AN ANALYSIS OF DEMAND FOR SECONDARY AGRICULTURE TEACHERS BY PATHWAY

A Dissertation

by

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ABSTRACT

News headlines across the country continue to include policy updates, new strategies, and other information relating to the continuing teacher shortage in the United States. School-based agricultural education is not immune to the teacher shortage. Agriculture teacher shortages have been documented for more than a century. Extensive research has been conducted on the agriculture teacher shortage dating back to the 1960s. However, the research has approached the problem from a monolithic position. Through this approach, the agriculture teacher shortage could be solved with any one teacher filling any one advertised position. This study sought to investigate the agriculture teacher shortage using a more specific approach by analyzing agriculture teacher demand by pathway.

Nearly ten years of job posting data from California and Texas were used to conduct a content analysis of position advertisements. Additionally, I surveyed agriculture teachers in California and Texas to identify teacher assignments by pathway.

I found that certain pathways were more frequently requested than others in position descriptions. Furthermore, current agriculture teachers were assigned to teach in specific pathways more frequently as well. In California, the agriscience and agricultural mechanics pathways were in higher demand than the other pathways. In Texas, the applied agricultural engineering and animal science pathways were in higher demand than the other pathways. Mirroring the advertised positions, agriculture teachers in California and Texas were more frequently assigned to teach in those same pathways.

DEDICATION

It is with genuine gratitude and love that I dedicate this dissertation to my family. First and foremost, my loving wife, I cannot begin to express my gratitude for your sacrifice and support during this journey. To my children, remember that no one can ever take your education away from you. It is my sincere prayer that each of you will continue to learn and seek out more knowledge throughout your life. My parents, I have been truly blessed with wonderful parents who encouraged me to always be the best that I can be. I am grateful for your love and support through the many years of school. To my grandfather, I wish you could have been here to see my graduation. Your life lessons and work ethic are some of my most cherished memories. To all of those who have supported me along the way thank you, this project and process would not have been possible without you.

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NOMENCLATURE

AFNR	Agriculture, Food, and Natural Resources
CTE	Career Technical Education (California) Career and Technical Education (Texas)
Pathway	A sub-content area within a specific career cluster
Program of study	A sub-content area within a specific career cluster in Texas
SBAE	School-based agricultural education

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CHAPTER I

INTRODUCTION

The United States relies on a skilled workforce to support the nearly $22 trillion domestic economy (United States Bureau of Economic Analysis, 2020). Technology and innovations drive global economies to be more efficient, thus demanding a skilled workforce. The U.S. Bureau of Labor Statistics (Toossi, 2013) forecast an increase of 850,000 new workers in the workforce each year. The skills gap in the United States grows as fewer individuals entering the workforce possess the necessary skills to fill available positions. In the next ten years (i.e., 2015 to 2025), it is estimated that 3.5 million manufacturing jobs will need to be filled, yet it is expected two million of the positions will go unfilled in part due to the skills gap (Giffi et al., 2015). Electricians, machine repairers, and pipefitters are just a few of the skilled positions that are becoming increasingly difficult for manufacturing companies to fill (Rosendin & Gielczyk, 2018). Furthermore, it is estimated that the United States could experience a shortfall estimated at 875,000 individuals with skill sets in welding, machining, industrial machine operation, and other highly skilled manufacturing positions by 2020 (Sirkin et al., 2013).

Career technical education (CTE) programs are an appropriate source for a skilled workforce. Students participating in CTE programs are provided with the skills needed in the U.S. workforce. By student enrollment, the fastest-growing pathway in the agriculture, food, and natural resources content area is applied agricultural engineering

(Texas Education Agency, 2022). Skills developed in the applied agricultural engineering pathway provide students with skills and abilities to fill high-wage and high-demand jobs necessary to close the skills gap.

CTE programs are important because they determine the course offerings and the resource allocations needed to prepare competent individuals to enter the workforce. Local CTE program decisions impact the direction of programs through decisions such as staffing, funding, and course offerings. Significant funding sources, including federal, state, and local grant opportunities, are driving school administrators to consider expanding, starting, or rejuvenating programs to meet the high-wage and high-demand job needs of the U.S. workforce (California Department of Education, 2019; *Jobs and Education for Texans Grant*, 2019; Texas Education Agency, 2019).

CTE teachers must be competent in subject matter to provide effective instruction and develop skillsets needed by students to enter the workforce. Teachers who lack preparation, training, and appropriate content knowledge to deliver high-quality instruction negatively impact student achievement. Dating back nearly a half-century, scholars have studied the impact of teacher training and competency on pupil outcomes (Brophy & Evertson, 1974; Good & Grouws, 1975; McDonald et al., 1975; Soar & Soar, 1972; Stallings & Kaskowitz, 1974). Borich (1979, 1980) calls for continual research on teacher competencies as it relates to student achievement.

Agriculture teacher preparation programs have traditionally prepared teachers in a holistic approach focusing on all areas of the AFNR career cluster equally (or nearly equally). However, specific demand information could be used to adjust or tailor minimum requirements in AFNR teacher preparation. Supply and demand studies are not new to the field of CTE. A limited body of literature addresses accommodation or response to pathway-specific demands from the profession. Needs within career pathways at the local level have not been examined (Camp, 2000; Camp et al., 2002; Foster et al., 2014, 2015; Kantrovich, 2007, 2010).

This study investigated teacher shortages with respect to CTE pathways. Through the study of position announcements and evaluation of current teacher assignments, a deeper more detailed understanding of the issue is possible. Position announcements and current teacher survey research can provide a foundation for response to current demand for teachers in specific pathways—regardless of other factors that contribute to widespread teacher shortage.

Problem

By examining AFNR position announcements and current AFNR teacher assignments, can researchers gather more information to understand the specific needs of local education agencies? Is there a disproportionate number of positions advertised for specific content area pathways? Are all AFNR positions suitable for all candidates? These questions remain unanswered in the literature addressing the AFNR teacher shortage. The composition and evaluation of the suggested data sources will provide additional insight into the specific demand for teachers in AFNR.

Conceptual Framework

The conceptual framework of this study emerges from the theory of Human Capital Investment. Thoroughly developed in the 1960s, the theory of Human Capital

Investment has roots in the United States that trace back to our founding, first outlined in 1776 in the book *An Inquiry into the Nature and Causes of the Wealth of Nations* (A. Smith, 2010). Other researchers (Becker, 1962, 1964, 1994; Mincer, 1958; Schultz, 1961) built upon and refined Smith's original theory of labor as a long-term, and therefore capital, component of wealth creation worthy of study and investment, coining the term Human Capital. Human capital is intangible, difficult to quantify with precision, and inseparable from the workers who possess it. Human Capital comprises all a person's knowledge, abilities, talents, skills, intelligence, training, judgment, and experience, as well as their overall health, their habits, and their personality. Lange et al. (2018) operationally defined human capital as the present value of future earnings in the labor force. The factors used to compute human capital in their study were education and skills attained, experience in the workforce, and the probability of labor force participation at various ages.

The theory of Human Capital can guide both public and private decisions regarding investment in education. Government investments in education lead to long-term economic growth through increased productivity, healthier lifestyles, and social stability. In the executive summary of their 2018 report describing more comprehensive measures of the wealth of nations Lange et al. (2018) concluded, "Human capital, measured as the value of earnings over a person's lifetime, is the most important component of wealth globally" (p. 1). They posit that human capital comprises two-thirds of total wealth globally: 70 percent of the wealth in high-income countries and 40 percent in low-income countries. Individual investments in education lead to increased lifetime earnings through access to better-paying jobs (Becker, 1994; Lange et al., 2018; Mincer, 1958; Schultz, 1961). In our increasingly knowledge-based economy, the importance of human capital is growing rapidly.

Gary Becker received the Nobel Prize in Economics in 1992 and the Presidential Medal of Freedom in 2007. Becker's research focused largely on education as a component of human capital. Becker pointed out that the costs of education included both time and money. Of these, opportunity cost, the investment of time, was the more valuable. By pursuing an education, students lose the opportunity to work, travel, and gain different experiences. Additionally, Human Capital Investment theory includes a discussion about generalized knowledge versus specialized or firm specific knowledge. For the purposes of this study, I assign the term firm to local education agencies.

The literature reviewed universally supports both public and private investment in education as a means of wealth creation. One aspect I focused on is educational attainment as one part of the theory of Human Capital Investment, and specifically on potential benefits for secondary teachers in AFNR. This study examined a very well-defined subset of investment choices for students in educator preparation programs leading to certification as AFNR teachers.

In the application of Human Capital Investment, firms are also investing in individuals. The investments often include training in firm specific knowledge, skills, and abilities (Becker, 1994). Employees typically bring with them a generalized knowledge in a given field. This generalized knowledge is obtained in different ways which may include secondary education, post-secondary education, and previous work experience. While generalized knowledge is considered transferrable, firm specific knowledge may not transfer between local education agencies (Becker 1964, 1994).

While secondary educator preparation programs in AFNR are more prescriptive than some collegiate majors, students do have choices, including those regarding which of the AFNR pathways to emphasize in their academic and experiential preparation for employment. These choices, which elective courses to take, and which extra-curricular experiences to obtain, create the opportunity to specialize in one or more pathways or to be more of a generalist within the field broadly defined as AFNR teacher. These choices amount to investments of the students' time and money. As with all investments, students deserve to make informed choices. Informing these decisions requires current information regarding the potential return of those investments.

Purpose of the study

The purpose of this study was to evaluate the demand for teachers in specific pathways as specified in AFNR position advertisements, to describe the current assignments of AFNR teachers by pathways and to refine our understanding of the personnel needs of secondary AFNR programs across a span of 10 years. To accomplish this purpose, two data sources were used to provide two perspectives of employment demand: a content analysis of AFNR job postings and a survey of current agriculture education teacher assignments.

CHAPTER II

LITERATURE REVIEW

A large body of research exists on a growing teacher shortage in the United States. As the U.S. population grows, the need for teachers grows. Substantial research on this topic identifies and explains the many negative implications a teaching shortage has on our children and our future as a nation. The available research focuses on the teacher shortage as a monolithic problem addressing the teacher shortage in a simplistic 1:1 manner. While these studies provide a valuable overview and address the overall concern of a teacher shortage, they provide only a general solution to the problem. The teacher shortage is complex, and effective solutions will require more nuanced approaches. A limited body of knowledge exists regarding the teacher shortage by pathway in school-based agricultural education (SBAE) programs.

Introduction

This chapter will provide a review of the existing literature about the agricultural education teacher shortage and the change in demand and supply over time. For the future growth of SBAE and agriculture as an industry, the agricultural education teacher shortage needs to be addressed. Some steps have been taken by state governments and institutions to address this shortage. However, this review of literature found the teacher shortage in school-based agricultural education is still quite high. While recognizing the large and growing teacher shortage in SBAE, I focus this literature review on the premise that pathway-specific demands differ in the agriculture, food, and natural resources career cluster.

United States Skills Gap

Between 2005 and 2018, U.S. employers faced great difficulty finding qualified individuals to fill critical positions, leading to a growing problem known as the skills gap (Eisen et al., 2005; Giffi et al., 2014, 2015; Jasinowski, 2015; Morrison et al., 2011). While manufacturing continues to be at the forefront of the skills gap discussion, other industry sectors such as agriculture, education, and information technology contribute to the need for decisions and policies at the federal, state, and local levels (National Research Council, 2010).

The phrase "manufacturing skills gap" was first introduced by Deloitte in its 2001 report (Giffi et al., 2015). The definition of manufacturing skills gap provided by Deloitte is a perceived mismatch between employer needs for specific skill sets, and the skill sets possessed by an available pool of potential employees. Specifically, Christo-Baker et al., (2017) posited that the gap is actually between the pool of unemployed workers seeking work and the available employment from employers. The mismatch is in the skill set that the available pool of employees currently holds and the required skills of available positions.

Political, societal, technological, educational and overall business environments make it difficult for employers to recruit and hire qualified, skilled workers who possess a good work ethic. According to Giffi et al. (2015), the greatest challenge facing manufacturers currently (2015) and in the future was recruiting a skilled workforce. The Manufacturing Institute and Deloitte conducted a study with 450 manufacturing executives. According to their findings, two million positions will go unfilled in the United States by 2025 if nothing is done to address the growing skills gap. Manufacturing is not the only industry expecting a continued labor shortage. Specifically, Hertz and Zahniser (2013) predicted that a growing labor shortage in agriculture will not only impact general labor but crew leaders and high-tech positions in agriculture. These are just a couple of the studies conducted by the vast array of institutions, companies, and organizations concerned about the growing issue of labor needs (P. H. Cappelli, 2015). Other studies posited a skills gap does not exist in the United States (P. Cappelli, 2008; P. H. Cappelli, 2015; Osterman & Weaver, 2014; A. Weaver & Osterman, 2017). While these studies claimed that a skills gap does not exist, they all acknowledged that there is a mismatch in the skill sets desired and the skill sets currently held by potential employees. Therefore, the claim is that the skills gap problem is instead a skill mismatch issue. Some believe that these issues are due in part to rapidly advancing technology in the workplace Cappelli, 2008; Cappelli, 2015; Osterman & Weaver, 2014; Weaver & Osterman, 2017).

Giffi et al. (2015) found that companies can lose more than 11% of their annual earnings if they are lacking a skilled workforce to meet customer demands. In the agricultural sector, history is set to repeat itself. Charlton et al. (2019) confirmed that innovations in agriculture are introduced at the greatest rates when labor shortages and issues are elevated. As evidenced by the evolution of combustion engines in agriculture during the great depression, and the widespread application of commercial fertilizer during World War II, the agricultural industry is experiencing another wave of innovation. The innovations in agriculture are driven to reduce the dependency on labor needs by replacing human beings with mechanized machinery where applicable (Charlton et al., 2019). However, these innovations in mechanized agriculture adopted to reduce the amount of human capital needed resulted in a significant increase in the need for highly qualified individuals to manufacture, operate, and maintain the innovative equipment (Charlton et al., 2019; Giffi et al., 2015). This phenomenon was described by employers with terminology including skills gap, skill shortages, and skill mismatches (Cappelli, 2015). As the extension service was born out of the need for more effective dissemination of research, a pressing need for career technical education has become apparent.

Some companies and industries face greater challenges with the U.S. skills gap. A collaborative approach to the skills gap utilizing educational opportunity, policy, and effective on-site training programs has provided many with limited relief (Giffi et al., 2015). Eisen et al. (2005) reported that many different factors that influence a skills gap, and a unified knowledge-sharing process can alleviate struggles that manufacturing companies face when dealing with a daunting skills gap. While a shortage or skills gap may exist, educational opportunities—if there are sufficient teachers—are available for students in both secondary and post-secondary settings to address the skills gap.

Career technical education (CTE), also referred to as vocational education, dates back to the early twentieth century. Most notably John Dewey and Charles Prosser each argued for education, and while they did not agree on the how, each had a lasting impact on education. Dewey opposed Prosser's vocational education focus as he was concerned that a vocational approach to education would hinder a student's intrinsic motivation to achieve (Wonacott, 2003). Prosser strongly believed that the purpose of public education was not to ultimately benefit the individual but to prepare citizens to contribute to society through meaningful work (Rojewski, 2002). Ultimately, Prosser won the debate as he assisted in the passage of the Smith-Hughes Act of 1917 (Wonacott, 2003). The 1917 act guaranteed vocational education would have a place in the American educational system then and now, more than a century later.

Career technical education serves many different industry sectors. Public schools across the United States offer courses in one or more of the 16 different career clusters (Advance CTE, 2022). The sixteen national career clusters are agriculture, food and natural resources; architecture and construction; arts, A/V technology & communications; business management and administration; education and training; finance; government and public administration; health science; hospitality and tourism; human services; information technology; law, public safety, corrections and security; manufacturing; marketing; science, technology, engineering and mathematics; and transportation, distribution and logistics (Advance CTE, 2022). Individual states have adopted similar career clusters, with many of the states adopting standards for each of their career clusters on a statewide level. California adopted a model with 15 career sectors: agriculture and natural resources; arts, media, and entertainment; building and construction trades; business and finance; education, child development, and family services; energy, environment, and utilities; engineering and architecture; fashion and interior design; health science and medical technology; hospitality, tourism, and recreation; information and communication technologies; manufacturing and product development; marketing sales and service; public services; and transportation (California Department of Education, 2017). Texas Education Agency (2019) adopted a statewide programs of study framework in 2019 that outlines 14 career sectors that make up the state's career technical education program of study. The Texas Education Agency (2019) lists the following career sectors in their programs of study: agriculture, food, and natural resources; architecture and construction; arts, audio/visual technology, and communications; business, marketing, and finance; education and training; energy; health science; hospitality and tourism; human services; information technology; law and public service; manufacturing; science, technology, engineering, and mathematics; and transportation, distribution, and logistics. Throughout these career technical education courses, secondary students have many opportunities to gain valuable skill sets needed for the ready and waiting workforce. However, a growing concern in the field of education is a teacher shortage. Without qualified teachers to facilitate and teach the career technical education courses, students may be left without the opportunity to develop needed skills and knowledge.

U.S. Teacher Shortage

Few educational issues have received the level of attention that the teacher shortage crisis has in recent times. In the U.S. there are more than 90,000 public schools that employ more than 3.6 million teachers (National Research Council, 2010). Sutcher et al. (2019) reported that 40 of the 50 states reported widespread teacher shortages, with many of the reporting states approaching 20 years or more of documented teacher shortages. Teacher shortages experienced by schools and districts vary. However, Castro et al. (2018, p. 2) reported the three most commonly cited teacher shortage gaps as:

> 1. A shortage of well-qualified, well-prepared teachers, especially in schools serving mostly students of color and students living in poverty; 2. A shortage of well-qualified, well-prepared teachers in specific content or subject areas; 3. A shortage of teachers of color to reflect the racial/ethnic diversity of the student population.

Sutcher et al. (2016, p. 1) defined a teaching shortage as "the inability to staff vacancies at current wages with individuals qualified to teach in the fields needed." Four main factors were identified as driving the evolving teacher shortage. The factors were a decline in teacher preparation enrollments, district efforts to return to pre-recession pupil-teacher ratios, and high teacher attrition rates (Sutcher et al., 2016). Furthermore, Sutcher et al. (2016) used modeling software to forecast the growing teacher shortage in the United States. They found that by 2020 a shortage of approximately 110,000 teachers could become reality. As school populations are expected to grow by nearly 3 million over the next decade (i.e., 2015 to 2025), teacher attrition rates estimated at 8% annually are the single most influential factor in the teacher shortage. The teaching workforce has continued to be described as a leaking bucket. The attrition of teachers between 1989 and 2010 nearly doubled in size from approximately 100,000 teachers leaving the profession pre-retirement in 1989 to almost 200,000 teachers leaving the profession pre-retirement in 2010. Sutcher et al. (2016) reported that between 2009 and 2014 enrollment in teacher preparation programs dropped to 451,000, representing a 35% reduction in pre-service teachers. Additionally, California teacher preparation programs reported a decline of 53% between 2008 and 2012 (Castro et al., 2018). With a shrinking number of students enrolling in teacher preparation programs, and a growing rate of attrition, the teacher shortage continues to pick up momentum.

Castro et al. (2018) estimated that nearly 16% of the teacher workforce, or 500,000 teachers, either move schools or leave the profession entirely on an annual basis. Of the 16%, half of those leave the profession entirely. Between 20 and 30% of teachers are projected to leave the profession before their fifth year in the classroom. While the trend for "teacher churn" (movers from one school to another) has stayed relatively stable over the past two decades, the percentage of teachers choosing to leave the profession has increased from 5% in 1990, to more than 8% in 2010 (Castro et al., 2018).

Teacher shortages are not all created equal. Shortages affect states, subject areas, and student populations differently. Sutcher et al. (2019) reported that differences in wages, working conditions, teacher preparation institutions, and widely varying policies drastically impact teacher shortages. Castro et al. (2018) reported that of the four major groups of hiring pools (elementary, English and social studies, STEM, and special education), the STEM and special education vacancies were nearly five times as high as those in elementary and English and social studies. The southern part of the United States experiences a higher turnover rate compared to the Northeast, the Midwest, and the West. The southern United States reported a 16.7% turnover rate while the northeast observed a 10.3% teacher turnover rate (Castro et al., 2018).

Special education specifically continues to face a debilitating shortage. California reported in 2015 that 48% of entering special education teachers were not fully prepared to enter the classroom (Sutcher et al., 2016). This was reported as especially alarming that the students who most need targeted and innovative instruction are being served by those with the least amount of preparation. California tripled the number of emergency and temporary teaching permits during the 2015-2016 school year to address the 25% teacher shortage across the state.

According to a report by Cross (2017), the U.S. Department of Education found that two-thirds of states experienced a shortage of CTE teachers in at least one area. Some of those states such as Maine, Maryland, and New York documented a CTE teacher shortage of more than 20 years. While the teacher shortage, and more specifically the CTE teacher shortage, results from the influence of many factors, the existing body of literature has identified the primary factors for the shortage as low teaching salaries when compared to industry salaries, difficulties recruiting teachers for rural schools, and a limited number of teacher candidates coming from formal CTE training programs. Conneely and Uy (2009) reported in their policy brief, *Teacher Shortage Undermines CTE,* that there was an increase of almost six million students enrolled in CTE courses in just seven years (i.e., 2002 to 2009), yet many existing teacher education programs in CTE have been eliminated. The number of CTE teacher preparation programs dropped from 432 to 385 (from 1990 to 2000)—a decrease of 11%. The growing numbers of teacher retirements have affected the supply of CTE teachers. With a shrinking pipeline to replenish retiring CTE teachers, the CTE teacher workforce ages with each passing year.

