This could take a form of a CTE teacher dashboard that helps to highlight positive and negative trends and allow stakeholders to manipulate the dataset to answer other questions. Potential examples to

explore would be the Massachusetts new teacher dashboard<sup>1</sup> and the Oakland, California staff retention dashboard<sup>2</sup>. Another way to leverage this data in an applied research format would be to produce an annual CTE workforce report. A number of states produce yearly teacher workforce reports that analyze a number of retention factors like new entrants, retirements, quits, and transfers to provide an annual snapshot of their teaching workforce. Georgia already produces a *Teacher and Leader Workforce Report*<sup>3</sup> each year that focuses on all of K-12 education. The general Georgia example could serve as a guide for a CTE specific workforce report.

---

<sup>1</sup> <https://profiles.doe.mass.edu/statereport/eppempratebyprogchars.aspx>

<sup>2</sup> <https://dashboards.ousd.org/t/HR/views/RetentionDashboardPublic/Introduction>

<sup>3</sup> <https://gosa.georgia.gov/georgia-k-12-teacher-and-leader-workforce-report>

## REFERENCES

- Adams, G. J. (1996). Using a Cox regression model to examine voluntary teacher turnover. *The Journal of Experimental Education*, 64(3), 267–285.  
<https://doi.org/10.1080/00220973.1996.9943807>
- Adams, G. J., & Dial, M. (1993). Teacher survival: A Cox regression model. *Education and Urban Society*, 26(1), 90–99. <https://doi.org/10.1177/0013124593026001008>
- Agresti, A. (2007). *An introduction to categorical data analysis* (2nd ed). Wiley-Interscience.
- Allison, P. (1999). *Logistic regression using the SAS system: Theory and application* (1st ed.). SAS Publishing.
- Allison, P. (2001). *Missing data*. Sage Publishing.
- Aragon, S. (2016). *Teacher shortages: What we know*. Education Commission of the States.
- Asunda, P. (2011). Career and Technical Education teacher preparation trends: A pilot study. *Online Journal for Workforce Education and Development*, 5(3), 1–26.
- Auguste, B., Kihn, P., & Miller, M. (2010). *Closing the talent gap: Attracting and retaining top-third graduates to careers in teaching: An international and market research-based perspective*. McKinsey.
- Bakker, B. F. M. (2012). Estimating the validity of administrative variables. *Statistica Neerlandica*, 66(1), 8–17. <https://doi.org/10.1111/j.1467-9574.2011.00504.x>

- Baugh, W. H., & Stone, J. A. (1982). Mobility and wage equilibration in the educator labor market. *Economics of Education Review*, 2(3), 253–274.  
[https://doi.org/10.1016/0272-7757\(82\)90032-2](https://doi.org/10.1016/0272-7757(82)90032-2)
- Bennett, P., Iverson, M., Rohs, F., Langone, C., & Edwards, M. (2004). *Job Satisfaction of Agriculture Teachers in Georgia and Selected Variables Indicating Their Risk of Leaving the Teaching Profession*.
- Billingsley, B. S. (1992). *Teacher retention/attrition: Issues for research* (No. 94–06; Six Papers on Teachers from the 1990-91 Schools and Staffing Survey and Other Related Surveys). National Center for Education Statistics.
- Boe, E. E., Bobbitt, S. A., & Cook, L. H. (1997). Whither didst thou go? Retention, reassignment, migration, and attrition of special and general education teachers from a national perspective. *The Journal of Special Education*, 30(4), 371–389.  
<https://doi.org/10.1177/002246699703000402>
- Borman, G. D., & Dowling, N. M. (2008). Teacher attrition and retention: A meta-analytic and narrative review of the research. *Review of Educational Research*, 78(3), 367–409. <https://doi.org/10.3102/0034654308321455>
- Bottoms, G., Egelson, P., Sass, H., & Uhn, J. (2013). *Improving the quality of career and technical alternative teacher preparation: An induction model of professional development and support*. National Research Center for Career and Technical Education.
- Bowling, A. M., & Ball, A. L. (2018). Alternative certification: A solution or an alternative problem? *Journal of Agricultural Education*, 59(2), 109–122.  
<https://doi.org/10.5032/jae.2018.02109>

- Boyd, D., Grossman, P., Ing, M., Lankford, H., Loeb, S., & Wyckoff, J. (2011). The influence of school administrators on teacher retention decisions. *American Educational Research Journal*, 48(2), 303–333.  
<https://doi.org/10.3102/0002831210380788>
- Brand, B., Valent, A., & Browning, A. (2013). *How Career and Technical Education can help students be college and career ready: A primer*. American Institutes for Research.
- Bruening, T. H., Scanlon, D. C., Hodes, C., Dhital, P., Shao, X., & Liu, S.-T. (2001). *The status of Career and Technical Education teacher preparation programs*. National Dissemination Center for Career and Technical Education.
- Bureau of Labor Statistics. (2019). *Career/Technical Education teachers, secondary school*. Bureau of Labor Statistics, Occupational Employment Statistics.  
<https://www.bls.gov/oes/current/oes252032.htm>
- Camp, W. (2001). Formulating and evaluating theoretical frameworks for career and technical education research. *Journal of Vocational Education Research*, 26(1), 4–25. <https://doi.org/10.5328/jver26.1.4>
- Camp, W., & Heath-Camp, B. (1989). *Induction detractors of beginning vocational teachers with and without teacher education*. American Vocational Education Research Association, Orlando, FL.
- Camp, W., & Heath-Camp, B. (2007). The status of CTE teacher education today. *Techniques*, 82(6), 16–19.

- Card, D., Chetty, R., Feldstein, M., & Saez, E. (2010). *Expanding access to administrative data for research in the united states* (National Science Foundation White Paper No. 10-069).
- Career Clusters*. (2020). Advance CTE. <https://careertech.org/career-clusters>
- Carnevale, A. P., Jayasundara, T., & Hanson, A. R. (2012). *Career and Technical Education: Five ways that pay along the way to the BA*. Georgetown University, Center on Education and the Workforce.
- Carver-Thomas, D. (2018). *Diversifying the teaching profession: How to recruit and retain teachers of color*. Learning Policy Institute.
- Chapman, D. (1983). A model of the influences on teacher retention. *Journal of Teacher Education, 34*(5), 43–49. <https://doi.org/10.1177/002248718303400512>
- Chapman, D. (1984). Teacher retention: The test of a model. *American Educational Research Journal, 21*(3), 645–658. <https://doi.org/10.2307/1162922>
- Chapman, D., & Green, M. S. (1986). Teacher retention: A further examination. *The Journal of Educational Research, 79*(5), 273–279. <https://doi.org/10.1080/00220671.1986.10885691>
- Chapman, D., & Hutcheson, S. (1982). Attrition from teaching careers: A discriminant analysis. *American Educational Research Journal, 19*(1), 93–105. <https://doi.org/10.2307/1162370>
- Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007a). *How and why do teacher credentials matter for student achievement?* (NBER Working Paper 12828). National Bureau of Economic Research.

- Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007b). Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. *Economics of Education Review*, 26(6), 673–682.  
<https://doi.org/10.1016/j.econedurev.2007.10.002>
- Collins, E., & Schaaf, K. (2020). *Teacher retention in Tennessee*. Tennessee Department of Education.
- Conneely, N., & Uy, E. (2009). *Teacher shortage undermines CTE*. National Association of State Directors of Career Technical Education Consortium.
- Council of Chief State School Officers, Advance CTE, & New Skills for Youth. (2016). *The state of Career Technical Education: Increasing access to industry experts in high school*.
- Cramer, K. (2004). *The vocational teacher pipeline: How academically well-prepared is the next generation of vocational teachers?* US Department of Education.
- Crawford Self, M. J. (2001). On retention of secondary trade and industrial education teachers: Voices from the field. *Journal of Industrial Teacher Education*, 38(4), 41–61.
- Creswell, J. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Prentice Hall.
- Creswell, J. (2014). *Research design* (4th ed.). Sage Publishing.
- Cross, F. (2016). *Teacher shortage areas nationwide listing 1990–1991 through 2016–2017* (p. 184). United States Department of Education, Office Postsecondary Education.

*CTE Teacher and Faculty Shortages*. (2018). Advance CTE.

[https://cte.careertech.org/sites/default/files/Teacher\\_Shortage\\_Fact\\_Sheet\\_2018.pdf](https://cte.careertech.org/sites/default/files/Teacher_Shortage_Fact_Sheet_2018.pdf)

Dahling, J. J., & Librizzi, U. A. (2015). Integrating the Theory of Work Adjustment and Attachment Theory to predict job turnover intentions. *Journal of Career Development*, 42(3), 215–228. <https://doi.org/10.1177/0894845314545169>

Dainty, J. D., Sandford, B. A., Su, S.-H., & Belcher, G. (2011). Factors influencing the retention of secondary family and consumer sciences teachers. *Journal of Career and Technical Education*, 26(2), 42–56. <https://doi.org/10.21061/jcte.v26i2.524>

Darling-Hammond, L. (1999). *Teacher quality and student achievement: A review of state policy evidence* (R-99-1). Center for the Study of Teaching and Policy.

Dawis, R. (1994). The theory of work adjustment as convergent theory. In M. L. Savikas & R. W. Lent (Eds.), *Convergence in career development theories: Implications for science and practice*. (pp. 33–43). CPP Books.