Castro et al. (2018) highlighted seven recommendations to address the growing teacher shortage crisis in the United States. The recommendations were dedicated state funding, better supply and demand data, design of stronger leadership systems in schools, development of leadership preparation programs, creation of sustainable teacher career pathways, implementation of grow-your-own programs, and continual professional development needs. A recent trend in education aimed at filling teaching vacancies is the use of alternatively certified teachers.

Two common routes or pathways to teacher certification were described as traditional and alternative certification (Bowling & Ball, 2018). Traditional certification was characterized by a program of study within a university teacher preparation program leading to professional licensure. Alternative certification, in part, was designed to fill a multi-generational teacher shortage for highly qualified teachers. According to the National Center for Education Statistics (2015), of the more than 3.2 million public school teachers, more than 250,000 chose to leave the classroom in 2014. A difference between the number of traditionally certified graduates and the number of positions open was more than 50,000. Therefore, without the pool of alternatively certified teachers 50,000 openings would have gone unfilled. In the first decade of the 21st century, 20-

30% of all public education teacher positions were filled with an alternatively certified candidates (National Research Council, 2010).

Historical Underpinnings of School-Based Agricultural Education

"America was such a vast and fertile country that it took the people over a century to find out that there was any limit to its productiveness" (Stimson & Lathrop, 1942, p. 1). Education in the field of agriculture is rather young when looked at through a historical lens. Formal agricultural education did not exist before the 19th century (2018). Organizations, originally referred to as agricultural societies, were established in the late 1700s in states such as Connecticut, Massachusetts, and South Carolina. These societies provided adult education in agriculture to farmers. School-based agricultural education and the birth of the National FFA Organization would not occur for almost 150 years from the onset of these early societies. Along the way, key political and educational leaders pushed the envelope and evolved the science of agriculture.

Rufus W. Stimson (1868 – 1947) grew up on a farm near Palmer, MA. Stimson was public school educated and would go on to study at Harvard under William James. Stimson's most important works came from his work in the early 20th century in the field of agriculture (Moore, 1988). Stimson, often called the father of the "project method," is responsible for developing the process of an applied project at the student's home farm. Stimson argued that the most influential manner for an educational institution to impart knowledge to older generations on the farm was for younger generations to demonstrate the new knowledge, processes, technology, and innovations

(Moore, 1988). Later, state-operated extension services would adopt similar practices in a youth program commonly known as 4-H today. Stimson advocated for a push away from college-owned or school-owned livestock. Stimson said, “Everywhere there is a tendency to discount college-owned or school-owned livestock and operations” (Stimson, 1914, p. 12). The project method would go on to serve as one of the tripartite cornerstones of modern school-based agricultural education.

John Dewey and Charles Prosser were both fundamental figures in the debate over educational reform at the turn of the 20th century. Dewey opposed Prosser’s focus on education as a role in preparing children to serve society through vocational training and labor. Dewey posited that vocational education was dangerous because it could become too “rote, mechanical, and slavish” (Wonacott, 2003, p. 6)**.** Dewey looked for education to foster civic duty and promote democracy. Ultimately, Prosser would prevail in this particular debate as he would go on to help author the monumental Smith-Hughes act of 1917 (Wonacott, 2003)**.** Dewey was not completely defeated in his philosophical approach to education, his work would later be considered foundational in experiential education (Wonacott, 2003). School-based agriculture education has evolved and grown tremendously since the Smith-Hughes Act of 1917.

School-based agricultural education at the secondary level did not begin with the Smith-Hughes Act of 1917. The 1917 act certainly did propel school-based agriculture education forward. However, prior to the 1917 act, during the 1914-1915 school year it was reported that 85,573 students were enrolled in agriculture-based courses in every state at more than 4,300 secondary schools (Moore, 1988)**.** The passage of the Smith-

Hughes Act in 1917 provided critical framework components including an increase in vocational skills, a decrease in the variability among programs, and arguably the most important aspect, federal funding to ensure sustainability (Moore, 1988).Later, the National FFA Organization, founded in 1928, the official student-run organization associated with school-based agricultural education has grown to nearly ¾ of a million students across the United States and associated territories (Meyer, 2020; Sheehan & Moore, 2019). With the tremendous growth in not only the National FFA Organization but also school-based agriculture education, challenges have faced the industry of agriculture. With the growth in student enrollment, the need for additional school-based agriculture education teachers grows as well.

Agricultural Education Teacher Shortage

The U.S. Department of Education (Cross, 2017) identified specific discipline areas of teacher shortages by state between 1990 and 2018. School-based agricultural education was identified in 21 states as a high need for teachers. Many of the states identified as experiencing agriculture teacher shortages faced multiple and consecutive years of shortages (Cross, 2017). Many researchers (Camp, 2000; Camp et al., 2002; Foster et al., 2014, 2015; Kantrovich, 2007, 2010; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; Woodin, 1967) have identified a critical need for key stakeholders in agricultural education to have valid and current supply and demand information. This information is critical for the stakeholders to continue to make policy decisions, target recruitment efforts, support early career teachers, and develop professional development aimed at decreasing teacher turnover.

The National Association of Agricultural Educators (NAAE) and the American Association for Agricultural Education (AAAE) both remain committed to addressing the growing need for agriculture teachers across the country. With broad support, the associations continue to support the National Agricultural Education Supply & Demand Studies that date back to the 1960s.

I robustly analyzed the history and evolution of the National Agricultural Education Supply & Demand Studies and resulting findings. Eck and Edwards (2019) discussed school-based agricultural education (SBAE) and highlighted the teacher shortage. This teacher shortage has grown over time. As per Eck and Edwards (2019), this shortage goes back to the Smith-Hughes Act. Eck and Edwards (2019) highlighted the changes in supply and demand reports from the earliest inception in 1965 with Dr. Ralph Woodin at The Ohio State University. Woodin (1967) identified 242 positions unfilled for the 1966-1967 school year. An additional 232 positions were filled by teachers with emergency certification. Over time these reports have evolved to include 12 different lead investigators representing eight universities and the National FFA Organization. Two things remaind consistent, the need and the overwhelming support from the professional associations connected to school-based agricultural education to conduct these studies.

This meta-analysis by Eck and Edwards (2019) reviewed data from SBAE teachers over more than five decades. The data provided an insight into the demand for and the supply of agricultural education teachers. More than half of the graduates who completed teacher certification in AFNR continued to teach after their first year in the profession. The focus of the study was to compare long-term/earlier graduates/experienced teachers to new entrants in the field of agricultural education teaching. Their research highlights multiple concerns about the AFNR teacher shortage, with one being the retention of current agricultural education teachers.

Eck and Edwards (2019) reported a combined trend in agriculture teacher demand based on the number of positions. They found that the total number of positions peaked in 1978 with 12,844 positions, while the next decade experienced a continual decline in agriculture teacher positions to a low point of fewer than 10,000 positions in 1992. Eck and Edwards (2019) posit that the downward trend was likely due to an ongoing teacher attrition problem and a significant reduction in funding to career technical education programs during the 1980s.

The teacher shortage has been described by some as not a shortage of qualified teachers but a shortage of qualified teachers choosing to enter the career field (R. Weaver, 2000). Weaver (2000, p. 14) stated "the problem is in converting quality agriculture education majors into agriculture teachers." While enrollment in agricultural education majors is down from the 1970s when enrollment peaked at just fewer than 1,800 students/graduates/newly certified or credentialed annually, the percentage of graduates deciding to teach has steadily increased since the 1970s (Camp, 2000; Camp et al., 2002; Foster et al., 2014, 2015; Kantrovich, 2007, 2010; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; Woodin, 1967). The shortage of school-based agriculture education teachers has been affected by the 51-year average of 56.4% of agricultural education graduates choosing to seek employment as school-based agricultural education teachers (Eck & Edwards, 2019).

Two common routes to teacher certification are traditional and alternative certification (Bowling & Ball, 2018). Traditional certification has been characterized by a program of study in a university teacher preparation program leading to professional licensure. Alternative certification typically is a post-baccalaureate program including internships and classroom instruction resulting in teacher certification. These programs typically do not include content specific instruction. Alternative certification, in part, was designed to fill a teacher shortage for highly qualified teachers.

The number of alternative certification teachers entering the field of school-based agricultural education is growing rapidly and showing no signs of slowing. Camp et al. (2002) found that 10.7% of open positions were filled with other types of graduates outside of a traditional bachelor's degree in agricultural education. Almost two decades later Smith et al. (2019) found that alternative certification, non-certified hires, and other types of hires accounted for 34% of positions filled in 2019.

California and Texas make up the two largest states in terms of membership in the National FFA Organization. National FFA Organization enrollment is a strong indicator of school-based agricultural education enrollment. For example, California is the original affiliation membership state (Sheehan & Moore, 2019). This model requires that all students participating in school-based agricultural education are members of the National FFA Organization. According to the California Agriculture Teachers

Association (2020), California FFA membership exceeded 95,000 students across 338 schools. While Texas, did not adopt a statewide affiliation model, Texas is home to a robust school-based agricultural education program with more than 220,000 student enrollments in AFNR courses (Texas Education Agency, 2022). The 220,000 student enrollments considered only unduplicated students. California and Texas, the top two states for National FFA Organization membership, combined to account for more than 200,000 of the over 760,000 members across the nation (Meyer, 2020). Student enrollments lead directly to the need for additional agriculture teachers.

In 2020, California was home to 988 school-based agricultural education teachers. It was reported that all of the 988 teachers served in a full-time capacity (Foster et al., 2020a). The number of full-time school-based agricultural education teachers increased from 741 in 2015 to 988 teachers in 2020 (Foster et al., 2020a). This is a 33 percent increase over those six years in California. During the same time period, the number of school-based agricultural education programs grew from 316 to 343, representing an 8.5 percent increase in the number of programs. Foster et al. (2020a), reported 112 new positions in California school-based agricultural education between 2015 and 2020. During the same period 34 positions were lost, providing a net gain of 78 positions over the period. Foster et al. (2020a), reported data from institutions of higher education in California indicating that 365 students completed their course of study in agricultural education. Furthermore, of the 365 graduates during the six years, 338 (92.6%) began teaching school-based agricultural education in California (Foster et al., 2020a). The 92.6% percent rate of graduates entering teaching in the school-based agricultural education field is higher than the historical average (Eck & Edwards, 2019).

In 2020, Texas was home to 2,500 school-based agricultural education teachers (Foster et al., 2020c). It was reported that 2,400 of 2,500 served in a full-time capacity with the remaining 100 serving in part-time roles (Foster et al., 2020c). The number of full-time school-based agricultural education teachers increased from 1,950 in 2015 to 2,400 teachers in 2020 (Foster et al., 2020c). This is a 23.1 percent increase over six years in Texas. During the same time period, Foster et al. (2020c) reported that the number of school-based agricultural education programs grew from 1,050 to 1,079, a 2.8 percent increase in the number of programs. Foster et al. (2020c), reported 160 new teaching positions in Texas school-based agricultural education between 2015 and 2020. During the same period, 27 positions were lost, providing a net gain of 133 positions. Foster et al. (2020c), reported data from institutions of higher education in Texas indicating that 1,002 students completed their course of study in agricultural education. Furthermore, of the 1,002 graduates during the six years, 677 (67.6%) began teaching school-based agricultural education in Texas. The 67.6 percent rate of graduates entering the school-based agricultural education field is consistent with the historical average (Eck & Edwards, 2019).

A review of the data revealed that programs in California are larger in terms of numbers of students and teachers when compared to Texas programs. Teachers in California are on average serving a greater number of students per teacher. Graduates/completers of California teacher education programs sought employment as school-based agricultural educators at a greater rate than did graduates/completers of Texas educator preparation programs.

The teacher shortage in school-based agricultural education is well documented from a supply and demand perspective. The shortage dates back as far as the inception of the Smith-Hughes Act of 1917 (Craig, 1981). While many factors may contribute to the continuing shortage, there are areas that have not been adequately explored relating to the teacher shortage in school-based agricultural education including how pathway specific demand may impact a shortage of qualified teachers.

Agricultural education teacher recruitment and retention

Extensive literature on school-based agricultural education has focused on teacher recruitment and retention (Eck & Edwards, 2019; Guarino et al., 2006; Lemons et al., 2015; Myers et al., 2005; Sorensen et al., 2016; Walker et al., 2004). Eck and Edwards (2019) discussed that more than the issue of recruiting teachers to teach in agricultural education is to the issue of retaining them. They explained that the recruiting and preparation stage in the provision of school-based agricultural education teachers is important, but retention of teachers is also important so that the issue of a perpetual shortage can be effectively addressed. In their study they also addressed that the demand and supply for teachers has been studied, but information related to pathways was not addressed in the study nor in the general body of research.

Eck and Edwards (2019) found that teachers usually left teaching agriculture for several reasons: low salaries, lack of work-life balance, and extended work hours.

However, teachers who stayed said that they stayed because of their positive experience in teaching agriculture students and also because of their positive perceptions of efficacy in the development of their curriculum.

Eck and Edwards (2019) discussed the importance of professional organizations in delivering meaningful professional development. For promoting and retaining teachers, they found that agricultural education professional development must be provided to both middle school and secondary school teachers, this professional development must be specific to agricultural education, and the organizations should strive to recruit new teachers. They also found that once the recruiting is done, the next two to three years in the career of teachers are important in terms of retention.

Eck and Edwards (2019) also found from their research that the significance of continuing professional development (CPD) is related to the retention of the SBAE teachers. They found that teachers who are actively engaged in professional development are likely to stay in the field longer.

Many professional organizations have provided professional development opportunities for SBAE teachers. University preparation programs serve as education providers (Eck & Edwards, 2019). The most prominent organizations that have worked for many years in the development of AFNR teachers are the National FFA Organization, NAAE, and state agricultural teacher associations. These organizations have focused on skill training of professionals, which assists teachers in developing the skills needed in a complete school-based agricultural education program. Additionally, developing skills to work with support staff, administration, and the community assists in the professional improvement of agriculture teachers, which ultimately provides teachers with greater self-efficacy (Eck & Edwards, 2019).

Rubenstein et al. (2014) researched the self-efficacy views of student teachers across specific SAE competencies. They found that pre-service teachers held high perceptions of their self-efficacy across the AAAE – SAE competency areas measured included keeping records, supervising projects, and assisting students in acquiring needed resources. However, these competencies did not include the ability to teach these skills in career pathways such as animal systems, plant systems, and/or power and technical systems.

Walker et al (2004) found that job satisfaction among teachers who chose to stay in the teaching profession and job satisfaction among those individuals who chose to exit the teaching profession were equal. They posited that individuals who left did so because of opportunities or benefits that they could not receive through teaching.

School-based agricultural education pathways and programs of study

Graduation requirements are different across states (California Department of Education, 2021; National Center for Education Statistics, 2014; Texas Education Agency, 2020). Currently, no national standard exists for secondary graduation (National Center on Educational Outcomes, 2022). Graduation requirements are set by states and in some cases by local education agencies, often referred to as districts (National Center on Educational Outcomes, 2022). Three states (Colorado, Massachusetts, and Pennsylvania) do not have state graduation requirements, instead, graduation requirements are locally determined (National Center for Education Statistics, 2014). Across the United States, 24 Carnegie units is the greatest number of units any state requires for graduation. The two lowest number of Carnegie units required are 11 in Maine and 13 in California (National Center for Education Statistics, 2014). However, it should be noted that in California local districts have the authority and discretion to require units for graduation above the state minimum (California Department of Education, 2021).

There is limited consistency across the United States in the content or subject matter of the required units for graduation. In California, three units of English, two units of math, two units of science, three units of social studies, and a unit of either art, foreign language, or career technical education are required for graduation (California Department of Education, 2021). In Texas, 22 credits are required for graduation. Students are required to successfully complete four credits of English, three credits of math, three credits of science, three credits of social studies, two credits in a foreign language, one physical education credit, one fine art credit, and five elective credits (Texas Education Agency, 2020). In Texas, students have the opportunity to earn a distinguished level of achievement diploma which requires four additional units and an endorsement. An endorsement can be earned in one of the following areas: Science, Technology, Engineering, and Mathematics (STEM), Business and Industry, Public Service, Arts and Humanities, and Multidisciplinary Studies (Texas Education Agency, 2020). Career technical education courses are integrated into the STEM, Business and Industry, and Public Service endorsement options. A variety of options exists for students across the United States. Currently, 41 states have adopted the Common Core as a standard for districts across the state (Common Core State Standards Initiative, 2022).

States use curriculum standards to ensure that teachers are provided with the guidance and framework to teach the subject and content adopted by state policy. Career technical education is not exempt from the state standards model outlined in the core subject areas. While there is no national set of standards for CTE similar to those of the common core, most states have adopted state standards for the respective CTE programs (Advance CTE, 2022; California Department of Education, 2021; National Center on Educational Outcomes, 2022; Texas Education Agency, 2020). On a national level, Advance CTE, a national consortium of state CTE leaders, outlines a framework of 16 career clusters that rare divided further into 79 career pathways for states to use in CTE programming (Advance CTE, 2022). Agriculture, Food, and Natural Resources (AFNR) is one of the 16 career clusters identified in the framework. In the AFNR career cluster seven career pathways are identified: agribusiness systems, animal systems, environmental service systems, food products and processing systems, natural resource systems, plant systems, and power, structural, and technical systems (Advance CTE, 2022).

Teachers facilitate the learning that occurs in each of the pathways (California) and programs of study (Texas). California and Texas are different in their respective approaches to standards for specific courses within the CTE field. In California, standards are provided broadly for each of the pathways (California Department of Education, 2017). In Texas, standards are provided in the form of the Texas Essential

Knowledge and Skill (TEKS) framework for each state-approved course of study (Texas Education Agency, 2019). The California Department of Education (2017) provides local districts with the authority to develop and manage courses and standards within the offered pathways. The Texas Education Agency (2019) developed standards for each of the 60 courses in the agriculture, food, and natural resources career cluster.

An important note for the purpose of this study is the difference in terminology between states. The national CTE framework uses the term “career cluster” to describe the broader differentiations between career areas such as agriculture and natural resources and health science. Additionally, the national CTE framework then provides greater detail within each of the career clusters in “career pathways” (Advance CTE, 2022). In California, the model curriculum includes industry sectors which are the equivalent term to the national career clusters; industry sectors are then divided into pathways within each of the industry sectors (California Department of Education, 2017). In Texas, the term career cluster is used in the same manner that it is used in the national framework (Advance CTE, 2022; Texas Education Agency, 2019). However, in Texas, the career clusters are then divided further into programs of study. The term “programs of study” is used in the same manner as “career pathways” in the national framework and “pathways” in the California model curriculum (Advance CTE, 2022; California Department of Education, 2017; Texas Education Agency, 2019). For the purposes of this study, I will use the term “pathway” to address both these organizations of AFNR curriculum.

Agricultural education geographic organization

Each state FFA Association chooses how to organize the membership for different program purposes. Program purposes include contest, administrative oversight, voting delegations, and others. In California and Texas, four levels of geographic or organizational distribution are used. The four levels from smallest to largest include chapter, section or district, region or area, and state. The California FFA Association uses the chapter, section, region, state language to differentiate the organizational structure (California Department of Education, 2019). In Texas, the Texas FFA Association uses the chapter, district, area, state language to differentiate the organizational structure (Texas FFA Association, 2016).