Dawis, R., Lofquist, L. H., & Weiss, D. J. (1968). A theory of work adjustment: A revision. *Minnesota Studies in Vocational Rehabilitation*, 23(15).

Devier, B. H. (2019). Teacher shortage and alternative licensure solutions for technical educators. *The Journal of Technology Studies*, 45(2), 48–59.

<https://doi.org/10.21061/jots.v45i2.a.1>

Dillon, N. (2009). Pay attention to retention. *American School Board Journal*, 196(9), 26–29.

- Elliott, K. S., Dainty, J. D., & Jones, J. (2017). A descriptive study of factors influencing the retention of secondary agriculture teachers. *Career and Technical Education Research, 42*(1), 3–20. <https://doi.org/10.5328/cter42.1.3>
- Figlio, D., Karbownik, K., & Salvanes, K. (2017). The promise of administrative data in education research. *Education Finance and Policy, 12*(2), 129–136. [https://doi.org/10.1162/EDFP\\_a\\_00229](https://doi.org/10.1162/EDFP_a_00229)
- Fletcher, E. C., & Gordon, H. R. D. (2017). The status of Career and Technical Education undergraduate and graduate programs in the United States. *Peabody Journal of Education, 92*(2), 236–253. <https://doi.org/10.1080/0161956X.2017.1302219>
- Fletcher, E. C., Gordon, H. R. D., Asunda, P., & Zirkle, C. (2015). A 2015 status study of career and technical education programs in the United States. *Career and Technical Education Research, 40*(3), 191–211. <https://doi.org/10.5328/cter40.3.191>
- Folsom, J. S., Osborne-Lampkin, L., & Herrington, C. D. (2014). *Using administrative data for research: A companion guide to a descriptive analysis of the principal workforce in Florida schools*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southeast.
- Frost, P. A. (1979). Proxy variables and specification bias. *The Review of Economics and Statistics, 61*(2), 323–325. <https://doi.org/10.2307/1924606>
- Futrell, M. H. (1999). The challenge of the 21st century: Developing a highly qualified cadre of teachers to teach our nation's diverse student population. *The Journal of Negro Education, 68*(3), 318–334. <https://doi.org/10.2307/2668104>

- Garcia, E., & Weiss, E. (2019). *The teacher shortage is real, large and growing, and worse than we thought* (No. 163651). Economic Policy Institute.
- Georgia Department of Education. (2018). *2018 school climate star ratings data calculation guide for principals and district users*.
- Georgia Department of Education. (2021). *FY2022 CPI data element detail*.
- Georgia Professional Standards Commission overview*. (n.d.).  
<https://www.gapsc.com/Commission/Home.aspx>
- Goerge, R. M., & Lee, B. J. (2002). Matching and cleaning administrative data. In M. Ver Ploeg, R. A. Moffit, & C. F. Citro (Eds.), *Studies of welfare populations: Data collection and research issues* (pp. 197–219). National Academies Press.  
<https://doi.org/10.17226/10206>
- Goldring, R., Taie, S., & Riddles, M. (2014). *Teacher attrition and mobility: Results from the 2012-13 Teacher Follow-up Survey* (No. 077; p. 40). National Center for Education Statistics.
- Gonzalez, L., Brown, M., & Slate, J. (2015). Teachers who left the teaching profession: A qualitative understanding. *The Qualitative Report, 13*(1).  
<https://doi.org/10.46743/2160-3715/2008.1601>
- Gordon, H. R. D., & Schultz, D. (2020). *The history and growth of Career and Technical Education in America* (5th ed.). Waveland Press, Inc.
- Grady, T., & Professor, A. (1990). Career mobility in agricultural education: A social learning theory approach. *Journal of Agricultural Education, 75–79*.

- Gray, K. C., & Walter, R. A. (2001). *Reforming Career and Technical Education teacher licensure and preparation: A public policy synthesis*. National Dissemination Center for Career and Technical Education.
- Gray, L., & Lewis, L. (2018). *Career and Technical Education programs in public school districts: 2016–17* (NCES 2018-028). U.S. Department of Education.
- Grissmer, D. W., & Kirby, S. N. (1987). *Teacher attrition: The uphill climb to staff the Nation's schools*. Rand, Center for the Study of the Teaching Profession.
- Gritz, R. M., & Theobald, N. D. (1996). The effects of school district spending priorities on length of stay in teaching. *Journal of Human Resources*, 31(3), 477–512. <https://doi.org/10.2307/146262>
- Guarino, C. M., Santibanez, L., & Daley, G. A. (2006). Teacher recruitment and retention: A review of the recent empirical literature. *Review of Educational Research*, 76(2), 173–208. <https://doi.org/10.3102/00346543076002173>
- Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Why public schools lose teachers. *Journal of Human Resources*, 39(2), 326–354. <https://doi.org/10.2307/3559017>
- Hanushek, E. A., Rivkin, S. G., & Schiman, J. C. (2016). Dynamic effects of teacher turnover on the quality of instruction. *Economics of Education Review*, 55, 132–148. <https://doi.org/10.1016/j.econedurev.2016.08.004>
- Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality and student achievement. *Journal of Public Economics*, 95(7–8), 798–812. <https://doi.org/10.1016/j.jpubeco.2010.11.009>