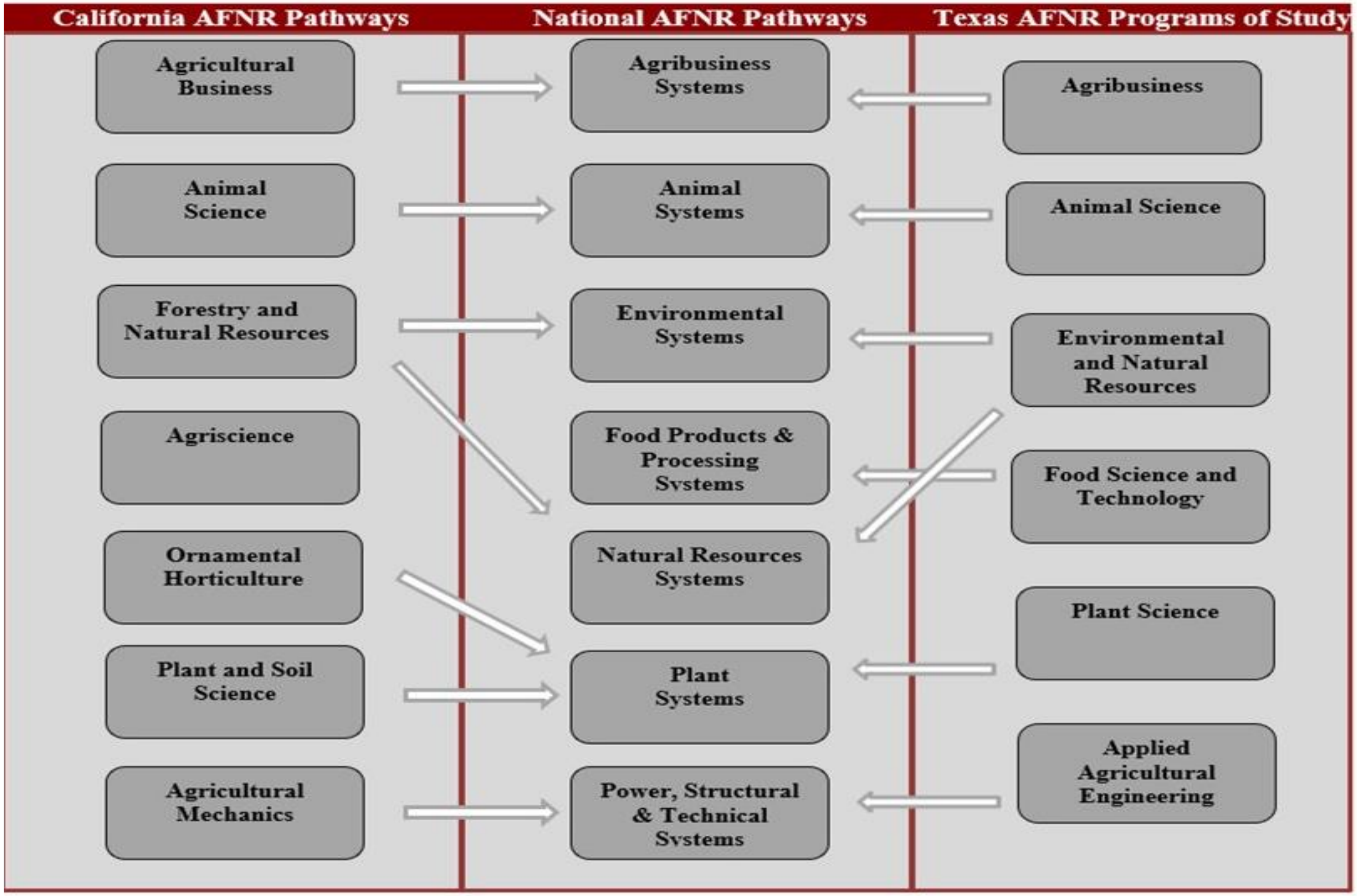
In California, six regions are divided across the state. The six regions are the Central, North Coast, San Joaquin, South Coast, Southern, and Superior regions. Each of the regions have potential differences in demographics and student enrollment numbers. However, each of the regions are still governed and expected to follow the state guidelines and model CTE curriculum provided by the department of education (California Department of Education, 2013).

In Texas, ten areas are divided across the state. The ten areas are numbered from 1 – 10. Area 1 encompasses the panhandle area of the state, whereas Area 10 encompasses a portion of the southeast part of Texas. In 2018, the Texas FFA Association completed an “Area” realignment project which added two additional areas and changed area boundary lines. A large focus of the area realignment project was to address the disproportionate membership numbers in some of the areas (Texas FFA Association, 2016).

Student enrollment growth across both California and Texas is well documented (California Department of Education, 2013; Texas Education Agency, 2020). Limited literature is available describing school-based agricultural education growth through a rural, suburban, and urban lens. Anecdotally, school-based agricultural education program growth has increased exponentially in the suburban settings of both California and Texas.

Figure 1

AFNR Crosswalk Between California, Texas, and National Frameworks



For the purpose of this study, an evaluation of the alignment between California and Texas pathways within AFNR was necessary. In examining the alignment, one may observe that four of the pathways were analogous: agribusiness; animal science; agricultural mechanics/applied agricultural engineering; and forestry and natural resources/environmental and natural resources. However, in California, the agriscience and ornamental horticulture pathways are not analogous to the Texas pathways. The focus area of ornamental horticulture is combined with the plant science program of study in Texas. Additionally, the food science and technology program of study in Texas is not included in the framework for California. Therefore, careful consideration was needed in the design and data analysis section of this study. See Figure 1 above for an illustration of the pathway and programs of study crosswalk.

A particular pathway of interest was the agriscience pathway in California. As illustrated in Figure 2, in 2011, the California Department of Education (2017) adopted a model to integrate agriculture courses into the core science requirements. Through this process, districts were able to integrate core science courses and CTE agriculture courses: biology and sustainable agriculture; chemistry and agriscience; and advanced interdisciplinary science and sustainable agriculture (California Department of Education, 2021). The integrated agriscience courses are recognized/used as core science credits in a student’s graduation plan. The inclusion of agriscience courses allowed for increased student enrollment and student retainment in school-based agricultural education programs across the state of California. With an increase in student enrollment and retention, program growth and success brought challenges such as hiring qualified teachers to fill the roles. As illustrated in Figure 3, Texas adopted an analogous model of programs of study (Texas Education Agency, 2019).

Figure 2

CA AFNR Pathways

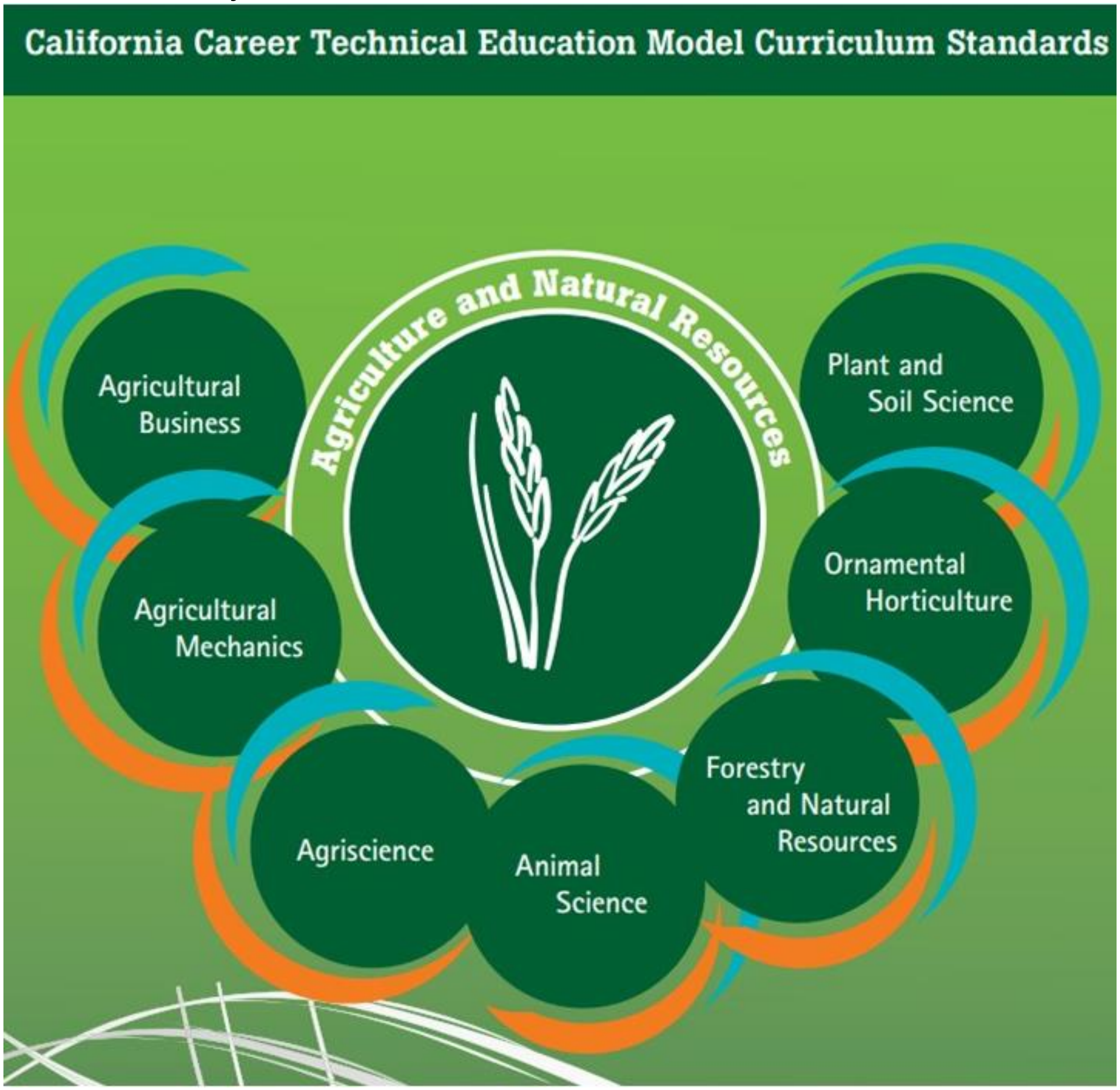
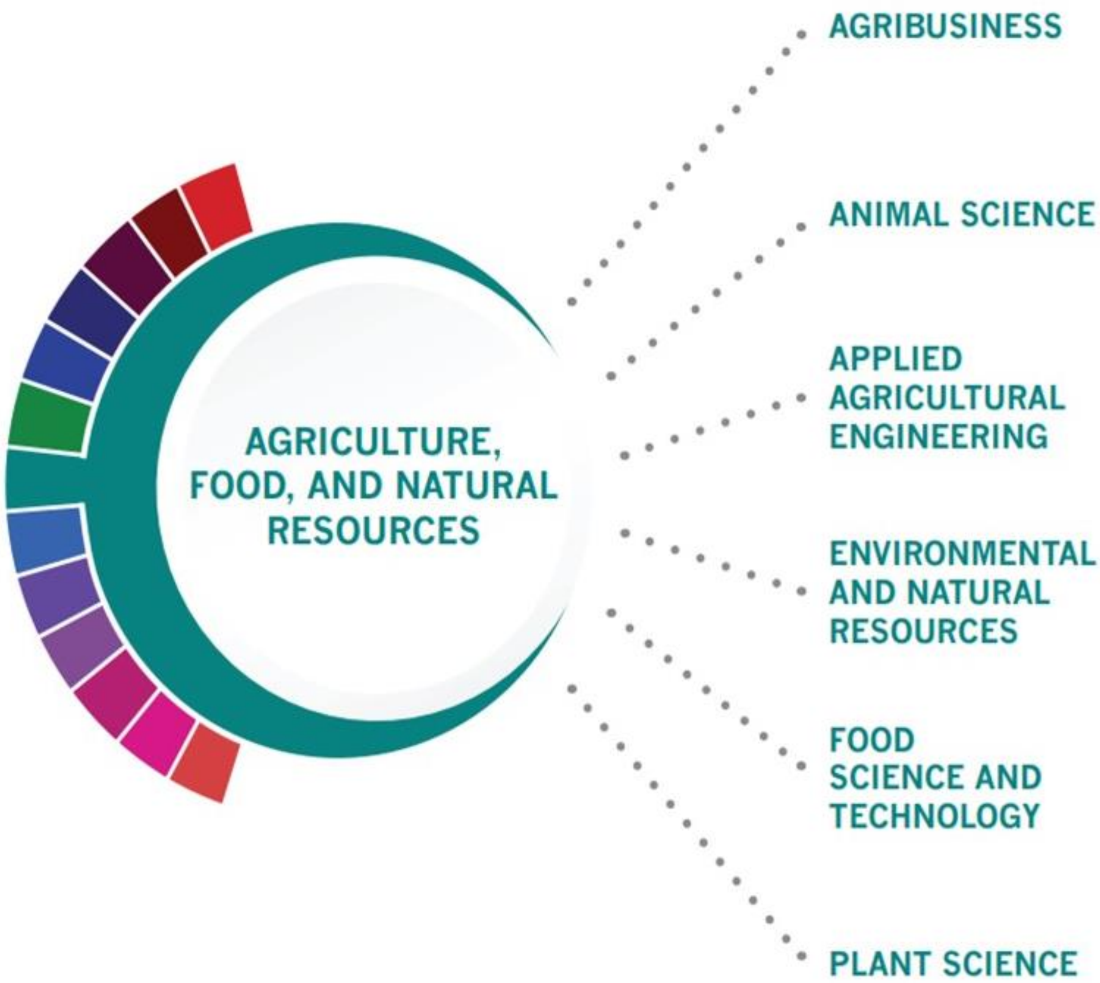


Figure 3

TX AFNR Programs of Study



Agricultural educator preparation programs

The preparation of agriculture teachers is a relatively young program in the history of academia and university programming. Specific training and university programs aimed at preparing secondary agriculture teachers began in the early part of the

20th century. The 16-year period leading up to the passage of the Smith-Hughes act of 1917 included foundational work for the monumental act (Hillison, 1987).

School-based agricultural education grew rapidly in the early 20th century. In the school year 1906-1907, it was reported that less than 100 public secondary schools offered secondary agriculture instruction. By the 1915-1916 school year, the number of schools offering agriculture instruction had increased to 3,675 schools with more than 73,000 students enrolled (True, 1929). The rapid growth quickly revealed a new challenge of sourcing qualified teachers in the field of agriculture. Bishop (1912) believed that the most pressing issue of the time was to source teachers with better training if school-based agricultural education was to survive in the United States.

Bricker (1914) identified four potential sources for secondary agriculture teachers: nature-study teachers, agricultural college graduates, high school science teachers, and individuals raised on farms. Critics including Bricker himself argued that using nature-study teachers would be a terrible mistake (Bailey, 1908; Bricker, 1914; Davenport, 1908). Concerns were raised regarding the use of college of agriculture graduates as teachers because it was believed that they lacked understanding of children, and possessed little to no skill in the methods of teaching (Bricker, 1914). Additionally, Bricker (1914), contrary to Bailey (1908), opposed the use of high-school science teachers as well, because high-school science teachers were versed in pure science but not in applied science, the basis of agriculture. Bricker (1914) criticized the thought or idea of using those individuals who possessed only the experience of being raised on a farm. He spoke harshly about the idea of allowing individuals with no formal training in education or agriculture to be secondary teachers of agriculture.

Limited options were available and great concern was presented regarding the qualifications of secondary agriculture teachers at the turn of the 20th century. Bricker (1914) proposed that teachers come from agricultural education departments within colleges of agriculture. Bricker (1914) stated, “They will come from *agricultural education departments* of our normal schools and agricultural colleges; and by the words in italics are meant those departments that give definite training in the theory and practice of teaching the subject in all grades of educational institutions including the elementary school and the college” (p. 121).

The 1907 Nelson Amendment would solidify the practice of preparing teachers specifically in the field of agricultural education (Hillison, 1987). The initial funding in 1908 provided each state with $25,000 annually to provide coursework to prepare teachers in the field of agricultural and mechanical arts (True, 1929). Land-grant institutions established under the Morrill Act of 1862 became a focal point of agricultural educator preparation programs (Hillison, 1987). By 1907, 26 state agricultural colleges offered coursework in preparing to teach secondary agriculture (True, 1929). There were variations between programs, and the level of intensity varied from courses offered lasting weeks to a full four-year program with an integrated curriculum throughout (True, 1929).

As agriculture teacher preparation programs began to fill the need for highly qualified and appropriately trained teachers, the Smith-Hughes Act of 1917 solidified and ensured the continuation of agriculture teacher preparation for many years (Hillison, 1987). However, the conversation about how to meet the demands for highly qualified secondary agriculture teachers would not soon dissipate.

Currently, mor than 13,000 teachers are located in 8,466 school-based agricultural education programs across the United States (Foster et al., 2020b). With 107 agriculture teacher education programs across the country, 16 of those programs are located in California and Texas (Foster et al., 2020b). The five institutions in California that prepare agriculture teachers are California State University Chico, California State University Fresno, Cal Poly Pomona, Cal Poly San Luis Obispo, and University of California Davis (Foster et al., 2020b). In Texas, the 11 institutions preparing agriculture teachers are Angelo State University, Sam Houston State University, Stephen F. Austin State University, Sul Ross State University, Tarleton State University, Texas A&M University, Texas A&M University Commerce, Texas A&M University Kingsville, Texas State University, Texas Tech University, and West Texas A&M University. In California, the five university-based teacher preparation programs prepared 76 students during the 2020 school year to teach secondary agriculture (Foster et al., 2020b). In 2020, Texas university-based agriculture teacher preparation programs prepared 154 students across the state to teach agriculture (Foster et al., 2020b).

Summary of the research and research gap

This chapter provided a literature review to fully describe previous research and policy regarding the topic of school-based agricultural education, the overall teacher shortage in the US, and teacher shortages in school-based agricultural education. The Topics in this section were the United States skills gap, the United States teacher shortage, the historical underpinnings of school-based agricultural education, the agricultural education teacher shortage, agriculture teacher recruitment and retention, the pathways within school-based agricultural education, and university-based educator preparation programs in agriculture.

As the United States skill gap continues to grow, the need for a skilled workforce becomes more and more apparent and critical Career technical education has been identified as a source to assist in training and developing a skilled workforce for the future. Specifically, the agriculture, food, and natural resource career cluster and CTE programs in agriculture serve to train and prepare students to enter the workforce with the skills needed for tomorrow's demands in agricultural industry. However, a growing AFNR teacher shortage continues to threaten the ability of local AFNR programs across the country to provide the needed education and training. As we investigate the AFNR teacher shortage, we must understand the pathways associated with the AFNR career cluster. Teacher preparation programs are tasked with supplying schools with qualified teachers who possess skill sets in the various pathways. A gap in the literature was identified in the area of agriculture teacher demand and, specifically, demand as it relates to pathways in the agriculture career cluster. Limited literature is available that focuses on the demand for teachers within specific pathways.

The gap between the specific demands for agricultural education teachers and the supply of those teachers is evident, and it has grown over time. Without proper planning to bridge this gap, the teacher shortage will continue. To bridge this gap, deeper understanding and identification of the specific demands within pathways in agricultural education are needed.

CHAPTER III

METHODS

The purpose of this study was to evaluate one portion of the secondary school-based agricultural education industry. Specifically, this study adds to the body of knowledge in the context of teacher shortages specific to pathways within the broad umbrella of the CTE career cluster of agriculture, food, and natural resources (AFNR). The purpose of this chapter is to identify and describe the research methods and procedures used. This study was a quantitative evaluation of CTE - AFNR programs, guided by two research objectives. The research objectives and questions, research design, target population and sampling procedures, data collection procedures, data analysis methods, and research standards compliance are described in this chapter.

Research Objectives and Questions

The established research objectives and questions for this study sought to further the body of literature and knowledge in the field of secondary school-based agricultural education. As presented in chapter two, teacher shortages are a widespread issue impacting schools across the U.S. Highlighted in the current body of literature and the comprehensive review conducted, teacher shortages are not all created equal. Therefore, it was necessary to study how pathways impact teacher shortages in the field of agriculture, food, and natural resources.

RO1.0 –

Research objective 1.0 was to describe, compare, and illustrate trends in CA and TX advertised AFNR job postings between 2011 and 2019. The following research questions were developed to address research objective 1.0.

RQ1.1 – What and how many AFNR teaching positions were advertised between 2011 and 2019 in CA and TX?

RQ1.2 – Were AFNR position advertisements different by pathway in CA FFA Regions and TX FFA Areas?

RQ1.3 – What AFNR pathways within positions were advertised by year?

RO2.0 –

Research objective 2.0 was to describe, compare, and illustrate the current status of AFNR teaching assignments by pathway in CA and TX.

RQ2.1 – What are selected demographic characteristics of AFNR teachers in CA and TX?

RQ2.2 – What are the current AFNR teaching assignments by pathway?

RQ2.3 – Are AFNR teacher assignments by pathway different in CA FFA Regions and TX FFA Areas?

RQ2.4 – What are AFNR teacher assignments by percentage of time spent within pathways in CA and TX?

RQ2.5 – What are teacher perceptions' of pathway growth at the local level in CA and TX?

Research Design

For this study, the authors incorporated multiple research methods as appropriate. The research methods included content analysis and survey methods in a single paradigm quantitative approach.

Content Analysis

In the initial phase of this study, I used a descriptive, cross-sectional content analysis to investigate the personnel needs of CTE programs. Content analysis is a preferred method for analyzing documents and text (Bryman, 2016). Specifically, content analysis is a structured approach with systematic and replicable procedures to capture quantitative data or qualitative themes from a text. The content analysis permits researchers to objectively, systematically, and quantitatively describe the contents of communications (Berelson, 1971; Krippendorff, 1980). I discuss the research questions and objectives used to guide this study in this section;. I report the results of the study in the subsequent chapter.

RO1.0 –

Identification of desired skill sets and pathways of concentration can best be observed in the advertised job postings by local education agencies (LEA). Therefore, I used a content analysis of communication materials, specifically job posting descriptions, to evaluate personnel needs for CTE programs. The content analysis procedures used in this study are guided and aligned with the recommendations described by Bryman (2016).

Survey Research

In the next phase of the research, I used a cross-sectional design following established survey research methods. Bryman (2016) posited that a cross-sectional design is the most common design used when collecting survey data. Survey research is often associated with the use of questionnaires and structured interviews. Dillman et al. (2014) noted that survey methods had evolved rapidly with society's quickly changing technology landscape. Electronic surveys through platforms such as Qualtrics assist in collecting responses, providing a more economical and more convenient manner to conduct survey research. However, new challenges are present, including digital saturation, impact response rates, and the risk of coverage error in electronic survey collection methods. The following information outlines the application of survey research specifically used in this study.

RO 2.0 –

Data sets were available from 2019 studies conducted with a sample of California and Texas AFNR teachers. The data sets were used to assist in describing the current status of CTE programs and perceptions of growth at the local level. The data sets included variables in the perception of growth, programmatic needs, and personnel assignments. The data sets were generated through survey research methods. The survey research was guided and conducted following Dillman's *Tailored Design Method* and the principles contained in the method framework (Dillman et al., 2014).

Target Population and Sampling Procedures

The target population of this study was AFNR teachers and hiring agents who posted AFNR position announcements. Specifically, samples and sampling procedures were broken down by research objectives as follows.

RO1.0

I used job postings from California and Texas in the content analysis portion of the study. Job postings were available in other states as well. However, for the purposes of this study and to maintain congruence in data sources, only job postings from California and Texas were included in the study. California State Polytechnic University–San Luis Obispo (Cal Poly SLO) managed job postings as a service to the profession in California. Public school administrators submitted job postings to be posted on a site maintained by Cal Poly SLO.

Additionally, I acquired job postings from the Vocational Agriculture Teachers Association of Texas (VATAT since renamed to ATAT). In Texas, the VATAT hosted the online job board as a service to the profession in Texas. Public school administrators submitted job postings on the VATAT site under the "Careers" tab. Job postings were available from 2011 to 2019 in both California and Texas. Inclusion and exclusion criteria ensured a compatible and consistent sample was obtained from the job postings. The inclusion and exclusion criteria were as follows:

1. Each position must be for a secondary AFNR position.
2. Each position must be for a position in California if it is in the data acquired for California or a position in Texas if it is in the data acquired for Texas.
3. A job position with no description will be excluded from the study.

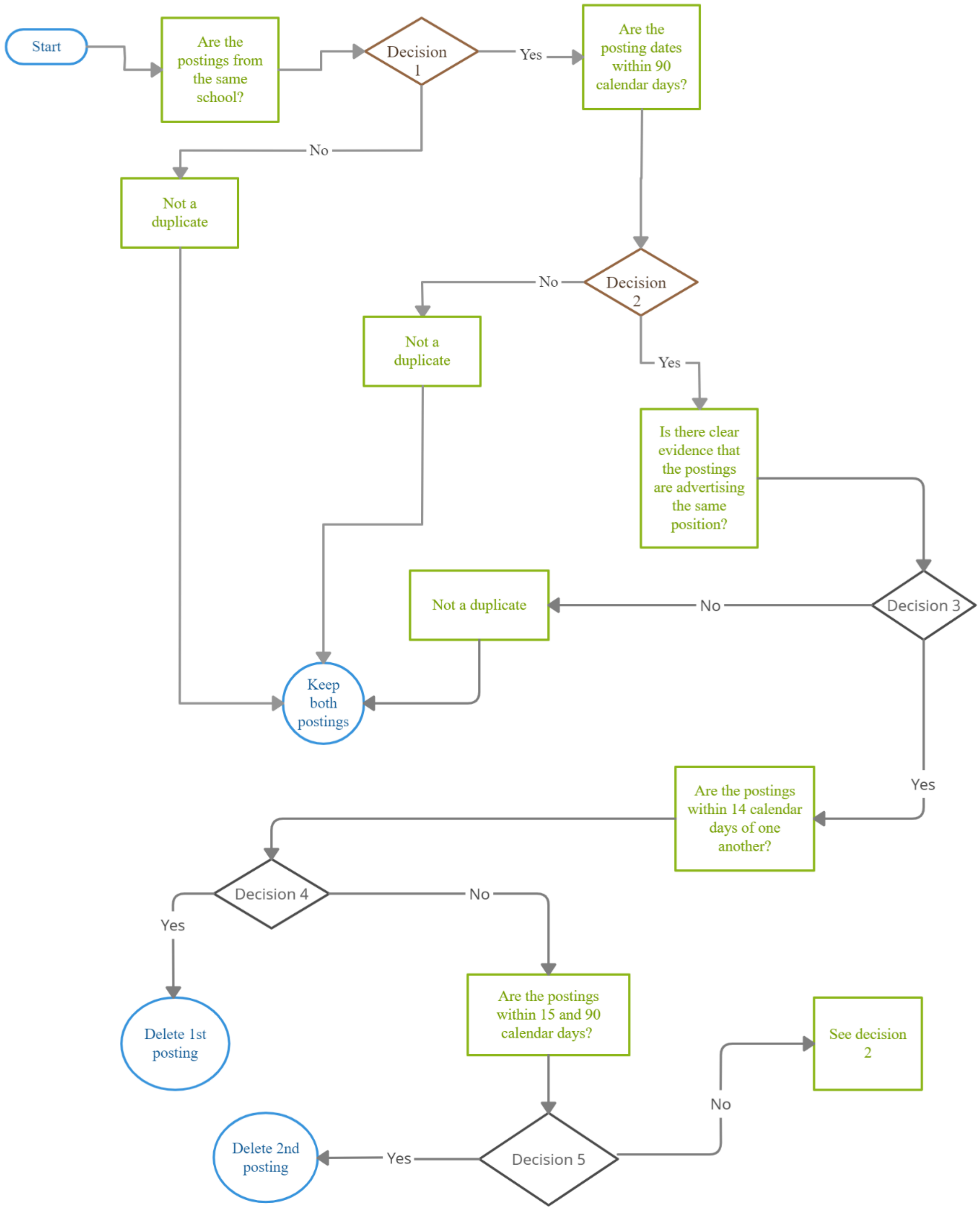
Duplicate job postings posed a threat to the validity of the data. The methods I used for cleaning duplicate job postings are outlined in this section. I developed three questions to assist in my eliminating duplicate postings:

1. Are the positions from the same school?
2. Are the positions posted within 90 calendar days?
3. Is there clear evidence that the positions are advertising the same position?

A “yes” answer for each of three questions was necessary to be considered a duplicate posting. I handled a duplicate posting using the following method. If a duplicate posting was posted within 14 calendar days based on the posting date, delete the 1st posting. This event was considered a repost with updated information. Secondly, if a duplicate posting was posted between 15 and 90 calendar days, delete the second posting. This event was considered a refreshed posting, still seeking a candidate for the first position. Therefore, to accurately reflect the original needs of the LEA, I deleted the second posting. Figure 3 provides a visual flowchart reference for the duplicate posting decision process.

Figure 4

Flowchart for Duplicate Position Decision Process



RO2.0

I collected data for RO2.0 from California (n = 462) and Texas (n = 1,279) secondary AFNR teachers. I used two inclusion criteria for participation in the survey research. First, active membership in the state's professional association, and second a participant must currently teach in a secondary school-based agricultural education position in CA or TX. Therefore, secondary school-based agricultural education teachers who held active membership in the California Agriculture Teachers Association (CATA) and the Vocational Agriculture Teachers Association of Texas (VATAT) in 2019 were included in the sampling frame.

The design of this study incorporated data collected from two different sources. The first source was the job postings from California and Texas; I used these data in the content analysis. The second source was survey data collected from AFNR teachers in California and Texas in 2019. The potential congruence or incongruence between these data sources provided an opportunity to contribute to the body of literature and the needs of the AFNR teaching field as they relate to AFNR teacher demand by pathway or program of study.

Research Objective 1.0

I analyzed job postings using content analysis. I developed a coding sheet and manual and used them to provide consistency in the content analysis procedures. An example of a coding schema used in the coding sheet is provided. For the complete coding schema, refer to Appendix C.

"Coding of a pathway-specific request in the position description.

For example variable J0003 shows the presence of a position description identifying agricultural business as a potential area of concentration. Suppose the position description specifies that the position available will or may be required to teach agricultural business. In that case, the variable is coded as a 1, which equals "yes." If the position description specifically indicates that agricultural business will not be an area of concentration, the variable is coded a two, which equals "no." If no mention of agricultural business is found in the job position description, the variable will be left blank, which equals "unknown."

Reliability

To test for inter-rater reliability, I provided a field expert with a coding schedule and coding manual and requested that they code 30 randomly selected job postings. The random selection was achieved by using a random number generator. Thirty numbers associated with the job postings for both California and Texas positions were drawn and compiled for the analysis of inter-rater reliability. A documentation sheet of the random number generator output is in Appendix D. According to Gisev et al. (2013), the most widely accepted method of calculating inter-rater agreement for this data type was the Kappa index. The Kappa index has values between -1 and +1, with a perfect agreement achieving a +1.00. The 0 value in the Kappa Index indicates that the level of agreement obtained can only be explained by chance. Gisey et al. (2013) provides six categories of inter-rater agreement of values of the Kappa index: from poor (index values <0.00) to almost perfect (index values of 0.81-1.00). (See Figure 5.)

Figure 5

Kappa Index Levels of Agreement
Note. Figure 5 was originally presented by Gisev et al. (2013)

Kappa	Interpretation
<0.00	Poor
0.00-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost perfect

Thus, I calculated a Kappa coefficient to determine inter-rater reliability. Kappa index values were calculated for both California and Texas positions. My coded values were compared with the industry expert. Because each of the Kappa index values was 0.86 or higher, I interpreted each of the inter-rater reliabilities to be a near-perfect agreement between me and the industry expert. Table 1 provides a summary of the observed Kappa values and the coefficient of determination (COD) for the California AFNR position advertisements. Table 2 provides a summary of the observed Kappa values and the coefficient of determination (COD) for the Texas AFNR position advertisements.

Table 1

Kappa Index – Inter-Rater Reliability for California Position Advertisements

	Kappa value	*COD*	*Agreement (percent)*
Agriscience	0.86	.74	74.0
Agricultural Mechanics	1.00	1.00	100.0
Animal Science	0.87	.76	76.0
Agribusiness	1.00	1.00	100.0
Ornamental Horticulture	0.92	.85	85.0
Plant and Soil Science	1.00	1.00	100.0
Forestry and Natural Resources	1.00	1.00	100.0

Note. A Kappa Coefficient was calculated using the procedures outlined by Gisev et al. (2013)

Table 2

Kappa Index – Inter-rater Reliability for Texas Position Advertisements

	Kappa value	*Agreement (percent)*
General AFNR	1.00	100.0
Applied Agricultural Engineering	0.93	97.2
Animal Science	0.92	94.5
Agribusiness	1.00	100.0
Food Science and Technology	1.00	100.0
Plant and Soil Science	1.00	100.0
Environmental and Natural Resources	1.00	100.0

Note. A Kappa Coefficient was calculated using the procedures outlined by Gisev et al. (2013)

Research Objective 2.0

Data from 2019 studies conducted at Texas A&M University served as the data for answering the research questions included in RO2.0. Variables included selected demographics, pathways of instruction, and perceptions of growth. Table 3 provides a summary of the identified variables, including variable coding references and variable type.

Table 3

Research Variables for RQ2.0

Variable Code	Variable Name	Type of Measurement
Demographics		
T0008	Age	Scale
T0009	Gender	Nominal
T0010	Years of experience	Scale
T0011	Region/Area	Nominal
Pathways currently teaching		
T0012_1	Agriscience	Nominal
T0012_2	Agricultural Mechanics	Nominal
T0012_3	Animal Science	Nominal
T0012_4	Ornamental Horticulture	Nominal
T0012_5	Agribusiness	Nominal
T0012_6	Plant and Soil Science	Nominal
T0012_7	Forestry and Natural Resources	Nominal
Time spent teaching in pathway		
T0013_1	Agriscience	Scale
T0013_2	Agricultural Mechanics	Scale
T0013_3	Animal Science	Scale

Table 3 continued

Variable Code	Variable Name	Type
T0013_4	Ornamental Horticulture	Scale
T0013_5	Agribusiness	Scale
T0013_6	Plant and Soil Science	Scale
T0013_7	Forestry and Natural Resources	Scale
T0013_8	Administrative Duties	Scale
Perceptions of growth		
T0020_1	Agriscience	Ordinal
T0020_2	Agricultural Mechanics	Ordinal
T0020_3	Animal Science	Ordinal
T0020_4	Ornamental Horticulture	Ordinal
T0020_5	Agribusiness	Ordinal
T0020_6	Plant and Soil Science	Ordinal
T0020_7	Forestry and Natural Resources	Ordinal

Note. Variable codes were assigned a priori during instrument design. A variable coding scheme was created to distinguish variables during data collection and analyses. Codes do not imply importance nor order. A preliminary list of variables is included in the appendices.

File Management

I acquired the raw data files from California Polytechnical State University San Luis Obispo, the Vocational Agricultural Teachers Association of Texas, and survey responses from teachers through the Qualtrics platform. Raw data files containing the survey responses were acquired and saved in a master data file. I saved the raw data files separately to maintain the integrity of the files. The master files provide for future reference and possible replication of the study to validate the findings.

Data Cleaning

I cleaned the working data files based on the recommendations and the framework of Osborne (2013). Specifically, the first step in cleaning the data was screening for problems in the data set. The variables of interest in this study were nominal. Therefore, a chi-square analysis was used to determine if there were differences in the sample. A description of the process for determining if the sample data from California and Texas could be pooled and analyzed or if it needed to be analyzed separately is included in this chapter. The second step in data cleaning was handling missing or incomplete data. Respondent demographics were compared between those who responded and those with missing data. The third step in the data cleaning process was to address extreme or influential values. Human error in the completion of survey questionnaires contributes to considerable portions of observed data errors. Extreme scores that could be accurately corrected and identified, were corrected. If not, the value was not included in the final analysis. No such extreme values existed in these data.

Non-response Error

Dillman et al. (2014) described the four cornerstones of survey research as coverage error, sampling error, measurement error, and non-response error. The method chosen to test for non-response error was a comparison of late respondents with early respondents (Lindner et al., 2001). Respondents in the final wave of responses are to be classified as late respondents and compared with the remaining responses classified as early respondents. A minimum of 30 respondents is required in the last wave to conduct the analysis. Additional methods for reliability and non-response error are available. Therefore, split-half reliability an alternative method, described by Lindner et al. (2001), was used to test for non-response error. Respondents were divided in half based on the instrument completion date. The latter half of the respondents were compared against the earlier respondents. A chi-square analysis was used to test statistically significant differences between early and late respondents. The chi-square analysis was completed using SPSS v.28.

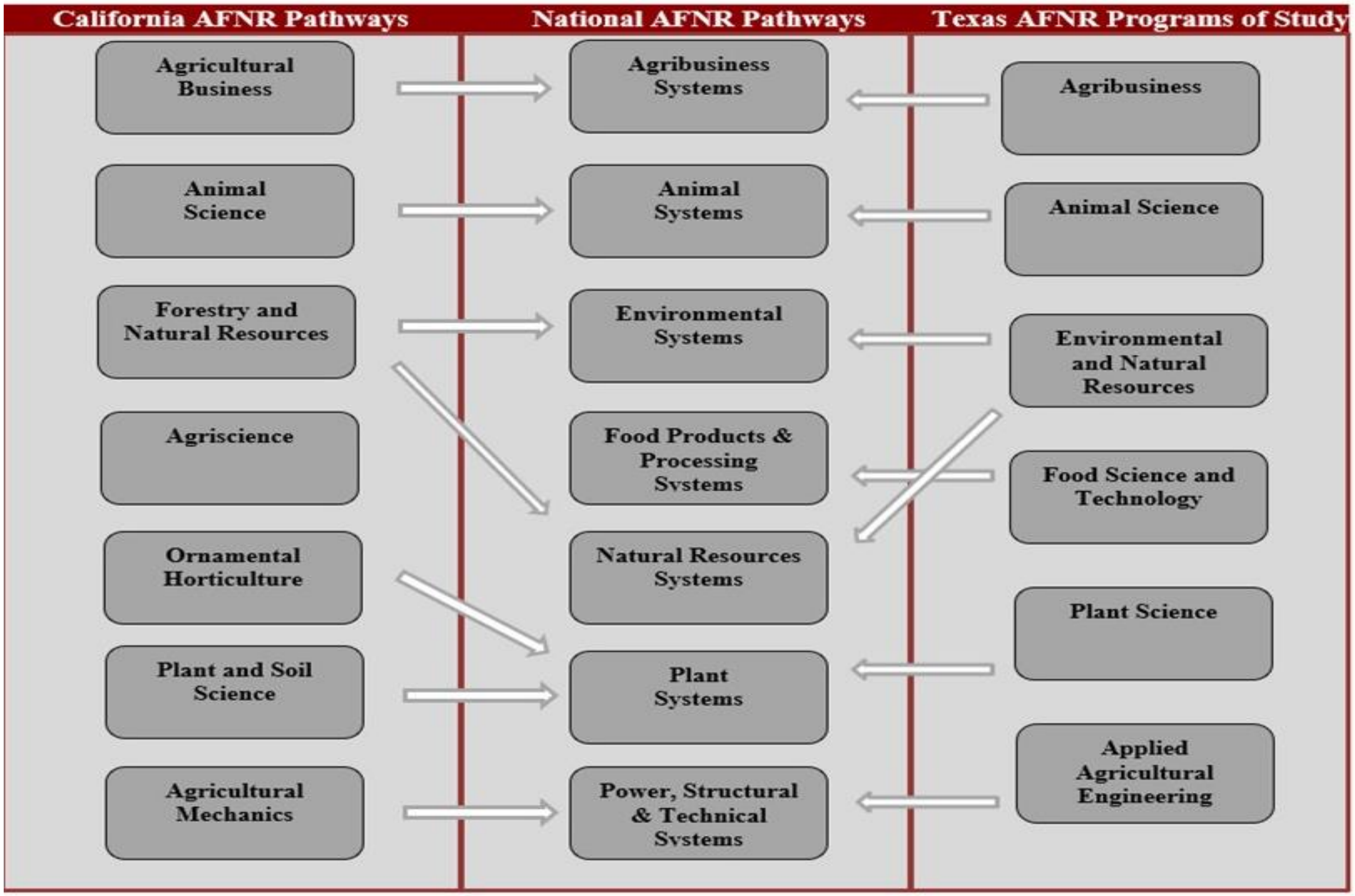
A chi-square analysis was completed separately for each of the pathways in California and Texas. In California, no statistical significance was observed at the .05 level between early and late respondents. Therefore, the data were pooled and analyses were conducted as described. In Texas, no statistical significance was observed at the .05 level between early and late respondents. Therefore, the data were pooled and analyses were conducted as described in this chapter. Because research has shown that late respondents are similar to non-respondents, and no differences were found between early and late respondents, I assumed that there was no non-response bias and, thus, our sample is representative of our target population.

Comparison of state data

Comparisons of California and Texas were not conducted in this study. Given the differences in frameworks for pathways, comparative analyses were not appropriate in this study. Specifically, the six AFNR pathways in California aligned marginally with the six pathways in Texas. That is, four of the six pathways in California and Texas are analogous. However, the other two are not. Figure 6 illustrates the congruence and incongruence between California pathways and Texas programs of study. As presented in the figure, considerable congruence is present between several of the pathways. However, incongruence is present in others. The presence of this incongruence prevented the researchers from conducting direct comparisons between California and Texas within the scope of this study.

Figure 6

AFNR Crosswalk Between California, Texas, and National Frameworks



Data Sources

The data used to answer the research questions to be answered in achieving research objective 1.0 were advertised job postings in CA and TX. Job announcements posted between 2011 and 2019 provided the data for the content analysis. The position announcements differed in the level of detail because of individual local education agency policies that govern position announcements. The inclusion and exclusion criteria described previously guided the research process of developing a final sample for research objective 1.0.

The data used to answer research questions in achieving research objective 2.0 were survey responses of secondary school-based agricultural education teachers from CA and TX. The survey responses were collected during 2019 as a part of a larger research project in which I participated. The inclusion and exclusion criteria described previously guided the research process of developing a final sample for research objective 2.0.

Data Collection

Data collection procedures for research questions within research objective 1.0 included securing archival job posting announcements from CA and TX. CA secondary school-based agricultural education position announcements were managed and archived by California Polytechnical State University-San Luis Obispo. Specifically, the Department of Agricultural Education manages the data associated with position announcements. The secondary school-based agricultural education position announcements in Texas are managed and archived by the Vocational Agricultural Teachers Association of Texas (VATAT)—now the Agricultural Teachers Association of Texas (ATAT).

The data files containing job posting announcements were secured from official representatives of each organization. I stored the original files received from the organizations separately from the working files used to conduct this research study. I provide further information regarding file management and security later in this chapter.

Data Analysis

Data analysis for this study used statistical procedures aligned with generally accepted practices in the field. The analysis of each data component was conducted in a manner consistent with IRB protocols and university guidelines. Raw data is stored in room 245 of the AGLS building. Data in electronic form was stored on password-protected computing machines. Data will be shared only with members of the research team. Data analysis was conducted using SPSS software and Microsoft Excel.

RO1.0

Research objective 1.0 was to describe the personnel needs and trends of AFNR programs between 2011 and 2019. Content analysis of job posting descriptions provided the most robust analysis to determine the personnel needs of AFNR programs.

Data sets were classified on an annual basis. Due to the limitations of available data, the annual cycle starts on November 1 of the previous year. Therefore, all position announcements posted between November 1 and the following October 31 were included in a single data set. For example, all positions posted between November 1, 2011, and October 31, 2012, were separated for initial coding. All of the positions in that data set were given a posting year code of 2012. This process was necessary because the CA data was provided in this format. That is, the position announcements were stored in a data file simply with the posting year code—and not an exact date of posting. TX data was provided with all positions in a single file that included the date of each posting. Therefore, it was necessary to separate the data in the same manner for both CA and TX ensuring appropriate analysis could be conducted for the posting year variable.

The coding process of the job descriptions used seven variables for the seven pathways identified for CA. The variables were coded separately for CA and TX because of differences in nomenclature ("pathways" versus "programs of study") and content (seven pathways versus six programs of study). Additionally, variables were created for posting ID, posting year, state code, CA FFA Region, TX FFA Area, and Full-Time Equivalent (FTE).