- Harron, K., Dibben, C., Boyd, J., Hjern, A., Azimae, M., Barreto, M. L., & Goldstein, H. (2017). Challenges in administrative data linkage for research. *Big Data & Society*, 4(2). <https://doi.org/10.1177/2053951717745678>
- Hasselquist, L., & Graves, N. A. (2020). CTE teacher retention: Lessons learned from mid-career teachers. *Career & Technical Education Research*, 45(1), 3–15. <https://doi.org/10.5328/cter45.1.3>
- Heath-Camp, B., & Camp, W. (1990). Induction experiences and needs of beginning vocational teachers without teacher education backgrounds. *Occupational Education Forum*, 19(1), 6–16.
- Henry, G. T., & Redding, C. (2020). The consequences of leaving school early: The effects of within-year and end-of-year teacher turnover. *Education Finance and Policy*, 15(2), 332–356. [https://doi.org/10.1162/edfp\\_a\\_00274](https://doi.org/10.1162/edfp_a_00274)
- Hilbe, J. M. (2016). *Practical Guide to Logistic Regression*. CRC Press.
- Holland, J. L. (1959). A theory of vocational choice. *Journal of Counseling Psychology*, 6(1), 35–45. <https://doi.org/10.1037/h0040767>
- Holland, J. L. (1973). *Making vocational choices: A theory of careers*. Prentice Hall.
- Holzer, H., Linn, D., & Monthey, W. (2013). *The promise of high-quality Career and Technical Education: Improving outcomes for students, firms, and the economy*. College Board.
- Horne, M. (2010). A new role for CTE. *Techniques*.
- Huberty, C. J. (1975). Discriminant analysis. *Review of Educational Research*, 45(4), 543–598. <https://doi.org/10.3102/00346543045004543>

- Huberty, C. J., & Olejnik, S. (2006). *Applied MANOVA and discriminant analysis* (2nd ed.). Wiley.
- Hyde, W. G. (2007). *Determining associations between nontraditionally prepared and traditionally prepared Career and Technical Education teachers in central Pennsylvania* [Doctoral dissertation]. Pennsylvania State University.
- Ingersoll, R. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal*, *38*(3), 499–534.  
<https://doi.org/10.3102/00028312038003499>
- Ingersoll, R. (2003). The teacher shortage: Myth or reality? *Educational Horizons*, *81*(3), 146–152.
- Ingersoll, R., May, H., & Collins, G. (2019). Recruitment, employment, retention and the minority teacher shortage. *Education Policy Analysis Archives*, *27*(37), 1–37.  
<https://doi.org/10.14507/epaa.27.3714>
- Ingersoll, R., Merrill, E., Stuckey, D., & Collins, G. (2018). *Seven trends: The transformation of the teaching force* (Research Report No. 2). Consortium for Policy Research in Education, University of Pennsylvania.
- Jacob, A., Vidyarthi, E., & Carroll, K. (2012). *The irreplaceables: Understanding the real retention crisis in America's urban schools*. TNTP.
- Jacob, H. (1984). *Using published data: Errors and remedies*. Sage.
- Job Openings and Labor Turnover Survey*. (2020). Bureau of Labor Statistics.  
<https://www.bls.gov/jlt/>

- Kelchtermans, G. (2017). 'Should I stay or should I go?': Unpacking teacher attrition/retention as an educational issue. *Teachers and Teaching*, 23(8), 961–977. <https://doi.org/10.1080/13540602.2017.1379793>
- Kitchel, T., & Ball, A. L. (2014). Quantitative theoretical and conceptual framework use in Agricultural Education research. *Journal of Agricultural Education*, 55(1), 186–199.
- Klecka, W. R. (1980). *Discriminant analysis*. Sage.
- Krumboltz, J. D., Mitchell, A. M., & Jones, G. B. (1976). A social learning theory of career selection. *The Counseling Psychologist*, 6(1), 71–81. <https://doi.org/10.1177/001100007600600117>
- Krumboltz, J. D., & Nichols, C. W. (1990). Integrating the Social Learning Theory of Career Decision Making. In W. B. Walsh & S. H. Osipow (Eds.), *Career counseling: Contemporary topics in vocational psychology* (pp. 159–192). Lawrence Erlbaum Associates, Inc.
- Krumboltz, J. D., & Worthington, R. L. (1999). The school-to-work transition from a learning theory perspective. *The Career Development Quarterly*, 47(4), 312–325. <https://doi.org/10.1002/j.2161-0045.1999.tb00740.x>
- Lankford, H., Loeb, S., & Wyckoff, J. (2002). Teacher sorting and the plight of urban schools: A descriptive analysis. *Educational Evaluation and Policy Analysis*, 24(1), 37–62. <https://doi.org/10.3102/01623737024001037>
- Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. *Quality & Quantity*, 43(2), 265–275. <https://doi.org/10.1007/s11135-007-9105-3>