Table 4

Research Variables for RO1.0

Variable Code	Variable Name	Type
Demographics		
J0001	Posting ID	Nominal
J0002	Posting Year	Nominal
P0003	State Code	Nominal
P0050	CA FFA Region	Nominal
P0051	TX FFA Area	Nominal
J0019	FTE	Scale
Pathway(s) advertised in posting		
J0003_1	CA Agricultural Business	Nominal
J0003_2	TX Agricultural Business	Nominal
J0004_1	CA Agricultural Mechanics	Nominal
J0004_2	TX Applied Agricultural Engineering	Nominal
J0005_1	CA Agriscience	Nominal
J0005_2	TX General AFNR	Nominal
J0006_1	CA Animal Science	Nominal
J0006_2	TX Animal Science	Nominal
J0007_1	CA Forestry and Natural Resources	Nominal
J0007_2	TX Environmental and Natural Resources	Nominal

Table 4 continued

J0008_1	CA Ornamental Horticulture	Nominal
J0008_2	TX Food Science and Technology	Nominal
J0009_1	CA Plant & Soil Science	Nominal
J0009_2	TX Plant Science	Nominal

Note. Variable codes were assigned a priori during instrument design. A variable coding scheme was created to distinguish variables during data collection and analyses. Codes do not imply importance or order. A list of variables is included in Appendix D.

Table 5

Data Analysis Plan

Research Question	Data Sources	Data Analysis
RQ 1.1	SBAE Position Announcements	Descriptive Statistics
RQ 1.2	SBAE Position Announcements	Chi Square
RQ 1.3	SBAE Position Announcements	Descriptive Statistics
RQ 2.1	Teacher Survey Responses	Descriptive Statistics
RQ 2.2	Teacher Survey Responses	Descriptive Statistics
RQ 2.3	Teacher Survey Responses	Chi Square
RQ 2.4	Teacher Survey Responses	Descriptive Statistics
RQ 2.5	Teacher Survey Responses	Mean Score

Note. Variable codes were assigned a priori during instrument design. A variable coding scheme was created to distinguish variables during data collection and analyses. Codes do not imply importance or order. A preliminary list of variables is included in the appendices.

RQ1.1

Research question 1.1 was addressed by describing posted AFNR positions in CA and TX between 2011 and 2019. Descriptive statistics (frequencies and percentages) were used to analyze and describe posted AFNR positions in CA and TX between 2011 and 2019. Frequencies and percentages were calculated using the variables outlined in the RQ1.0 variable coding sheet. State, FFA region, FFA area, FTE, Posting Year, and advertised pathway(s) variables all contribute to the description of the AFNR advertised job postings.

RQ1.2

Research question 1.2 was addressed by examining AFNR position pathways by CA FFA Region and TX FFA Area. A chi-square (χ^2) test of independence was used to examine the relation between advertised position pathways (J0003_1 through J0009_2) and region (P0050) or area (P0051).

RQ1.3

Research question 1.4 was addressed by illustrating AFNR position trends between 2011 and 2019 by pathway. Descriptive statistics including frequencies and percentages were used to analyze and describe posted AFNR positions in CA and TX between 2011 and 2019. Frequencies and percentages were used to examine advertised position pathways (J0003_1 through J0009_2) and posting year (J0002).

In this study, I used the chi-square statistical analysis to compare nominal groups of data. Given the not mutually exclusive nature of position pathway indications, an individual chi-square analysis was conducted for each of the identified pathways. It is important to note that the repeated chi-square measurements of the same subjects violate the assumption that the observations are independent. Caution should be exercised when interpreting the results of this study.

RO2.0

Research objective 2.0 was to identify and describe the current status of CTE programs and compare personnel assignments. Descriptive statistics form the basis of understanding for the remaining analysis. The first goal was to understand the respondents and critical factors about the respondents. The typical respondent was classified by region or area membership, years of teaching experience, age, and gender.

RQ2.1

Research question 2.1 was to answer demographic characteristics of AFNR teacher respondents. Descriptive statistics (frequencies and measures of central tendency) were used to describe the respondents.

RQ2.2

Research question 2.2 was answered by describing current agriculture teacher assignments by pathway. The California Department of Education (2017) breaks the AFNR career cluster into seven pathways: agriscience, agricultural mechanics, animal science, ornamental horticulture, agribusiness, plant and soil science, and forestry and natural resources. In Texas, the Texas Education Agency (2019) divides the AFNR career cluster into seven pathways: agribusiness, animal science, applied agricultural engineering, food science, and technology, environmental and natural resources, plant science, and general AFNR.

Respondents were asked to indicate pathways in which they were currently assigned to teach and the percentage of time they spent instructing in each pathway. An "administrative duties" category was added to the list. Respondents' selection of pathways they currently are assigned to is a nominal variable. The most appropriate analysis for this variable was frequency distribution and percentages because these were nominal variables.

RQ2.3

Research question 2.3 was answered by comparing personnel pathway assignments by CA FFA Region and TX FFA Area. Descriptive statistics were calculated to observe pathway assignments (T0012_1 through T0012_7) by region (P0005) and area (T0005_3) using cross tabs. A chi-square (χ^2) test of independence was used to examine the relationship between pathway assignment (T0012_1 through T0012_7) and region (P0005) or area (T0005_3).

In this study, I used the chi-square statistical analysis to compare nominal groups of data. Given the not mutually exclusive nature of teacher assigned pathways, an individual chi-square analysis was conducted for each of the identified pathways. It is important to note that the repeated chi-square measurements of the same subjects violate the assumption that the observations are independent. Caution should be exercised when interpreting the results of this study.

RQ2.4

Research question 2.4 was best addressed by describing and comparing the time teachers spend teaching in each pathway daily. Respondents were asked to indicate what percentage of their teaching day did they spend teaching in each of the pathways. Descriptive statistics, including frequencies, percentages, and measures of central tendencies were used to describe and compare time spent teaching in the different pathways.

RQ2.5

Research question 2.5 was addressed by describing the perceptions of growth in CTE programs at the local level. Respondents were asked to rank the seven pathways in order by fastest-growing to the pathway with the least amount of growth in their local communities. Respondents were able to drag and drop the pathways into the desired rank order. A mean score analysis was conducted to determine the overall rank order.

Research Standards Compliance

Careful consideration was taken to ensure that this study was completed in accordance with all applicable regulations. As recommended by the National Academies of Science, Engineering, and Medicine, respect for individuals, care, and impartiality were addressed to ensure this research study followed ethical procedures. Before conducting research activities associated with this study, the Institutional Review Board (IRB) at Texas A&M University was notified and the appropriate applications were completed. Survey data from previous studies were used as one part of this study; the researchers in that study secured IRB approval (TAMU IRB2013-0109D). The content analysis portion of this study received a non-human subjects' determination from the Texas A&M University IRB (TAMU IRB2018-1306). The IRB approval documentation can be found in Appendices A and B.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

Like many other subject areas in the education field, school-based agricultural education is experiencing a continuing teacher shortage. Extensive literature addresses the AFNR teacher shortage dating back to the turn of the 20th century (Camp, 2000; Camp et al., 2002; Foster et al., 2014, 2015; Kantrovich, 2007, 2010; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; True, 1929; R. Weaver, 2000; Woodin, 1967). However, no research specifically addresses the demand for school-based agricultural education teachers by specific pathway or program of study. To more fully understand the teacher shortage in agriculture, I initiated a deeper dive of demand for SBAE teachers. The purpose of this study was to evaluate the demand for specific pathways included in AFNR position advertisements and current teacher assignments by AFNR pathways as it relates to personnel needs of secondary AFNR programs. I addressed the following research objectives and questions in this study:

RO1.0 –

Research objective 1.0 aimed to describe, compare, and illustrate trends in CA and TX advertised AFNR job postings between 2011 and 2019. The following research questions were used to support research objective 1.0.

RQ1.1 – Describe AFNR positions advertised between 2011 - 2019 in CA and TX.

RQ1.2 – Are AFNR position advertisements different by pathway in CA FFA Regions and TX FFA Areas?

RQ1.3 – Describe AFNR pathways within positions advertised by year.

RO2.0 –

Research objective 2.0 aimed to describe, compare, and illustrate the current status of AFNR teaching assignments by pathway in CA and TX.

RQ2.1 – Describe the demographic characteristics of AFNR teachers in CA and TX.

RQ2.2 – Describe current AFNR teaching assignments by pathway.

RQ2.3 – Are AFNR teacher assignments by pathway different in CA FFA Regions and TX FFA Areas?

RQ2.4 – Describe AFNR teacher assignments by time spent within pathways in CA and TX.

RQ2.5 – Describe teacher perceptions of pathway growth at the local level in CA and TX.

Research Objective 1.0

RQ1.1

The focus of research question 1.1 was to describe AFNR positions advertised between 2011 and 2019 in California and in Texas. Of all the positions advertised in California and Texas between 2011 and 2019 (N = 3,289), a significant majority of the positions were advertised in Texas (n = 2,582) when compared to California (n = 707). Greater descriptive detail is provided in Table 6

Table 6

Frequency Distribution of Advertised AFNR Positions by State

		f	%
Valid	California	707	21.5
	Texas	2582	78.5
Missing		0	0.0
Total		3289	100.0

Note. No missing values for state data. All positions provided for the study had state association information.

Advertised positions in California and Texas were grouped by CA FFA Region (Central, North Coast, San Joaquin, South Coast, Southern, and Superior) and Texas FFA Area (Areas 1-10). The Texas FFA Association participated in an area realignment at the end of the 2017–2018 school year. All positions advertised after the FFA Area realignment were recoded to align with the old/previous FFA Area alignment.

The modal California AFNR position advertised was in the San Joaquin Region (n = 214), between November 1, 2014, and October 31, 2015 (n = 130). A summary of advertised AFNR positions in California is reported in Table 7.

Table 7

Summary of Advertised AFNR Positions in California

	f	%
California FFA Region		
Central Region	189	26.7
North Coast Region	58	8.2
San Joaquin Region	214	30.3
South Coast Region	101	14.3
Southern Region	84	11.9
Superior Region	61	8.6
Posting Year		
2012	54	7.6
2013	89	12.6
2014	101	14.3
2015	130	18.4
2016	112	15.8
2017	91	12.9
2018	54	7.6
2019	76	10.7

The modal Texas AFNR position advertised was in Area 3 (n = 488), between November 1, 2018, and October 31, 2019 (n = 130). A summary of advertised AFNR positions in Texas is reported in Table 8.

Table 8

Summary of Advertised AFNR Positions in Texas

	f	%
TX FFA Area		
Area 1	153	5.9
Area 2	177	6.9
Area 3	488	18.9
Area 4	170	6.6
Area 5	299	11.6
Area 6	263	10.2
Area 7	321	12.4
Area 8	310	12.0
Area 9	256	9.9
Area 10	145	5.6
Posting Year		
2012	219	8.5
2013	279	10.8
2014	339	13.1
2015	343	13.3

Table 8 continued

2016	322	12.5
2017	341	13.2
2018	357	13.8
2019	382	14.8

Advertised AFNR positions in California and Texas were coded to address full and part-time positions in each state. A scaled variable was used to indicate the percentage of a 1.0 Full-Time Equivalent (FTE). Temporary positions such as long-term substitute positions seeking to fill in for maternity leave were coded separately. The modal California AFNR position was a full-time 1.0 FTE position (n = 616) and the modal Texas AFNR position was a full-time 1.0 FTE position (n = 2,566). A summary of FTE data is illustrated in Table 9.

Table 9

Summary of Advertised AFNR Positions by FTE

	N = 3289	
	f	%
California		
0.20 FTE	1	0.14
0.40 FTE	6	0.85
0.50 FTE	10	1.40
0.57 FTE	1	0.14
0.60 FTE	1	0.14
0.66 FTE	1	0.14
0.67 FTE	1	0.14
0.72 FTE	1	0.14
0.80 FTE	5	0.70
1.00 FTE	616	87.13
Temporary	57	8.10
Texas		
0.50 FTE	2	0.07
1.00 FTE	2566	99.38
Temporary	14	0.54

In the content analysis process of advertised AFNR positions, positions were coded based upon desired or requested AFNR pathways that a potential candidate should be willing and able to teach. Of the California advertised AFNR positions, the agriscience pathway was the most requested ($n = 426$). In Texas the most requested pathway was applied agricultural engineering ($n = 1,093$). A summary of requested AFNR pathways in position advertisements between 2011 and 2019 is provided in Table 10.

Table 10

Summary of Advertised AFNR Positions in California and Texas

	N = 3289	
	f	%
CA AFNR Pathway (*n* = 707)		
Agricultural Business	49	6.9
Agricultural Mechanics	288	40.7
Agri-Science	426	60.3
Animal Science	166	23.5
Forestry and Natural Resources	12	1.7
Ornamental Horticulture	137	19.4
Plant and Soil Science	105	14.9
TX AFNR Pathway (*n* = 2582)		
Agricultural Business	39	1.5
Applied Agricultural Engineering	1093	42.3
General AFNR	503	19.5
Animal Science	582	22.5
Environmental and Natural Resource	256	9.9
Food Science and Technology	40	1.5
		17.1
Plant and Soil Science	441	

Position advertisements are not exclusive in terms of requesting specific pathways of emphasis. Local education agencies advertise positions indicating the needs of the specific position. In many cases, it was observed that advertised positions requested more than one pathway or focus area for the specific job advertised.

In California, 707 positions were advertised between 2011 and 2019. Of the 707 positions, 86 position advertisements made no specific request for pathways of focus or experience. The typical position advertisement in California specified just one pathway of focus or experience (n = 287). Measures of central tendency were computed to summarize the data for the number of pathways selected per position advertisement in California. Measures of dispersion were computed to understand the variability for the number of pathways selected per position advertisement in California. The following are the results of this analysis: N = 707, M = 1.67, SD = 1.16. Most position advertisements indicated one or two pathways. Based on the relatively small standard deviation, the number of pathways selected per position advertisement in California was that same one or two pathways.

In Texas, 2,582 positions were advertised between 2011 and 2019. Of the 2,582 positions, 872 position advertisements made no specific request for pathways of focus or experience/expertise. The typical position advertisement in Texas specified one pathway of focus or experience (n = 973). Measures of central tendency were computed to summarize the data for the number of pathways selected per position advertisement in Texas. Measures of dispersion were computed to understand the variability for the number of pathways selected per position advertisement in Texas. The following are the results of this analysis: N = 2,582, M = 1.14, SD = 1.15. Most position advertisements selected one pathway. The higher number of positions advertised in Texas that did not specify a pathway contributes to the lower mean score. Based on the relatively small standard deviation, the number of pathways selected per position advertisement in Texas was most frequently none or one. Table 11 provides further detail of the specification called for in AFNR positions in California and Texas between 2011 and 2019.

Table 11

Summary of AFNR Position Advertisement Specificity in California and Texas

	N = 3,289	
	f	%
Number of CA AFNR Pathways Indicated (*n* = 707)		
0 Pathways Selected	86	12.2
1 Pathway Selected	287	40.6
2 Pathways Selected	175	24.8
3 Pathways Selected	106	15.0
4 Pathways Selected	37	5.2
5 Pathways Selected	16	2.3
Number of TX AFNR Pathways Indicated (*n* = 2582)		
0 Pathways Selected	872	33.8
1 Pathway Selected	973	37.7
2 Pathways Selected	366	14.2
3 Pathways Selected	262	10.1
4 Pathways Selected	87	3.4
5 Pathways Selected	17	0.7
6 Pathways Selected	5	0.2

Implications of RQ1.1

Research question 1.1 sought to describe positions advertised for AFNR positions in California and Texas. Through the analysis of the available data I found the following to be notable implications for research question 1.1. The following section will outline the practical impacts of the data revealed to the authors.

California and Texas are the two largest states in the National FFA Organization in terms of student membership (Meyer, 2020). The number of positions advertised between Texas and California is consistent with the number of programs found in each state. In California, 707 positions were advertised between 2011 and 2019 which represents 27.4% of the number of positions advertised in Texas during the same period. This figure aligns with the research reported by Foster et al. (Foster et al., 2020a, 2020c) that California employs approximately 38.0% of the number of AFNR teachers employed in Texas on an average between 2015 and 2020.

As population densities shift in large areas such as California and Texas student enrollment and the need for teachers is expected to differ as well. California and Texas each have FFA regions and areas that are more populous than others. In California, the Central and San Joaquin regions account for 57% of all the positions advertised between 2011 and 2019. In Texas, Areas 3, 7, and 8 account for 43.3% of all the positions advertised between 2011 and 2019. The incongruence in the number of teachers is driven by population shifts, and student enrollment. The incongruence (number of job postings by area) found in job posting advertisements is supported by the Texas FFA

Association's (2016) realignment report that realigned the Texas FFA Areas beginning in the 2018-2019 school year.

Similar to other supply and demand studies in school-based agricultural education, part-time positions, any position less than 1.0 FTE, made up less than 4% in California and less than 1% in Texas. It is important to note that California position advertisements did include approximately 8% of positions that were deemed temporary (e.g., long-term sub, maternity leave). The low percentage of part-time positions is supported in the literature for much of the past half century's supply and demand studies (Camp, 2000; Camp et al., 2002; Craig, 1981; Foster et al., 2014, 2015, 2020c, 2020a; Kantrovich, 2007, 2010; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; Woodin, 1967).

Position advertisements in California and Texas were coded for pathway-specific skill or assignment requests. In California, over 55% of advertised positions requested that candidates be willing and able to teach in agriscience or agricultural mechanics. In Texas, over 42% (n = 1,093) of advertised positions requested that candidates be willing and able to teach in the applied agricultural engineering pathway. Animal Science was the second most requested pathway with 19.7% (n = 582) of position advertisements seeking a candidate in this pathway. No literature directly explores position advertisements by pathway in AFNR. However, the findings do support the anecdotal evidence of difficulty in hiring (i.e., large demand compared to supply) qualified teachers in the applied agricultural engineering field.

RQ 1.2

Research question 1.2 aimed to compare AFNR position pathway advertisements by California FFA region and Texas FFA area. Position advertisements were compared within each pathway in the different FFA regions and areas. The null hypothesis was that there would be no difference in the number of positions advertised for specific pathways between CA FFA regions or TX FFA areas. California and Texas were not compared due to the significant differences in size and programs.

A Chi-square test of independence (3 x 10) was calculated comparing the frequency of positions advertised for applied agricultural engineering (1) between TX FFA Areas. A significant interaction was found between TX FFA Areas (χ^2 *(*18, 2582*) = 93.73, p* < .001*).* A contingency coefficient (C = .187, *p* < .001) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, TX FFA Areas 3, 4, and 6 observed more positions advertised for applied agricultural engineering (1) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 1, 5, and 10 observed fewer positions advertised for applied agricultural engineering (1) than expected based on the Chi-square analysis. Table 12 provides further detail of the Chi-square analysis completed.

Table 12

Chi-Square Analysis to Examine Differences in Applied Agricultural Engineering (1) Position Request by TX FFA Area

		Total N = 2582		No Pathway Requested N = 872		Pathway (1) Selected N = 1093		Pathway (1) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Area 1	Observed	153	5.9	86.0	56.2	54.0	35.3	13.0	8.5	
	Expected			51.7	33.8	64.8	42.3	36.6	23.9	
Area 2	Observed	177	6.9	75.0	42.4	79.0	44.6	23.0	13.0	
	Expected			59.8	33.8	74.9	42.3	42.3	23.9	93.73*
Area 3	Observed	488	18.9	128.0	26.2	217.0	44.5	143.0	29.3	
	Expected			164.8	33.8	206.6	42.3	116.6	23.9	
Area 4	Observed	170	6.6	58.0	57.4	83.0	48.8	29.0	17.1	
	Expected			57.4	33.8	72.0	42.3	40.6	23.9	

Table 12 continued

Area 5	Observed	299	11.6	107.0	35.8	100.0	33.4	92.0	30.8
	Expected			101.0	33.8	126.6	42.3	71.4	23.9
Area 6	Observed	263	10.2	69.0	26.2	129.0	49.0	65.0	24.7
	Expected			88.8	33.8	111.3	42.3	62.8	23.9
Area 7	Observed	321	12.4	106.0	33.0	140.0	43.6	75.0	23.4
	Expected			108.4	33.8	135.9	42.3	76.7	23.9
Area 8	Observed	310	12.0	105.0	33.9	127.0	41.0	78.0	25.2
	Expected			104.7	33.8	131.2	42.3	74.1	23.9
Area 9	Observed	256	9.9	85.0	33.2	110.0	43.0	61.0	23.8
	Expected			86.5	33.8	108.4	42.3	61.2	23.9
Area 10	Observed	145	5.6	53.0	36.6	54.0	37.2	38.0	26.2
	Expected			49.0	33.8	61.4	42.3	34.6	23.9

* $p < .05$

A Chi-square test of independence (3 x 10) was performed examining the frequency of positions advertised for general AFNR (2) (e.g., Principles of AFNR, Practicum) between TX FFA Areas. A significant interaction was found between TX FFA Areas (χ^2 (18, 2582) = 85.24, p < .001). A contingency coefficient (C = .179, p < .001) described a small association between area and specification of pathway(s) in the job announcement. Specifically, TX FFA Areas 3, 6, 8, and 9 observed more positions advertised for general AFNR (2) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 1, 2, and 5 observed fewer positions advertised for general AFNR (2) than expected based on the Chi-square analysis. Table 13 provides further detail of the Chi-square analysis completed.