- Levesque, K., Laird, J., Hensley, E., Choy, S. P., Cataldi, E. F., & Hudson, L. (2008). *Career and Technical Education in the United States: 1990 to 2005*. U.S. Department of Education.
- Lodder, P. (2013). To impute or not impute: That's the question. In G. Mellenbergh & J. Ader (Eds.), *Advising on research methods: Selected topics*. Johannes van Kessel Publishing.
- Loeb, S., Darling-Hammond, L., & Luczak, J. (2005). How teaching conditions predict teacher turnover in California schools. *Peabody Journal of Education*, 80(3), 44–70. [https://doi.org/10.1207/s15327930pje8003\\_4](https://doi.org/10.1207/s15327930pje8003_4)
- Lynch, R. L. (1996). In search of vocational and technical teacher education. *Journal of Vocational and Technical Education*, 13(1), 5–16. <https://doi.org/10.21061/jcte.v13i1.508>
- McCandless, D., & Sauer, A. (2010). Retention of construction teachers engaged in Missouri's secondary school system. *Journal of Career and Technical Education*, 25(2), 63–77. <https://doi.org/10.21061/JCTE.V25I2.480>
- McCaslin, N. L., & Parks, D. (2002). *Teacher education in career and technical education: Background and policy implications for the new millennium*. National Dissemination Center for Career and Technical Education.
- McKnight, P. E. (2007). *Missing Data: A Gentle Introduction*. Guilford Press.
- Menard, S. (1995). *Applied Logistic Regression Analysis*. SAGE Publications.
- Moore, L., Rosenblatt, K., Badgett, K., & Eldridge, J. (2018). Urban Texas teacher retention: Unbelievable empirical factors tied to urban teacher persistence and

retention. *Literacy Information and Computer Education Journal*, 9(2), 2923–2931.

Mordan, B. R. (2012). *Retention and professional mentoring of beginning Career and Technical Education teachers* [Doctoral dissertation]. Pennsylvania State University.

*National Assessment of Career and Technical Education: Final report to Congress.*

(2014). US Department of Education, Office of Planning, Evaluation and Policy Development.

National Association of State Directors of Career Technical Education Consortium.

(2010). *Teacher and faculty shortage* (No. 3; A Look inside: A Synopsis of CTE Trends).

National Commission on Teaching and America's Future. (2007). *The high cost of teacher turnover.*

Nauta, M. M. (2010). The development, evolution, and status of Holland's theory of vocational personalities: Reflections and future directions for counseling psychology. *Journal of Counseling Psychology*, 57(1), 11–22.  
<https://doi.org/10.1037/a0018213>

Osborne, J. (2006). Bringing balance and technical accuracy to reporting odds ratios and the results of logistic regression analyses. *Practical Assessment, Research, and Evaluation*, 11(7). <https://doi.org/10.4135/9781412995627.d30>

Osborne, J. (2012). Logits and tigers and bears, oh my! A brief look at the simple math of logistic regression and how it can improve dissemination of results. *Practical*

*Assessment, Research, and Evaluation*, 17(11). <https://doi.org/10.7275/39H8-N858>

Osborne, J. (2015). *Best Practices in Logistic Regression*. SAGE Publications.

Owens, S. J. (2015). *Georgia's teacher dropout crisis*. Georgia Department of Education. <https://www.gadoe.org/External-Affairs-and-Policy/communications/Documents/Teacher%20Survey%20Results.pdf>

*Perkins Data Explorer*. (n.d.). U.S. Department of Education. <https://perkins.ed.gov/pims/DataExplorer>

Raue, K., & Gray, L. (2015). *Career paths of beginning public school teachers: Results from the first through fifth waves of the 2007—08 beginning teacher longitudinal study* (NCES-2015 No. 196). National Center for Education Statistics.

Rice, J. K. (2003). *Teacher quality: Understanding the effectiveness of teacher attributes*. Economic Policy Institute.

Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, 73(2), 417–458. <https://doi.org/10.1111/j.1468-0262.2005.00584.x>

Rots, I., & Aelterman, A. (2008). Two profiles of teacher education graduates: A discriminant analysis of teaching commitment. *European Educational Research Journal*, 7(4), 523–534. <https://doi.org/10.2304/eej.2008.7.4.523>

Rots, I., Aelterman, A., Vlerick, P., & Vermeulen, K. (2007). Teacher education, graduates' teaching commitment and entrance into the teaching profession. *Teaching and Teacher Education*, 23(5), 543–556. <https://doi.org/10.1016/j.tate.2007.01.012>

- Ruhland, S. K. (2001a). Factors that influence the turnover and retention of Minnesota's technical college teachers. *Journal of Vocational Education Research*, 26(1), 56–76. <https://doi.org/10.5328/jver26.1.56>
- Ruhland, S. K. (2001b). Teacher shortage: An analysis of factors influencing the turnover and retention of secondary Career and Technical Education teachers. *Journal of Career and Technical Education*, 17(2), 36–47.
- Ruhland, S. K., & Bremer, C. D. (2002). *Alternative teacher certification procedures and professional development opportunities for Career and Technical Education teachers*. National Research Center for Career and Technical Education.
- Ruhland, S. K., & Bremer, C. D. (2003). Perceptions of traditionally and alternatively certified career and technical education teachers. *Journal of Vocational Education Research*, 28(3), 285–302. <https://doi.org/10.5328/JVER28.3.285>
- Ryan, S. V., von der Embse, N. P., Pendergast, L. L., Saeki, E., Segool, N., & Schwing, S. (2017). Leaving the teaching profession: The role of teacher stress and educational accountability policies on turnover intent. *Teaching and Teacher Education*, 66, 1–11. <https://doi.org/10.1016/j.tate.2017.03.016>
- Scafidi, B. (2010). *An analysis of the retention rates of Georgia public school teachers*. Georgia Governor's Office of Student Achievement.
- Scafidi, B., Sjoquist, D. L., & Stinebrickner, T. R. (2007). Race, poverty, and teacher mobility. *Economics of Education Review*, 26(2), 145–159. <https://doi.org/10.1016/j.econedurev.2005.08.006>
- Schaffer, M. J. H. (2017). *Training and certification of Career and Technical Education (CTE) Teachers: A case study in perception of teacher preparedness and*

*educational satisfaction experienced by CTE students in eastern Pennsylvania alternative certification programs* [Doctoral dissertation]. Delaware Valley University.

Schmidtke, C. (2017). Commonly used theories in CTE research: Toward a core theory base for CTE. *Career and Technical Education Research*, 42(3), 193–217.

<https://doi.org/10.5328/cter42.3.193>

*School Codes*. (n.d.). Georgia Department of Education. <https://www.gadoe.org/Finance-and-Business-Operations/Facilities-Services/Pages/School-Codes.aspx>

Shen, J. (1997). Teacher retention and attrition in public schools: Evidence from SASS91. *The Journal of Educational Research*, 91(2), 81–88.

<https://doi.org/10.1080/00220679709597525>

Simon, N. S., Johnson, S. M., & Reinhorn, S. K. (2015). *The matchmaking process: Teacher hiring in six successful, high-poverty, urban schools*. The Project on the Next Generation of Teachers.

Sims, C. (2010). Increasing the minority CTE teacher pipeline. *Techniques*, 85(1), 26–29.

Smith, E. (2008). Pitfalls and promises: The use of secondary data analysis in educational research. *British Journal of Educational Studies*, 56(3), 323–339.

<https://doi.org/10.1111/j.1467-8527.2008.00405.x>

Solomonson, J. (2017). *Determining why agricultural educators are leaving the profession and how to increase the retention rate* [Doctoral dissertation]. Iowa State University.

Song, J. H., Martens, J., McCharen, B., & Ausburn, L. J. (2011). Multi-structural relationships among organizational culture, job autonomy, and CTE teacher

turnover intention. *Career and Technical Education Research*, 36(1), 3–26.

<https://doi.org/10.5328/cter36.1.3>

Stephens, C., Hall, T., & McCampbell, C. (2015). *The 2015 Georgia public P-12 teacher workforce*. Georgia Professional Standards Commission.

Stone, J. (2011). *Delivering STEM education through career and technical education schools and programs*. Workshop on Successful STEM Education in K-12 Schools, Washington, DC.

Strengthening Career and Technical Education for the 21st Century Act, Pub. L. No. 115–224 (2019).

Su, S.-H., Dainty, J., Sandford, B., Townsend, D., & Belcher, G. (2011). A descriptive study of the retention of secondary trade and industrial teachers in Kansas. *Career and Technical Education Research*, 36(3), 187–205.

<https://doi.org/10.5328/cter36.3.187>

Symonds, W., Schwartz, R., & Ferguson, R. (2011). *Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century*. Harvard Graduate School of Education.

Theobald, N. D. (1990). An examination of the influence of personal, professional, and school district characteristics on public school teacher retention. *Economics of Education Review*, 9(3), 241–250. [https://doi.org/10.1016/0272-7757\(90\)90005-P](https://doi.org/10.1016/0272-7757(90)90005-P)

Thomsen, J. (2016). *State level data around teacher attrition*. Education Commission of the States.

Tio, R. (2019). *2017 Georgia K-12 Teacher and Leader Workforce Report*. Georgia Governor's Office of Student Achievement.

- Tippens, A., Ricketts, J., Morgan, A. C., Navarro, M., & Flanders, F. (2013). Factors related to teachers' intention to leave the classroom early. *Journal of Agricultural Education*, 58–72. <https://doi.org/10.5032/jae.2013.04058>
- Tuckman, B. W. (1999). *Conducting educational research* (5th ed.). Harcourt Brace.
- Vagi, R., Pivovarova, M., & Miedel Barnard, W. (2019). Keeping our best? A survival analysis examining a measure of preservice teacher quality and teacher attrition. *Journal of Teacher Education*, 70(2), 115–127. <https://doi.org/10.1177/0022487117725025>
- Waid, T. (2004). Race issues in Career and Technical Education: A snapshot in black and white. *Techniques*, 79(3), 40–43.
- Watlington, E., Shockley, R., Guglielmino, P., & Felsher, R. (2010). The high cost of leaving: An analysis of the cost of teacher turnover. *Journal of Education Finance*, 36(1), 22–37. <https://doi.org/10.1353/jef.0.0028>
- Web tables—Public high school teachers of Career and Technical Education in 2007-08* (No. 235). (2011). National Center for Education Statistics.
- Weiss, D. (1976). Multivariate procedures. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology* (pp. 327–362). Rand McNally.
- Whipp, J. L., & Geronime, L. (2015). Experiences that predict early career teacher commitment to and retention in high-poverty urban schools. *Urban Education*, 52(7), 799–828. <https://doi.org/10.1177/0042085915574531>
- Zhang, G., & Zeller, N. (2016). A longitudinal investigation of the relationship between teacher preparation and teacher retention. *Teacher Education Quarterly*, 43(2), 73–92.

Zirkle, C. J., Martin, L., & McCaslin, N. L. (2007). *Study of state certification/licensure requirements for secondary Career and Technical Education teachers*. National Research Center for Career and Technical Education.

## Appendix A.

### Variable Codebook

Variable	Description	Original Coding	Recode, Yes or No?	Recode	Recode Rationale
<b>Stayed in CTE (DV)</b>	This will be calculated from the dataset. If a new teacher present in the 1 <sup>st</sup> year of the data set is present in the 5 <sup>th</sup> year then they will be considered to have stayed in CTE.	1=Stayed in CTE 0=Did not stay in CTE	No		
<b>Beginning age</b>	The age of new CTE teachers during the initial year of teaching. This will be a categorical variable (under 40 and 40+)	Continue variable 18-82	Yes	1=Over 40 0=39 and under	Transform continuous variable into a binary variable to aid in analysis
<b>Subject Taught in Demand?</b>	The subject area that the teacher spends a majority of their time teaching.	See Appendix B for the complete subject code listing.	Yes	1=In Demand Cluster 0=Not in High Demand Cluster  See Appendix B	There are 95 unique subject codes for Georgia teachers. Labor market demand may explain some of the challenges of retaining CTE teachers when they strong prospects in the larger labor market (Song et al., 2011). This recode sought to differentiate teachers teaching in subjects with high labor market

Variable	Description	Original Coding	Recode, Yes or No?	Recode	Recode Rationale
<b>School Climate Rating</b>	A 1-5 categorical variable (1=weakest school climate and 5=strongest school climate) that details the school climate as measured by a Georgia Department of Education criteria. The school climate measure is a calculation that weights data collected from several sources (e.g., student survey, parent survey, staff attendance data, discipline data) to approximate the school's climate for learning (Georgia Department of Education, 2018).	1=school climate score <2 standard deviations below the state average 2=school climate score between 1 and 2 standard deviations below the state average 3=school climate score less than 1 standard deviation below the state average 4=school climate score greater than the state average by less than 1 standard deviation	No	for the In Demand Subject Codes	demand and subjects with lower labor market demand. Data from Advance CTE ( <i>CTE Teacher and Faculty Shortages</i> , 2018) was used to identify the clusters with the highest teacher shortages. The third column indicates if each subject code is in-demand or not.