Table 13

Chi-Square Analysis to Examine Differences in General AFNR (2) Position Request by TX FFA Area

		Total N = 2582		No Pathway Requested N = 872		Pathway (2) Selected N = 1093		Pathway (2) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Area 1	Observed	153	5.9	86.0	56.2	5.0	3.3	62.0	40.5	
	Expected			51.7	33.8	29.8	19.5	71.5	46.7	
Area 2	Observed	177	6.9	75.0	42.4	20.0	11.3	82.0	46.3	
	Expected			59.8	33.8	34.5	19.5	82.7	46.7	85.24*
Area 3	Observed	488	18.9	128.0	26.2	112.0	23.0	248.0	50.8	
	Expected			164.8	33.8	95.1	19.5	228.1	46.7	
Area 4	Observed	170	6.6	58.0	57.4	30.0	17.6	82.0	48.2	
	Expected			57.4	33.8	33.1	19.5	79.5	46.7	

Table 13 continued

Area 5	Observed	299	11.6	107.0	35.8	52.0	17.4	140.0	46.8
	Expected			101.0	33.8	58.2	19.5	139.8	46.7
Area 6	Observed	263	10.2	69.0	26.2	56.0	21.3	138.0	52.5
	Expected			88.8	33.8	51.2	19.5	122.9	46.7
Area 7	Observed	321	12.4	106.0	33.0	64.0	19.9	151.0	47.0
	Expected			108.4	33.8	62.5	19.5	150.1	46.7
Area 8	Observed	310	12.0	105.0	33.9	67.0	21.6	138.0	44.5
	Expected			104.7	33.8	60.4	19.5	144.9	46.7
Area 9	Observed	256	9.9	85.0	33.2	66.0	25.8	105.0	41.0
	Expected			86.5	33.8	49.9	19.5	119.7	46.7
Area 10	Observed	145	5.6	53.0	36.6	31.0	21.4	61.0	42.1
	Expected			49.0	33.8	28.2	19.5	67.8	46.7

* $p < .05$

A Chi-square test of independence (3 x 10) was performed to examine the frequency of positions advertised for animal science (3) by TX FFA Areas. A significant relationship was found for the frequency of animal science positions and TX FFA Areas (χ^2 (18, 2582) = 79.72, $p < .001$). A contingency coefficient (C = .173, $p < .001$) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, TX FFA Areas 3, 5, and 9 observed more positions advertised for animal science (3) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 1, 5, and 10 observed fewer positions advertised for animal science (3) than expected based on the Chi-square analysis. Table 14 provides further detail of the Chi-square analysis completed.

Table 14

Chi-Square Analysis to Examine Differences in Animal Science (3) Position Request by TX FFA Area

		Total N = 2582		No Pathway Requested N = 872		Pathway (3) Selected N = 1093		Pathway (3) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Area 1	Observed	153	5.9	86.0	56.2	14.0	9.2	53.0	34.6	
	Expected			51.7	33.8	34.5	22.5	66.8	43.7	
Area 2	Observed	177	6.9	75.0	42.4	25.0	14.1	77.0	43.5	
	Expected			59.8	33.8	39.9	22.5	77.3	43.7	79.72*
Area 3	Observed	488	18.9	128.0	26.2	124.0	25.4	236.0	48.4	
	Expected			164.8	33.8	110.0	22.5	213.2	43.7	
Area 4	Observed	170	6.6	58.0	57.4	40.0	23.5	72.0	42.4	
	Expected			57.4	33.8	38.3	22.5	74.3	43.7	

Table 14 continued

Area 5	Observed	299	11.6	107.0	35.8	84.0	28.1	108.0	36.1
	Expected			101.0	33.8	67.4	22.5	130.6	43.7
Area 6	Observed	263	10.2	69.0	26.2	55.0	20.9	139.0	52.9
	Expected			88.8	33.8	59.3	22.5	114.9	43.7
Area 7	Observed	321	12.4	106.0	33.0	76.0	23.7	139.0	43.3
	Expected			108.4	33.8	72.4	22.5	140.2	43.7
Area 8	Observed	310	12.0	105.0	33.9	69.0	22.3	136.0	43.9
	Expected			104.7	33.8	69.9	22.5	135.4	43.7
Area 9	Observed	256	9.9	85.0	33.2	64.0	25.0	107.0	41.8
	Expected			86.5	33.8	57.7	22.5	111.8	43.7
Area 10	Observed	145	5.6	53.0	36.6	31.0	21.4	61.0	42.1
	Expected			49.0	33.8	32.7	22.5	63.3	43.7

* $p < .05$

A Chi-square test of independence (3 x 10) was performed to examine the frequency of positions advertised for environmental science (4) by TX FFA Areas. A significant correlation was found for TX FFA Area and frequency of position advertised for environmental science (χ^2 (18, 2582) = 75.37, $p < .001$). A contingency coefficient (C = .173, $p < .001$) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, TX FFA Areas 3, 5, 8, and 9 observed more positions advertised for environmental science (4) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 1, 2, 4, and 10 observed fewer positions advertised for environmental science (4) than expected based on the Chi-square analysis. Table 15 provides further detail of the Chi-square analysis completed.

Table 15

Chi-Square Analysis to Examine Differences in Environmental Science (4) Position Request by TX FFA Area

		Total N = 2582		No Pathway Requested N = 872		Pathway (4) Selected N = 1093		Pathway (4) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Area 1	Observed	153	5.9	86.0	56.2	2.0	1.3	65.0	42.5	75.37*
	Expected			51.7	33.8	15.2	9.9	86.2	56.3	
Area 2	Observed	177	6.9	75.0	42.4	10.0	5.6	92.0	52.0	
	Expected			59.8	33.8	17.5	9.9	99.7	56.3	
Area 3	Observed	488	18.9	128.0	26.2	61.0	12.5	299.0	61.3	
	Expected			164.8	33.8	48.4	9.9	274.8	56.3	
Area 4	Observed	170	6.6	58.0	57.4	13.0	7.6	99.0	58.2	
	Expected			57.4	33.8	16.9	9.9	95.7	56.3	

Table 15 continued

Area 5	Observed	299	11.6	107.0	35.8	34.0	11.4	158.0	52.8
	Expected			101.0	33.8	29.6	9.9	168.4	56.3
Area 6	Observed	263	10.2	69.0	26.2	28.0	10.6	166.0	63.1
	Expected			88.8	33.8	26.1	9.9	148.1	56.3
Area 7	Observed	321	12.4	106.0	33.0	30.0	9.3	185.0	57.6
	Expected			108.4	33.8	31.8	9.9	180.8	56.3
Area 8	Observed	310	12.0	105.0	33.9	35.0	11.3	170.0	54.8
	Expected			104.7	33.8	30.7	9.9	174.6	56.3
Area 9	Observed	256	9.9	85.0	33.2	33.0	12.9	138.0	53.9
	Expected			86.5	33.8	25.4	9.9	144.2	56.3
Area 10	Observed	145	5.6	53.0	36.6	10.0	6.9	82.0	56.6
	Expected			49.0	33.8	14.4	9.9	81.7	56.3

* $p < .05$

A Chi-square test of independence (3 x 10) was calculated comparing the frequency of positions advertised for plant science (5) between TX FFA Areas. A significant interaction was found between TX FFA Areas (χ^2 (18, 2582) = 93.41, p < .001). A contingency coefficient (C = .187, p < .001) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, TX FFA Areas 3, 5, 6, and 9 observed more positions advertised for plant and soil science (5) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 1, 2, and 7 observed fewer positions advertised for plant and soil science (5) than expected based on the Chi-square analysis. Table 16 provides further detail of the Chi-square analysis completed.

Table 16

Chi-Square Analysis to Examine Differences in Plant and Soil Science (5) Position Requests by TX FFA Area

		Total N = 2582		No Pathway Requested N = 872		Pathway (5) Selected N = 1093		Pathway (5) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Area 1	Observed	153	5.9	86.0	56.2	7.0	4.6	60.0	39.2	93.41*
	Expected			51.7	33.8	26.1	17.1	75.2	49.1	
Area 2	Observed	177	6.9	75.0	42.4	16.0	9.0	86.0	48.6	
	Expected			59.8	33.8	30.2	17.1	87.0	49.1	
Area 3	Observed	488	18.9	128.0	26.2	104.0	21.3	256.0	52.5	
	Expected			164.8	33.8	83.3	17.1	239.8	49.1	
Area 4	Observed	170	6.6	58.0	57.4	23.0	13.5	89.0	52.4	
	Expected			57.4	33.8	29.0	17.1	83.6	49.1	

Table 16 continued

Area 5	Observed	299	11.6	107.0	35.8	62.0	20.7	130.0	43.5
	Expected			101.0	33.8	51.1	17.1	147.0	49.1
Area 6	Observed	263	10.2	69.0	26.2	58.0	22.1	136.0	51.7
	Expected			88.8	33.8	44.9	17.1	129.3	49.1
Area 7	Observed	321	12.4	106.0	33.0	38.0	11.8	177.0	55.1
	Expected			108.4	33.8	54.8	17.1	157.8	49.1
Area 8	Observed	310	12.0	105.0	33.9	49.0	15.8	156.0	50.3
	Expected			104.7	33.8	52.9	17.1	152.4	49.1
Area 9	Observed	256	9.9	85.0	33.2	55.0	21.5	116.0	45.3
	Expected			86.5	33.8	43.7	17.1	125.8	49.1
Area 10	Observed	145	5.6	53.0	36.6	29.0	20.0	63.0	43.4
	Expected			49.0	33.8	24.8	17.1	71.3	49.1

* $p < .05$

A Chi-square test of independence (3 x 6) was calculated comparing the frequency of positions advertised for agricultural business (1) between CA FFA Regions. A significant interaction was found between CA FFA Regions (χ^2 *(*10, 707*) = 19.96, p =* .030*).* A contingency coefficient (C = .166, *p* = .030) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, Central, San Joaquin, and Southern CA FFA Regions observed more positions advertised for agricultural business (1) than expected based on the Chi-square analysis. Conversely, the North Coast, South Coast, and Superior CA FFA Regions observed fewer positions advertised for agricultural business (1) than expected based on the Chi-square analysis. Table 17 provides further detail of the Chi-square analysis completed.

Table 17

Chi-Square Analysis to Examine Differences in Agricultural Business (1) Position Request by CA FFA Region

		Total N = 2582		No Pathway Requested N = 872		Pathway (1) Selected N = 1093		Pathway (1) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Central	Observed	189	26.7	14.0	7.4	15.0	7.9	160.0	84.7	
	Expected			23.0	12.2	13.1	6.9	152.9	80.9	
North Coast	Observed	58	8.2	14.0	24.1	3.0	5.2	41.0	70.7	
	Expected			7.1	12.2	4.0	6.9	46.9	80.9	
San Joaquin	Observed	214	30.3	32.0	15.0	16.0	7.5	166.0	77.6	19.96*
	Expected			26.0	12.2	14.8	6.9	173.1	80.9	
South Coast	Observed	101	14.3	11.0	10.9	5.0	5.0	85.0	84.2	
	Expected			12.3	12.2	7.0	6.9	81.7	80.9	

Table 17 continued

Southern	Observed	84	11.9	7.0	8.3	9.0	10.7	68.0	81.0
	Expected			10.2	12.25	5.8	6.9	68.0	80.9
Superior	Observed	61	8.6	8.0	13.1	1.0	1.6	52.0	85.2
	Expected			7.4	12.2	4.2	6.9	49.4	80.9

* $p < .05$

A Chi-square test of independence (3 x 6) was calculated comparing the frequency of positions advertised for agricultural mechanics (2) between CA FFA Regions. A significant interaction was found between CA FFA Regions (χ^2 *(*10, 707*)* = *23.26*, *p* = .010*).* A contingency coefficient (C = .178, *p* = .010) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, the Superior CA FFA Region observed more positions advertised for agricultural mechanics (2) than expected based on the Chi-square analysis. Conversely, the Central, and North Coast CA FFA Regions observed fewer positions advertised for agricultural mechanics (2) than expected based on the Chi-square analysis. Table 18 provides further detail of the Chi-square analysis completed.

Table 18

Chi-Square Analysis to Examine Differences in Agricultural Mechanics (2) Position Request by CA FFA Region

		Total N = 2582		No Pathway Requested N = 872		Pathway (2) Selected N = 1093		Pathway (2) Not Selected N = 617		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Central	Observed	189	26.7	14.0	7.4	72.0	38.1	103.0	54.5	
	Expected			23.0	12.2	77.0	40.7	89.0	47.1	
North Coast	Observed	58	8.2	14.0	24.1	17.0	29.3	27.0	46.6	
	Expected			7.1	12.2	23.6	40.7	27.3	47.1	23.26*
San Joaquin	Observed	214	30.3	32.0	15.0	88.0	41.1	94.0	43.9	
	Expected			26.0	12.2	87.2	40.7	100.8	47.1	
South Coast	Observed	101	14.3	11.0	10.9	42.0	41.6	48.0	47.5	
	Expected			12.3	12.2	41.1	40.7	47.6	47.1	

Table 18 continued

Southern	Observed	84	11.9	7.0	8.3	36.0	42.9	41.0	48.8
	Expected			10.2	12.25	34.2	40.7	39.6	47.1
Superior	Observed	61	8.6	8.0	13.1	33.0	54.1	20.0	32.8
	Expected			7.4	12.2	24.8	40.7	28.7	47.1

* $p < .05$

A Chi-square test of independence (3 x 6) was calculated comparing the frequency of positions advertised for agri-science (3) between CA FFA Regions. A significant interaction was found between CA FFA Regions (χ^2 *(*10, 707*) = 40.10*, *p* < .001*)*. A contingency coefficient (C = .232, *p* < .001) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, the Central and Southern CA FFA Regions observed more positions advertised for agri-science (3) than expected based on the Chi-square analysis. Conversely, the San Joaquin and Superior CA FFA Regions observed fewer positions advertised for agri-science (3) than expected based on the Chi-square analysis. Table 19 provides further detail of the Chi-square analysis completed.

Table 19

Chi-Square Analysis to Examine Differences in Agri-Science (3) Position Request by CA FFA Region

		Total N = 707		No Pathway Requested N = 86		Pathway (3) Selected N = 426		Pathway (3) Not Selected N = 195		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Central	Observed	189	26.7	14.0	7.4	131.0	69.3	44.0	23.3	40.10*
	Expected			23.0	12.2	113.9	60.3	52.1	27.5	
North Coast	Observed	58	8.2	14.0	24.1	32.0	55.2	12.0	20.7	
	Expected			7.1	12.2	34.9	60.3	16.0	27.5	
San Joaquin	Observed	214	30.3	32.0	15.0	103.0	48.1	79.0	43.9	
	Expected			26.0	12.2	128.9	60.3	59.0	27.5	
South Coast	Observed	101	14.3	11.0	10.9	66.0	65.3	24.0	23.8	
	Expected			12.3	12.2	60.9	60.3	27.9	27.5	

Table 19 continued

Southern	Observed	84	11.9	7.0	8.3	63.0	75.0	14.0	16.7
	Expected			10.2	12.25	50.6	60.3	23.2	27.5
Superior	Observed	61	8.6	8.0	13.1	31.0	50.8	22.0	36.1
	Expected			7.4	12.2	36.8	60.3	16.8	27.5

* p < .05

A Chi-square test of independence (3 x 6) was calculated comparing the frequency of positions advertised for animal science (4) between CA FFA Regions. A significant interaction was found between CA FFA Regions (χ^2 (10, 707) = 81.10, p < .001). A contingency coefficient (C = .321, p < .001) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, the South Coast and Southern CA FFA Regions observed more positions advertised for animal science (4) than expected based on the Chi-square analysis. Conversely, the Central, San Joaquin, and Superior CA FFA Regions observed fewer positions advertised for animal science (4) than expected based on the Chi-square analysis. Table 20 provides further detail of the Chi-square analysis completed.

Table 20

Chi-Square Analysis to Examine Differences in Animal Science (4) Position Requests by CA FFA Region

		Total N = 707		No Pathway Requested N = 86		Pathway (4) Selected N = 166		Pathway (4) Not Selected N = 455		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Central	Observed	189	26.7	14.0	7.4	38.0	20.1	137.0	72.5	81.10*
	Expected			23.0	12.2	44.0	23.3	121.6	64.3	
North Coast	Observed	58	8.2	14.0	24.1	12.0	20.7	32.0	55.2	
	Expected			7.1	12.2	13.6	23.3	37.3	64.3	
San Joaquin	Observed	214	30.3	32.0	15.0	34.0	15.9	148.0	69.2	
	Expected			26.0	12.2	50.2	23.3	137.7	64.3	
South Coast	Observed	101	14.3	11.0	10.9	32.0	31.7	58.0	57.4	
	Expected			12.3	12.2	23.7	23.3	65.0	64.3	

Table 20 continued

Southern	Observed	84	11.9	7.0	8.3	46.0	54.8	31.0	36.9
	Expected			10.2	12.25	19.7	23.3	54.1	64.3
Superior	Observed	61	8.6	8.0	13.1	4.0	6.6	49.0	80.3
	Expected			7.4	12.2	14.3	23.3	39.3	64.3

* $p < .05$

A Chi-square test of independence (3 x 6) was calculated comparing the frequency of positions advertised for ornamental horticulture (5) between CA FFA Regions. A significant interaction was found between CA FFA Regions (χ^2 *(*10, 707*) = 27.74, p =* .002*).* A contingency coefficient (C = .194, *p* = .002) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, the South Coast and Southern CA FFA Regions observed more positions advertised for ornamental horticulture (5) than expected based on the Chi-square analysis. Conversely, the Central, San Joaquin, and Superior CA FFA Regions observed fewer positions advertised for ornamental horticulture (5) than expected based on the Chi-square analysis. Table 21 provides further detail of the Chi-square analysis completed.

Table 21

Chi-Square Analysis to Examine Differences in Ornamental Horticulture (5) Position Request by CA FFA Region

		Total N = 707		No Pathway Requested N = 86		Pathway (5) Selected N = 137		Pathway (5) Not Selected N = 484		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Central	Observed	189	26.7	14.0	7.4	37.0	19.6	138.0	73.0	27.74*
	Expected			23.0	12.2	36.6	19.4	129.4	68.5	
North Coast	Observed	58	8.2	14.0	24.1	12.0	20.7	32.0	55.2	
	Expected			7.1	12.2	11.2	19.4	39.7	68.5	
San Joaquin	Observed	214	30.3	32.0	15.0	28.0	13.1	154.0	72.0	
	Expected			26.0	12.2	41.5	19.4	146.5	68.5	
South Coast	Observed	101	14.3	11.0	10.9	30.0	29.7	60.0	59.4	
	Expected			12.3	12.2	19.6	19.4	69.1	68.5	

Table 21 continued

Southern	Observed	84	11.9	7.0	8.3	20.0	23.8	57.0	67.9
	Expected			10.2	12.25	16.3	19.4	57.5	68.5
Superior	Observed	61	8.6	8.0	13.1	10.0	16.4	43.0	70.5
	Expected			7.4	12.2	11.8	19.4	41.8	68.5

* $p < .05$

A Chi-square test of independence (3 x 6) was calculated comparing the frequency of positions advertised for plant and soil science (6) between CA FFA Regions. A significant interaction was found between CA FFA Regions (χ^2 *(*10, 707*) = 21.11, p* = .020*).* A contingency coefficient (C = .170, *p* = .020) for the Chi-square analysis described a small association between area and specification of pathway(s) in the job announcement. Specifically, the South Coast and Southern CA FFA Regions observed more positions advertised for plant and soil science (6) than expected based on the Chi-square analysis. Conversely, the Central and Superior CA FFA Regions observed fewer positions advertised for plant and soil science (6) than expected based on the Chi-square analysis. Table 22 provides further detail of the Chi-square analysis completed.

Table 22

Chi-Square Analysis to Examine Differences in Plant and Soil Science (6) Position Request by CA FFA Region

		Total N = 707		No Pathway Requested N = 86		Pathway (6) Selected N = 105		Pathway (6) Not Selected N = 516		
		n	%	*n*	%	*n*	%	*n*	%	χ^2
Central	Observed	189	26.7	14.0	7.4	26.0	13.8	149.0	78.8	
	Expected			23.0	12.2	28.1	14.9	137.9	72.9	
North Coast	Observed	58	8.2	14.0	24.1	8.0	13.8	36.0	62.1	
	Expected			7.1	12.2	8.6	14.9	42.3	72.9	21.11*
San Joaquin	Observed	214	30.3	32.0	15.0	30.0	14.0	152.0	71.0	
	Expected			26.0	12.2	31.8	14.9	156.2	72.9	
South Coast	Observed	101	14.3	11.0	10.9	17.0	16.8	73.0	72.3	
	Expected			12.3	12.2	15.0	14.9	73.7	72.9	

Table 22 continued

Southern	Observed	84	11.9	7.0	8.3	19.0	22.6	58.0	69.0
	Expected			10.2	12.25	12.5	14.9	61.3	72.9
Superior	Observed	61	8.6	8.0	13.1	5.0	8.2	48.0	78.7
	Expected			7.4	12.2	9.1	14.9	44.5	72.9

* $p < .05$

Implications of RQ1.2

Research question 1.2 aimed to compare AFNR position pathway advertisements by California FFA region and Texas FFA area. Position advertisements were compared within each pathway in the different FFA regions and areas. Through the analysis of the available data, the researchers believe the following to be notable implications in research question 1.2. The following section will outline the practical impacts of the data revealed to the authors.