Variable	Description	Original Coding	Recode, Yes or No?	Recode	Recode Rationale
<b>Highest Education Level</b>	The highest level of education completed by new CTE teachers	5=school climate score greater than state average by more than 1 standard deviation 1=High school diploma or GED 2=Associate's Degree 4=Bachelor's Degree 5=Master's Degree 6=Education Specialist Degree 7=Ph.D. or Ed.D.	Yes	1=Less than Bachelor's Degree 2=Bachelor's Degree 3=Master's Degree or Higher	To prepare the data for analysis
<b>Rural-Urban Continuum Codes</b>	A classification scheme developed by the US Department of Agriculture that classifies every county in the US on a scale of rural-urban based on population and if they are adjacent to larger metropolitan areas.	1=Counties in metro areas of 1 million population or more 2=Counties in metro areas of 250,000 to 1 million population 3=Counties in metro areas of fewer than 250,000 population 4=Urban population of 20,000 or more, adjacent to a metro area 5=Urban population of 20,000 or more,	Yes	1=Metro (Codes 1-3) 2=Non Metro (Code 4-9)	To aid in the analysis. Creating a binary variable will allow for simpler analysis.

Variable	Description	Original Coding	Recode, Yes or No?	Recode	Recode Rationale
		not adjacent to a metro area 6=Urban population of 2,500 to 19,999, adjacent to a metro area 7=Urban population of 2,500 to 19,999, not adjacent to a metro area 8=Completely rural or less than 2,500 urban population, adjacent to a metro area 9=Completely rural or less than 2,500 urban population, not adjacent to a metro area			

## Appendix B.

### CTE Subject Codes by High Demand Factor

Subject Code	Subject Title	High Demand?
010	Agricultural Business & Production Technology	
012	Agricultural Business & Production Technology	
013	Agricultural Business & Production Technology	
018	Agricultural Business & Production Technology	
020	Agricultural Sciences & Technology	
022	Agricultural Sciences & Technology	
023	Agricultural Sciences & Technology	
028	Agricultural Sciences & Technology	
030	Conservation & Renewable Natural Resources	
032	Conservation & Renewable Natural Resources	
033	Conservation & Renewable Natural Resources	
038	Conservation & Renewable Natural Resources	
060	Business Management	
062	Business Management	
063	Business Management	
068	Business Management	
070	Business Administration	
072	Business Administration	
073	Business Administration	
078	Business Administration	
080	Marketing & Distribution	
082	Marketing & Distribution	
083	Marketing & Distribution	
088	Marketing & Distribution	
100	Communication Technologies	
102	Communication Technologies	
103	Communication Technologies	
108	Communication Technologies	
110	Computer & Other Informational Sciences	X
112	Computer & Other Informational Sciences	X
113	Computer & Other Informational Sciences	X
115	Computer & Other Informational Sciences	X
118	Computer & Other Informational Sciences	X
120	Personal Services Occupations	
122	Personal Services Occupations	
123	Personal Services Occupations	

Subject Code	Subject Title	High Demand?
128	Personal Services Occupations	
130	Education	
132	Education	
133	Education	
138	Education	
170	Health	
172	Health	
173	Health	
178	Health	
200	Home Economics	
202	Home Economics	
203	Home Economics	
208	Home Economics	
210	Technology Education	X
212	Technology Education	X
213	Technology Education	X
218	Technology Education	X
250	Health and Medical Occupations	X
252	Health and Medical Occupations	X
253	Health and Medical Occupations	X
255	Health and Medical Occupations	X
258	Health and Medical Occupations	X
280	Military Science	
282	Military Science	
283	Military Science	
284	Military Science	
288	Military Science	
320	Program of Education & Career Exploration Connection	
322	Program of Education & Career Exploration Connection	
323	Program of Education & Career Exploration Connection	
328	Program of Education & Career Exploration Connection	
350	Personal, Interpersonal & Social Skills	
352	Personal, Interpersonal & Social Skills	
353	Personal, Interpersonal & Social Skills	
358	Personal, Interpersonal & Social Skills	
430	Protective Services	
432	Protective Services	
433	Protective Services	
438	Protective Services	
460	Construction Technology	
462	Construction Technology	

Subject Code	Subject Title	High Demand?
463	Construction Technology	
468	Construction Technology	
470	Mechanical Occupations (Including DCT)	
472	Mechanical Occupations (Including DCT)	
473	Mechanical Occupations (Including DCT)	
478	Mechanical Occupations (Including DCT)	
480	Precision Production Occupations	
482	Precision Production Occupations	X
483	Precision Production Occupations	X
488	Precision Production Occupations	X
490	Manufacturing Sciences	X
492	Manufacturing Sciences	X
498	Manufacturing Sciences	X
700	Professional/Career Preparation	
702	Professional/Career Preparation	
703	Professional/Career Preparation	
708	Professional/Career Preparation	