A statistically significant, at the $p < .05$ level, chi-square statistic was observed in each of the chi-square analyses conducted. In addition to the chi-square statistic, a contingency coefficient value was calculated for each of the contingency tables. The calculated contingency coefficients remained stable across the chi-square analysis by pathway. Five chi-square statistics and coefficients were calculated with the advertised positions in Texas. The coefficients suggested small effect size in each of the pathways by Texas FFA Area. The square of the correlation coefficients indicates that in Texas no more than 3.5% of the variance can be explained by differences in FFA Areas. Whereas in California, six chi-square statistics and coefficients were calculated with the advertised positions. The coefficient for the animal science pathway suggested a modest effect size. The square of the correlation coefficient for the animal science pathway suggests that 10.3% of the variance can be explained by differences in FFA Region. While the remaining pathway coefficients suggested small effect size. In the remaining pathways of California, the square of the correlation coefficient indicates that less 5.4% of the variance between pathways can be explained by differences in FFA Regions.

There are statistically significant differences in positions advertised by pathway and CA FFA region and TX FFA area. Notably, regional differences in program planning support the federal Perkins legislation (Hyslop, 2018). Local education agencies are required to hold advisory board meetings designed to assist local programs in course offerings, planning, development, implementation, and evaluation of career technical education programs (Hyslop, 2018). Therefore, these programs should be different within different regions of the states. Areas with a heavy emphasis on forestry and timber should differ from areas with a heavy emphasis on field crops and livestock. These differences have implications on teacher preparation programs, recruitment of teachers, and professional development needs of the different regions and areas.

RQ 1.3

Research question 1.3 sought to investigate advertised job postings in California and Texas on an annual basis. The data collected in the content analysis section of the study includes information on advertised AFNR positions on a per-year continuum. Advertised AFNR position data are available between November 1, 2011, through October 31, 2019, in both California and Texas. The greatest number of positions advertised in CA by pathway was agriscience in 2013 (n = 61). A summary of California positions by AFNR pathway and posting year is provided in Table 23. The greatest number of positions advertised in TX by pathway was applied agricultural engineering in 2018 (n = 173). A summary of Texas positions by AFNR pathway and posting year is provided in Table 24.

Table 23

Summary of CA Positions by AFNR Pathway and Posting Year

	Agribusiness		Agricultural Mechanics		Animal Science		Agriscience		Forestry & Nat. Resources		Plant Science		Ornamental Horticulture		
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	Total
2012	2.0	2.06	19.0	19.59	17.0	17.53	40.0	41.24	2.0	2.06	5.0	5.15	12.0	12.37	97.0
2013	5.0	3.42	35.0	23.97	20.0	13.70	61.0	41.78	4.0	2.74	10.0	6.85	11.0	7.53	146.0
2014	4.0	2.26	42.0	23.73	23.0	12.99	68.0	38.42	2.0	1.13	18.0	10.17	20.0	11.30	177.0
2015	12.0	5.38	54.0	24.22	32.0	14.35	70.0	31.39	1.0	0.45	23.0	10.31	31.0	13.90	223.0
2016	7.0	4.07	49.0	28.49	20.0	11.63	58.0	33.72	0.0	0.00	18.0	10.47	20.0	11.63	172.0
2017	10.0	5.68	41.0	23.30	25.0	14.20	59.0	33.52	1.0	0.57	18.0	10.23	22.0	12.50	176.0
2018	3.0	3.90	21.0	27.27	15.0	19.48	27.0	35.06	0.0	0.00	3.0	3.90	8.0	10.39	77.0
2019	6.0	5.22	27.0	23.48	14.0	12.17	43.0	37.39	2.0	1.74	10.0	8.70	13.0	11.30	115.0
Total	49.0	4.14	288.0	24.34	166.0	14.03	426.0	36.01	12.0	1.01	105.0	8.88	137.0	11.58	1183.0

Table 24

Summary of TX Positions by AFNR Pathway and Posting Year

	Agribusiness		Applied Ag Engineering		Animal Science		General AFNR		Food Science & Technology		Natural Resources		Plant Science		
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	Total
2012	2	0.83	79.0	32.64	51.0	21.07	45.0	18.60	2.0	0.83	28.0	11.57	35.0	14.46	242.0
2013	7	2.10	118.0	35.33	61.0	18.26	60.0	17.96	8.0	2.40	32.0	9.58	48.0	14.37	334.0
2014	10	2.58	139.0	35.92	74.0	19.12	57.0	14.73	7.0	1.81	36.0	9.30	64.0	16.54	387.0
2015	6	1.46	142.0	34.63	83.0	20.24	72.0	17.56	3.0	0.73	37.0	9.02	67.0	16.34	410.0
2016	8.0	2.48	119.0	36.96	63.0	19.57	58.0	18.01	7.0	2.17	22.0	6.83	45.0	13.98	322.0
2017	4.0	1.00	152.0	38.10	78.0	19.55	68.0	17.04	4.0	1.00	38.0	9.52	55.0	13.78	399.0
2018	1.0	0.23	173.0	40.42	85.0	19.86	73.0	17.06	3.0	0.70	30.0	7.01	63.0	14.72	428.0
2019	1.0	0.23	171.0	39.58	87.0	20.14	70.0	16.20	6.0	1.39	33.0	7.64	64.0	14.81	432.0
Total	39.0	1.32	1093.0	37.00	582.0	19.70	503.0	17.03	40.0	1.35	256.0	8.67	441.0	14.93	2954.0

Discussion of RQ1.3

Research question 1.3 aimed to investigate AFNR position pathway advertisements in California and Texas on an annual basis. Position advertisements between 2011 and 2019were evaluated.

In California, advertisements for specific pathways were relatively consistent across the eight years. The agriscience pathway had higher demand in 2012 and 2013. This can be attributed to a large push for the integrated agriscience curriculum that was adopted by the California State Board of Education in 2011 (California Department of Education, 2013). Students enrolled in the integrated science courses in California earn University of California system-approved science credits by successfully completing the science-approved courses in agriculture. The agricultural-based science courses are the primary driver for the need to hire teachers willing and able to teach in the agriscience pathway.

In Texas, the applied agricultural engineering pathway showed growth from 2012 to 2019. In 2012, position advertisements for applied agricultural engineering accounted for 32.6% of all pathways requested. By 2019, the applied agricultural engineering pathway accounted for nearly 40% of all position advertisements. Not only is there a continued desire to offer applied agricultural engineering pathway on the local level but there may also be a decrease in the number of newly certified teachers willing to accept positions that require them to teach in the applied agricultural engineering pathway. This latter possibility is supported by a wide body of literature centered on pre-service teacher's perceived level of skill and preparation in the field of agricultural mechanics

(Blackburn et al., 2015; Burris et al., 2005, 2010; Leiby et al., 2013; Shultz et al., 2014; Tummons et al., 2017; Wells et al., 2013). Position advertisements were significantly less frequent for the next two pathways in rank order. Animal science and general AFNR together/combined accounted for 36.7% of the two pathways. Local education agencies are not as concerned with specifically requesting animal science and general AFNR pathways. This is because local education agencies are confident that any qualified AFNR teacher will be willing and able to teach in the animal science and general AFNR pathways.

Research Objective 2.0

Research objective 2.0 was to describe and compare AFNR teacher assignments by pathway in California and Texas. California agriculture teachers (N = 944) received a survey electronically in the spring of 2019. Texas agriculture teachers (N = 2,511) received a survey electronically in the fall of 2019. The electronic surveys asked teachers to provide information about their daily schedule such as which pathways they taught in, how much time they spent in each pathway, and which pathways were perceived to be the fastest-growing in their local program. Of the 944 surveys sent out to California agriculture teachers, 462 usable responses were captured to provide a 48.9% response rate. Of the 2,511 surveys sent out to Texas agriculture teachers, 1,279 usable responses were captured to provide a 50.9% response rate.

RQ 2.1

The purpose of research question 2.1 was to describe the demographic characteristics of the survey respondents. Descriptive statistics including frequencies and measures of central tendency were used to describe respondents by age, gender, years of teaching experience, and FFA area or region membership. The typical respondent from California in this study was a 39-year-old, female teacher (n = 279) from the Central region (n = 122) with 11.73 years of teaching experience. A summary of this descriptive information is provided in Table 25.

Table 25

Demographic Characteristics of California Respondents (n = 462)

Characteristic	*f*	%	*Min.*	*Max.*	*M*	*SD*
Years of teaching experience			0	42	11.73	9.63
Respondent Age			24	67	39.19	11.44
Gender						
Male	180.0	39.0				
Female	279.0	60.4				
Prefer to Not Answer	1.0	0.2				
Missing	2.0	0.4				
Region						
Central	122.0	26.4				
North Coast	36.0	7.8				
San Joaquin	119.0	25.8				
South Coast	54.0	11.7				
Southern	66.0	14.3				
Superior	64.0	13.9				
Missing	1.0	0.2				

The typical respondent from Texas in this study was a 39-year-old, male teacher (*n* = 725), from TX FFA Area 3 (*n* = 249) with 12.9 years of teaching experience. A summary of this descriptive information is provided in Table 26.

Table 26

Demographic Characteristics of Texas Respondents (n = 1323)

Characteristic	*f*	%	*Min.*	*Max.*	*M*	*SD*
Years of teaching experience			0	49	12.9	10.21
Respondent Age			20	74	39.1	11.65
Gender						
Male	725	54.8				
Female	531	40.1				
Prefer not to answer	2	0.2				
Missing	65	4.9				
Area						
Area 1	90	6.8				
Area 2	74	5.6				
Area 3	249	18.8				
Area 4	111	8.4				
Area 5	139	10.5				
Area 6	117	8.8				
Area 7	119	9.0				
Area 8	149	11.3				
Area 9	107	8.1				
Area 10	93	7.0				
Missing	75	5.7				

RQ 2.2

The purpose of research question 2.2 was to describe teacher assignments by pathway in California and Texas. Seven pathways were identified in California using the CTE frameworks (California Department of Education, 2013):agribusiness, agricultural mechanics, animal science, agriscience, forestry and natural resources, plant and soil science, and ornamental horticulture. Of the teacher responses (*n* = 462), teachers reported they were most often assigned to teach in the agriscience pathway (61.3 %, *n = 283)*. Respondents reported just 2.8% (*n* = 13) of teachers spent time teaching in the forestry and natural resources pathway. A summary of pathway assignment frequency descriptions is provided in Table 27.

Table 27

Summary of AFNR Teacher Pathway Assignments in California

	f	%
California AFNR Pathways		
Agribusiness	84.0	18.2
Agricultural Mechanics	160.0	34.6
Animal Science	136.0	29.4
Agriscience	283.0	61.3
Forestry and Natural Resources	13.0	2.8
Plant and Soil Science	131.0	28.4
Ornamental Horticulture	74.0	16.0

Seven pathways were identified in Texas using the CTE Program of Study framework (Texas Education Agency, 2019). The seven pathways identified are agribusiness, animal science, applied agricultural engineering, natural resources, food science technology, plant science, and general AFNR. Of the teacher survey responses (*n* = 1,250), the most common AFNR teacher-assigned pathway was animal science with 54.2 % (*n = 678)*. Based on survey responses, 4.9% (*n* = 61) of teachers spent time teaching in the food science technology pathway. A summary of frequency descriptions is provided in Table 28.

Table 28

Summary of AFNR Teacher Pathway Assignments in Texas

	f	%
Texas AFNR Pathways		
Agribusiness	98.0	7.8
Animal Science	678.0	54.2
Applied Agricultural Engineering	378.0	30.2
Natural Resources	143.0	11.4
Food Science Technology	61.0	4.9
Plant Science	290.0	23.2
General AFNR	326.0	26.1

Discussion of RQ2.2

The objective of research question 2.2 was to describe teacher assignments by pathway in California and Texas. Teacher survey data from 2019 provided the data for the analysis and findings. Through the analysis of the available data, the researchers believe the following to be notable implications in research question 1.2. The following section will outline the practical impacts the data revealed to the authors.

Responses to the questionnaire regarding teacher assignment allowed the researchers to be more targeted in their approach to understanding AFNR teacher demand. A more robust understanding of teacher assignments significantly contributes to the depth of this study. In California, the top two pathway areas by teacher assignment are agriscience and agricultural mechanics. Of the usable responses, 61.3% (*n* = 283) of teachers reported that they were assigned to teach some part of their day in the agriscience pathway. About 34.6% (*n* = 160) of teachers reported that they were assigned to teach some part of their day in the agricultural mechanics pathway. The data from previous research questions aligns well with this, indicating that the positions requested by local education agencies match the pathways teachers are assigned to teach. For example, the agriscience pathway in California accounted for 60.3% of position advertisements, while 61.3% of teachers were assigned to teach in that pathway. On a similar note, the forestry and natural resources (2.8%) and agribusiness (18.2%) pathways have the lowest percentage of teachers assigned to pathways in California. This is supported by the data in the previous research questions that indicated forestry and natural resources and agribusiness each accounted for just 1.5% of advertised positions. This significantly lower teacher assignment to forestry and natural resources may be due to policies and regulations that have significantly reduced the forestry and timber industries in the state of California.

Whereas in Texas, the animal science and applied agricultural engineering pathways accounted for the largest percentage of teachers assigned to pathways. Of the usable responses, 54.2% (*n* = 678) of teachers reported that they were assigned to teach some part of their day in the animal science pathway. Also, 30.2% (*n* = 378) of teachers reported that they were assigned to teach some part of their day in the applied agricultural engineering pathway. These findings are supported to a small extent by the

Texas Education Agency's (TEA) (2022) FTE enrollment data for the 2020-2021 school year. In that report, the TEA reported that 27% of AFNR teacher FTEs were spent in the general AFNR pathway, while the animal science pathway accounted for 24%, and the applied agricultural engineering pathway accounted for 21% of the Texas AFNR teacher FTE. The agribusiness and food science technology pathways account for just 1% each of the FTEs in Texas. While they are the two lowest pathways in terms of FTE counts, respondents self-reported a slightly higher percentage of their assignments in the agribusiness and food science and technology pathways (Texas Education Agency, 2022). The applied agricultural engineering pathway was the fourth largest in terms of student enrollment (Texas Education Agency, 2022). This mismatch between the FTE count and student enrollment is believed to be attributed to the typically smaller class sizes maintained in the laboratory-based applied agricultural engineering pathway courses.

RQ 2.3

Research question 2.3 aimed to compare AFNR pathway teacher assignments by California FFA region and Texas FFA area. AFNR pathway teacher assignments were compared within each pathway in the different FFA regions and areas. Null Hypothesis – There is no difference in the number of teachers assigned to teach in the identified pathways between TX FFA areas and CA FFA regions.

TX Agribusiness

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach agribusiness (1) between TX FFA Areas. A significant interaction was not found between TX FFA Areas (χ^2 *(9,* 1248*) = 15.83, p* = .071*).* A contingency coefficient (C = .112, *p* = .071) for the Chi-square analysis described a small association between TX FFA area and assignment to teach agribusiness that was not statistically significant. Table 29 provides further detail of the Chi-square analysis completed.

Table 29

Chi-Square Analysis to Examine Differences in Agribusiness (1) Assignment by TX FFA Area

		Total		Pathway (1) Not Assigned		Pathway (1) Assigned		
		n = 1248		*n* = 1150		*n* = 98		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	76.0	84.4	14.0	15.6	
	Expected			82.9	92.1	7.1	7.9	
Area 2	Observed	74.0	5.9	68.0	91.9	6.0	8.1	
	Expected			68.2	92.1	5.8	7.9	
Area 3	Observed	249.0	20.0	228.0	91.6	21.0	8.4	
	Expected			229.4	92.1	19.6	7.9	
Area 4	Observed	111.0	8.9	106.0	95.5	5.0	4.5	15.83
	Expected			102.3	92.1	8.7	7.9	
Area 5	Observed	139.0	11.1	133.0	95.7	6.0	4.3	
	Expected			128.1	92.1	10.9	7.9	
Area 6	Observed	117.0	9.4	105.0	89.7	12.0	10.3	
	Expected			107.8	92.1	9.2	7.9	
Area 7	Observed	119.0	9.5	106.0	89.1	13.0	10.9	
	Expected			109.7	92.1	9.3	7.9	

Table 29 continued

Area 8	Observed	149.0	11.9	140.0	94.0	9.0	6.0
	Expected			137.3	92.1	11.7	7.9
Area 9	Observed	107.0	8.6	100.0	93.5	7.0	6.5
	Expected			98.6	92.1	8.4	7.9
Area 10	Observed	93.0	7.5	88.0	94.6	5.0	5.4
	Expected			85.7	92.1	7.3	7.9

TX Applied Agricultural Engineering

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach in applied agricultural engineering (2) between TX FFA Areas. A significant interaction was found between TX FFA Areas (χ^2 *(9*, 1248*) = 30.37, p* < .001*).* A contingency coefficient (C = .154, *p* < .001) for the Chi-square analysis described a small association between TX FFA area and assignment to teach in applied agricultural engineering (2). Specifically, TX FFA Areas 4, 7, 8, and 9 observed more teachers assigned to teach in applied agricultural engineering (2) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 3, 5, and 10 observed fewer teachers assigned to teach in applied agricultural engineering (2) than expected based on the Chi-square analysis. Table 30 provides further detail of the Chi-square analysis completed.

Table 30

Chi-Square Analysis to Examine Differences in Applied Agricultural Engineering (2) Assignment by TX FFA Area

		Total n = 1248		Pathway (2) Not Assigned n = 870		Pathway (2) Assigned n = 378		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	65.0	72.2	25.0	27.8	
	Expected			62.7	69.7	27.3	30.3	
Area 2	Observed	74.0	5.9	50.0	67.6	24.0	32.4	
	Expected			51.6	69.7	22.4	30.3	
Area 3	Observed	249.0	20.0	196.0	78.7	53.0	21.3	
	Expected			173.6	69.7	75.4	30.3	
Area 4	Observed	111.0	8.9	65.0	58.6	46.0	41.4	30.37*
	Expected			77.4	69.7	33.6	30.3	
Area 5	Observed	139.0	11.1	104.0	74.8	35.0	25.2	
	Expected			96.9	69.7	42.1	30.3	
Area 6	Observed	117.0	9.4	86.0	73.5	31.0	26.5	
	Expected			81.6	69.7	35.4	30.3	
Area 7	Observed	119.0	9.5	76.0	63.9	43.0	36.1	
	Expected			83.0	69.7	36.0	30.3	

Table 30 continued

Area 8	Observed	149.0	11.9	90.0	60.4	59.0	39.6
	Expected			103.9	69.7	45.1	30.3
Area 9	Observed	107.0	8.6	68.0	63.6	39.0	36.4
	Expected			74.6	69.7	32.4	30.3
Area 10	Observed	93.0	7.5	70.0	75.3	23.0	24.7
	Expected			64.8	69.7	28.2	30.3

TX Animal Science

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach animal science (3) between TX FFA Areas. A significant interaction was found between TX FFA Areas (χ^2 *(9*, 1248*) = 17.91*, p = .036*)*. A contingency coefficient (C = .119, p = .036) for the Chi-square analysis described a small association between TX FFA area and assignment to teach in animal science (3). Specifically, TX FFA Areas 1, 2, and 5 observed more teachers assigned to teach animal science (3) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 4, 6, 7, and 9 observed fewer teachers assigned to teach animal science (3) than expected based on the Chi-square analysis. Table 31 provides further detail of the Chi-square analysis completed.

Table 31

Chi-Square Analysis to Examine Differences in Animal Science (3) Assignment by TX FFA Area

		Total *n* = 1248		Pathway (3) Not Assigned *n* = 571		Pathway (3) Assigned *n* = 677		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	33.0	36.7	57.0	63.3	
	Expected			41.2	45.8	48.8	54.2	
Area 2	Observed	74.0	5.9	29.0	39.2	45.0	60.8	
	Expected			33.9	45.8	40.1	54.2	
Area 3	Observed	249.0	20.0	115.0	46.2	134.0	53.8	
	Expected			113.9	45.8	135.1	54.2	
Area 4	Observed	111.0	8.9	55.0	49.5	56.0	50.5	17.91*
	Expected			50.8	45.8	60.2	54.2	
Area 5	Observed	139.0	11.1	53.0	38.1	86.0	61.9	
	Expected			63.6	45.8	75.4	54.2	
Area 6	Observed	117.0	9.4	58.0	49.6	59.0	50.4	
	Expected			53.5	45.8	63.5	54.2	
Area 7	Observed	119.0	9.5	59.0	49.6	60.0	50.4	
	Expected			54.4	45.8	64.6	54.2	

Table 31 continued

Area 8	Observed	149.0	11.9	68.0	45.6	81.0	54.4
	Expected			68.2	45.8	80.8	54.2
Area 9	Observed	107.0	8.6	63.0	58.9	44.0	41.1
	Expected			49.0	45.8	58.0	54.2
Area 10	Observed	93.0	7.5	38.0	40.9	55.0	59.1
	Expected			42.6	45.8	50.4	54.2

TX Environmental Science

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach environmental science (4) between TX FFA Areas. A significant interaction was not found between TX FFA Areas (χ^2 *(9*, 1248*)* *= 9.23, p* = .416*).* A contingency coefficient (C = .086, *p* = .416) for the Chi-square analysis described a small association between TX FFA area and assignment to teach in environmental science (4) that was not statistically significant. Specifically, TX FFA Areas 4, 6, and 9 observed more teachers assigned to teach environmental science (4) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 1, 2, and 5 observed fewer teachers assigned to teach environmental science (4) than expected based on the Chi-square analysis. Table 32 provides further detail of the Chi-square analysis completed.

Table 32

Chi-Square Analysis to Examine Differences in Environmental Science (4) Assignment by TX FFA Area

		Total n = 1248		Pathway (4) Not Assigned n = 1105		Pathway (4) Assigned n = 143		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	82.0	91.1	8.0	8.9	
	Expected			79.7	88.6	10.3	11.4	
Area 2	Observed	74.0	5.9	68.0	91.9	6.0	8.1	
	Expected			65.5	88.6	8.5	11.4	
Area 3	Observed	249.0	20.0	220.0	88.4	29.0	11.6	
	Expected			220.5	88.6	28.5	11.4	
Area 4	Observed	111.0	8.9	96.0	86.5	15.0	13.5	9.23
	Expected			98.3	88.6	12.7	11.4	
Area 5	Observed	139.0	11.1	129.0	92.8	10.0	7.2	
	Expected			123.1	88.6	15.9	11.4	
Area 6	Observed	117.0	9.4	97.0	82.9	20.0	17.1	
	Expected			103.6	88.6	13.4	11.4	
Area 7	Observed	119.0	9.5	106.0	89.1	13.0	10.9	
	Expected			105.4	88.6	13.6	11.4	

Table 32 continued

Area 8	Observed	149.0	11.9	134.0	89.9	15.0	10.1
	Expected			131.9	88.6	17.1	11.4
Area 9	Observed	107.0	8.6	92.0	86.0	15.0	14.0
	Expected			94.7	88.6	12.3	11.4
Area 10	Observed	93.0	7.5	81.0	87.1	12.0	12.9
	Expected			82.3	88.6	10.7	11.4

TX Food Science and Technology

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach food science and technology (5) between TX FFA Areas. A significant interaction was not found between TX FFA Areas (χ^2 *(9,* 1248*) = 13.96, p =* .124*).* A contingency coefficient (C = .105, *p* = .124) for the Chi-square analysis described a small association between TX FFA area and assignment to teach in food science and technology (5) that was not statistically significant. Table 33 provides further detail of the Chi-square analysis completed.

Table 33

Chi-Square Analysis to Examine Differences in Food Science and Technology (5) Assignment by TX FFA Area

		Total *n* = 1248		Pathway (5) Not Assigned *n* = 1187		Pathway (5) Assigned *n* = 61		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	83.0	92.2	7.0	7.8	
	Expected			85.6	95.1	4.4	4.9	
Area 2	Observed	74.0	5.9	68.0	91.9	6.0	8.1	
	Expected			70.4	95.1	3.6	4.9	
Area 3	Observed	249.0	20.0	235.0	94.4	14.0	5.6	
	Expected			236.8	95.1	12.2	4.9	
Area 4	Observed	111.0	8.9	109.0	98.2	2.0	1.8	13.96
	Expected			105.6	95.1	5.4	4.9	
Area 5	Observed	139.0	11.1	136.0	97.8	3.0	2.2	
	Expected			132.2	95.1	6.8	4.9	
Area 6	Observed	117.0	9.4	114.0	97.4	3.0	2.6	
	Expected			111.3	95.1	5.7	4.9	
Area 7	Observed	119.0	9.5	111.0	93.3	8.0	6.7	
	Expected			113.2	95.1	5.8	4.9	

Table 33 continued

Area 8	Observed	149.0	11.9	144.0	96.6	5.0	3.4
	Expected			141.7	95.1	7.3	4.9
Area 9	Observed	107.0	8.6	98.0	91.6	9.0	8.4
	Expected			101.8	95.1	5.2	4.9
Area 10	Observed	93.0	7.5	89.0	95.7	4.0	4.3
	Expected			88.5	95.1	4.5	4.9

TX Plant Science

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach plant science (6) between TX FFA Areas. A small and statistically insignificant interaction was no found between TX FFA Areas and frequency of teachers assigned to teach plant science.(χ^2 *(9*, 1248*) = 12.47*, *p =* .188*).* A contingency coefficient (C = .099, *p* = .188) for the Chi-square analysis described a small association between TX FFA area and assignment to teach in plant science (6) that was not statistically significant. Table 34 provides further detail of the Chi-square analysis completed.

Table 34

Chi-Square Analysis to Examine Differences in Plant Science (6) Assignment by TX FFA Area

		Total *n* = 1248		Pathway (6) Not Assigned *n* = 959		Pathway (6) Assigned *n* = 289		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	72.0	80.0	18.0	20.0	
	Expected			69.2	76.9	20.8	23.1	
Area 2	Observed	74.0	5.9	64.0	86.5	10.0	13.5	
	Expected			56.9	76.9	17.1	23.1	
Area 3	Observed	249.0	20.0	182.0	73.1	67.0	26.9	
	Expected			191.3	76.9	57.7	23.1	
Area 4	Observed	111.0	8.9	90.0	81.1	21.0	18.9	12.47
	Expected			85.3	76.9	25.7	23.1	
Area 5	Observed	139.0	11.1	102.0	73.4	37.0	26.6	
	Expected			106.8	76.9	32.2	23.1	
Area 6	Observed	117.0	9.4	93.0	79.5	24.0	20.5	
	Expected			89.9	76.9	27.1	23.1	
Area 7	Observed	119.0	9.5	85.0	71.4	34.0	28.6	
	Expected			91.4	76.9	27.6	23.1	

Table 34 continued

Area 8	Observed	149.0	11.9	119.0	79.9	30.0	20.1
	Expected			114.5	76.9	34.5	23.1
Area 9	Observed	107.0	8.6	84.0	78.5	23.0	21.5
	Expected			82.2	76.9	24.8	23.1
Area 10	Observed	93.0	7.5	68.0	73.1	25.0	26.9
	Expected			71.5	76.9	21.5	23.1

TX General AFNR

A Chi-square test of independence (2 x 10) was calculated comparing the frequency of AFNR teachers assigned to teach in general AFNR (7) between TX FFA Areas. A significant interaction was not found between TX FFA Areas (χ^2 *(9*, 1248*)* = *11.61, p* = .236*)*. A contingency coefficient (C = .096, *p* = .236) for the Chi-square analysis described a small association between TX FFA area and assignment to teach in general AFNR (7) that was not statistically significant. Specifically, TX FFA Areas 1, 4, 8, and 9 observed more teachers assigned to teach in general AFNR (7) than expected based on the Chi-square analysis. Conversely, TX FFA Areas 2, 5, and 7 observed fewer teachers assigned to teach in general AFNR (7) than expected based on the Chi-square analysis. Table 35 provides further detail of the Chi-square analysis completed.

Table 35

Chi-Square Analysis to Examine Differences in General AFNR (7) Assignment by TX FFA Area

		Total n = 1248		Pathway (7) Not Assigned n = 923		Pathway (7) Assigned n = 325		
		n	%	*n*	%	*n*	%	χ^2
Area 1	Observed	90.0	7.2	65.0	72.2	25.0	27.8	
	Expected			66.6	74.0	23.4	26.0	
Area 2	Observed	74.0	5.9	58.0	78.4	16.0	21.6	
	Expected			54.7	74.0	19.3	26.0	
Area 3	Observed	249.0	20.0	184.0	73.9	65.0	26.1	
	Expected			184.2	74.0	64.8	26.0	
Area 4	Observed	111.0	8.9	80.0	72.1	31.0	27.9	11.61
	Expected			82.1	74.0	28.9	26.0	
Area 5	Observed	139.0	11.1	108.0	77.7	31.0	22.3	
	Expected			102.8	74.0	36.2	26.0	
Area 6	Observed	117.0	9.4	85.0	72.6	32.0	27.4	
	Expected			86.5	74.0	30.5	26.0	
Area 7	Observed	119.0	9.5	97.0	81.5	22.0	18.5	
	Expected			88.0	74.0	31.0	26.0	

Table 35 continued

Area 8	Observed	149.0	11.9	106.0	71.1	43.0	28.9
	Expected			110.2	74.0	38.8	26.0
Area 9	Observed	107.0	8.6	69.0	64.5	38.0	35.5
	Expected			79.1	74.0	27.9	26.0
Area 10	Observed	93.0	7.5	71.0	76.3	22.0	23.7
	Expected			68.8	74.0	24.2	26.0

CA Agribusiness

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach in agribusiness (1) between CA FFA regions. A significant interaction was not found between CA FFA regions (χ^2 *(5*, 461*) = 5.20, p* = .392*).* A contingency coefficient (C = .106, *p* = .392) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in agribusiness (1) that was not statistically significant. Specifically, CA FFA regions South Coast and Superior observed more teachers assigned to teach in agribusiness (1) than expected based on the Chi-square analysis. Conversely, CA FFA regions Central and North Coast observed fewer teachers assigned to teach in agribusiness (1) than expected based on the Chi-square analysis. Table 36 provides further detail of the Chi-square analysis completed.

Table 36

Chi-Square Analysis to Examine Differences in Agribusiness (1) Assignment by CA FFA Region

		Total n = 461		Pathway (1) Not Assigned n = 378		Pathway (1) Assigned n = 83		
		n	%	*n*	%	*n*	%	χ^2
Central	Observed	122.0	26.5	105.0	86.1	17.0	13.9	
	Expected			100.0	82.0	22.0	18.0	
North Coast	Observed	36.0	7.8	32.0	88.9	4.0	11.1	
	Expected			29.5	82.0	6.5	18.0	
San Joaquin	Observed	119.0	25.8	96.0	80.7	23.0	19.3	
	Expected			97.6	82.0	21.4	18.0	5.20
South Coast	Observed	54.0	11.7	40.0	74.1	14.0	25.9	
	Expected			44.3	82.0	9.7	18.0	
Southern	Observed	66.0	14.3	54.0	81.8	12.0	18.2	
	Expected			54.1	82.0	11.9	18.0	
Superior	Observed	64.0	13.9	51.0	79.5	13.0	20.3	
	Expected			52.5	82.0	11.5	18.0	

CA Agricultural Mechanics

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach agricultural mechanics (2) between CA FFA regions. A significant interaction was not found between CA FFA regions (χ^2 *(5,* 461*) = 9.39, p* = .095*).* A contingency coefficient (C = .141, *p* = .095) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in agricultural mechanics (2) that was not statistically significant. Specifically, CA FFA regions Superior and South Coast observed more teachers assigned to teach agricultural mechanics (2) than expected based on the Chi-square analysis. Conversely, CA FFA regions North Coats and Southern observed fewer teachers assigned to teach agricultural mechanics (2) than expected based on the Chi-square analysis. Table 37 provides further detail of the Chi-square analysis completed.

Table 37

Chi-Square Analysis to Examine Differences in Agricultural Mechanics (2) Assignment by CA FFA Region

		Total n = 461		Pathway (2) Not Assigned n = 301		Pathway (2) Assigned n = 160		
		n	%	n	%	n	%	χ^2
Central	Observed	122.0	26.5	78.0	63.9	44.0	36.1	
	Expected			79.7	65.3	42.3	34.7	
North Coast	Observed	36.0	7.8	27.0	75.0	9.0	25.0	
	Expected			23.5	65.3	12.5	34.7	
San Joaquin	Observed	119.0	25.8	77.0	64.7	42.0	35.3	
	Expected			77.7	65.3	41.3	34.7	9.39
South Coast	Observed	54.0	11.7	33.0	61.1	21.0	38.9	
	Expected			35.3	65.3	18.7	34.7	
Southern	Observed	66.0	14.3	51.0	77.3	15.0	22.7	
	Expected			43.1	65.3	22.9	34.7	
Superior	Observed	64.0	13.9	35.0	54.7	29.0	45.3	
	Expected			41.8	65.3	22.2	34.7	

CA Agriscience

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach in agriscience (3) between CA FFA regions. A significant interaction was not found between CA FFA regions (χ^2 *(5*, 461*) = 10.26, p =* .068*).* A contingency coefficient (C = .148, *p* = .068) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in agriscience (3) that was not statistically significant. Specifically, CA FFA regions North Coast and Southern observed more teachers assigned to teach in agriscience (3) than expected based on the Chi-square analysis. Conversely, CA FFA regions Central, San Joaquin, and Superior observed fewer teachers assigned to teach in agriscience (3) than expected based on the Chi-square analysis. Table 38 provides further detail of the Chi-square analysis completed.

Table 38

Chi-Square Analysis to Examine Differences in Agriscience (3) Assignment by CA FFA Region

		Total n = 461		Pathway (3) Not Assigned n = 178		Pathway (3) Assigned n = 283		
		n	%	*n*	%	*n*	%	χ^2
Central	Observed	122.0	26.5	49.0	40.2	73.0	59.8	10.26
	Expected			47.1	38.6	74.9	61.4	
North Coast	Observed	36.0	7.8	12.0	33.3	24.0	66.7	
	Expected			13.9	38.6	22.1	61.4	
San Joaquin	Observed	119.0	25.8	56.0	47.1	63.0	52.9	
	Expected			45.9	38.6	73.1	61.4	
South Coast	Observed	54.0	11.7	19.0	35.2	35.0	64.8	
	Expected			20.9	38.6	33.1	61.4	
Southern	Observed	66.0	14.3	16.0	24.2	50.0	75.8	
	Expected			25.5	38.6	40.5	61.4	
Superior	Observed	64.0	13.9	26.0	40.6	38.0	59.4	
	Expected			24.7	38.6	39.3	61.4	

CA Animal Science

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach animal science (4) between CA FFA regions. A significant interaction was not found between CA FFA regions ($\chi^2(5, 461) = 9.88, p = .079$). A contingency coefficient (C = .145, p = .079) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in animal science (4) that was not statistically significant. Specifically, CA FFA regions Southern and Superior observed more teachers assigned to teach animal science (4) than expected based on the Chi-square analysis. Conversely, CA FFA regions North Coast and San Joaquin observed fewer teachers assigned to teach animal science (4) than expected based on the Chi-square analysis. Table 39 provides further detail of the Chi-square analysis completed.

Table 39

Chi-Square Analysis to Examine Differences in Animal Science (4) Assignment by CA FFA Region

		Total *n* = 461		Pathway (4) Not Assigned *n* = 326		Pathway (4) Assigned *n* = 135		
		n	%	*n*	%	*n*	%	χ^2
Central	Observed	122.0	26.5	88.0	72.1	34.0	27.9	
	Expected			86.3	70.7	35.7	29.3	
North Coast	Observed	36.0	7.8	29.0	80.6	7.0	19.4	
	Expected			25.5	70.7	10.5	29.3	
San Joaquin	Observed	119.0	25.8	90.0	75.6	29.0	24.4	
	Expected			84.2	70.7	34.8	29.3	
South Coast	Observed	54.0	11.7	40.0	74.1	14.0	25.9	9.88
	Expected			38.2	70.7	15.8	29.3	
Southern	Observed	66.0	14.3	39.0	59.1	27.0	40.9	
	Expected			46.7	70.7	19.3	29.3	
Superior	Observed	64.0	13.9	40.0	62.5	24.0	37.5	
	Expected			45.3	70.7	18.7	29.3	

CA Forestry and Natural Resources

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach in forestry and natural resources (5) between CA FFA regions. A significant interaction was not found between CA FFA regions (χ^2 *(5*, 461*) = 4.72*, *p* = .451*).* A contingency coefficient (C = .101, *p* = .451) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in forestry and natural resources (5) that was not statistically significant. Specifically, CA FFA regions Central and San Joaquin observed more teachers assigned to teach in forestry and natural resources (5) than expected based on the Chi-square analysis. Conversely, CA FFA regions North Coast and Southern observed fewer teachers assigned to teach in forestry and natural resources (5) than expected based on the Chi-square analysis. Table 40 provides further detail of the Chi-square analysis completed.

Table 40

Chi-Square Analysis to Examine Differences in Forestry and Natural Resources (5) Assignment by CA FFA Region

		Total *n* = 461		Pathway (5) Not Assigned *n* = 448		Pathway (5) Assigned *n* = 13		
		n	%	*n*	%	*n*	%	χ^2
Central	Observed	122.0	26.5	117.0	95.9	5.0	4.1	
	Expected			118.6	97.2	3.4	2.8	
North Coast	Observed	36.0	7.8	36.0	100.0	0.0	0.0	
	Expected			35.0	97.2	1.0	2.8	
San Joaquin	Observed	119.0	25.8	114.0	95.8	5.0	4.2	
	Expected			115.6	97.2	3.4	2.8	4.72
South Coast	Observed	54.0	11.7	53.0	98.1	1.0	1.9	
	Expected			52.5	97.2	1.5	2.8	
Southern	Observed	66.0	14.3	66.0	100.0	0.0	0.0	
	Expected			64.1	97.2	1.9	2.8	
Superior	Observed	64.0	13.9	62.0	96.9	2.0	3.1	
	Expected			62.2	97.2	1.8	2.8	

CA Ornamental Horticulture

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach in ornamental horticulture (6) between CA FFA regions. A significant interaction was not found between CA FFA regions (χ^2 *(5,* 461*) = 1.07, p* = .957*).* A contingency coefficient (C = .048, *p* = .957) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in ornamental horticulture (6) that was not statistically significant. Specifically, CA FFA regions San Joaquin, South Coast, and Southern observed more teachers assigned to teach in ornamental horticulture (6) than expected based on the Chi-square analysis. Conversely, CA FFA regions Central and North Coast observed fewer teachers assigned to teach in ornamental horticulture (6) than expected based on the Chi-square analysis. Table 41 provides further detail of the Chi-square analysis completed.

Table 41

Chi-Square Analysis to Examine Differences in Ornamental Horticulture (6) Assignment by CA FFA Region

		Total n = 461		Pathway (6) Not Assigned n = 331		Pathway (6) Assigned n = 130		
		n	%	*n*	%	*n*	%	χ^2
Central	Observed	122.0	26.5	90.0	73.8	32.0	26.2	
	Expected			87.6	71.8	34.4	28.2	
North Coast	Observed	36.0	7.8	27.0	75.0	9.0	25.0	
	Expected			25.8	71.8	10.2	28.2	
San Joaquin	Observed	119.0	25.8	84.0	70.6	35.0	29.4	
	Expected			85.4	71.8	33.6	28.2	1.07
South Coast	Observed	54.0	11.7	38.0	70.4	16.0	29.6	
	Expected			38.8	71.8	15.2	28.2	
Southern	Observed	66.0	14.3	45.0	68.2	21.0	31.8	
	Expected			47.4	71.8	18.6	28.2	
Superior	Observed	64.0	13.9	47.0	73.4	17.0	26.6	
	Expected			46.0	71.8	18.0	28.2	

CA Plant Science

A Chi-square test of independence (2 x 6) was calculated comparing the frequency of AFNR teachers assigned to teach plant science (7) between CA FFA regions. A significant interaction was not found between CA FFA regions (χ^2 *(5*, 461*) = 1.07, p =* .957*).* A contingency coefficient (C = .048, *p* = .957) for the Chi-square analysis described a small association between the CA FFA region and assignment to teach in plant science (7) that was not statistically significant. Specifically, CA FFA regions Southern and Superior observed more teachers assigned to teach plant science (7) than expected based on the Chi-square analysis. Conversely, CA FFA regions Central and North Coast observed fewer teachers assigned to teach plant science (7) than expected based on the Chi-square analysis. Table 42 provides further detail of the Chi-square analysis completed.

Table 42

Chi-Square Analysis to Examine Differences in Plant Science (7) Assignment by CA FFA Region

		Total n = 461		Pathway (7) Not Assigned n = 387		Pathway (7) Assigned n = 74		
		n	%	*n*	%	*n*	%	χ^2
Central	Observed	122.0	26.5	107.0	87.7	15.0	12.3	
	Expected			102.4	83.9	19.6	16.1	
North Coast	Observed	36.0	7.8	32.0	88.9	4.0	11.1	
	Expected			30.2	83.9	5.8	16.1	
San Joaquin	Observed	119.0	25.8	97.0	81.5	22.0	18.5	
	Expected			99.9	83.9	19.1	16.1	1.07
South Coast	Observed	54.0	11.7	47.0	87.0	7.0	13.0	
	Expected			45.3	83.9	8.7	16.1	
Southern	Observed	66.0	14.3	53.0	80.3	13.0	19.7	
	Expected			55.4	83.9	10.6	16.1	
Superior	Observed	64.0	13.9	51.0	79.7	13.0	20.3	
	Expected			53.7	83.9	10.3	16.1	

Implications of RQ2.3

Research question 2.3 aimed to compare AFNR teacher-assigned pathways by California FFA region and TX FFA area. AFNR teacher assignments were compared within each pathway in the different FFA regions and areas. Through the analysis of the available data, the researchers believe the following to be notable implications in research question 2.3. The following section will outline the practical impacts the data revealed to the authors.

A statistically significant, at the $p < .05$ level, chi-square statistic was observed in just two of the chi-square analyses conducted. The applied agricultural engineering and animal science pathways were the only pathways that contained a statistically significant chi-square statistic when compared between TX FFA areas. In addition to the chi-square statistic, a contingency coefficient value was calculated for each of the chi-square analyses. The calculated contingency coefficients remained stable across the chi-square analysis by pathway. Seven chi-square statistics and coefficients were calculated with the pathway assignments in Texas. Of the seven pathways, in just two of them can we attribute any of the observed variance to TX FFA area in terms of teacher assignment by pathway.

Whereas in California, seven chi-square statistics and coefficients were calculated with the pathway assignments. No chi-square statistics returned a statistically significant value in California. Therefore, the researchers cannot attribute any of the shared variance to the different CA FFA regions. Notably, regional differences in program planning support the federal Perkins legislation (Hyslop, 2018). Local education agencies are required to hold advisory board meetings designed to assist local programs in course offerings, planning, development, implementation, and evaluation of career technical education programs (Hyslop, 2018). The lack of significant findings when comparing teacher assignment pathways by FFA area and region indicates that the need for teachers to teach in the different pathways is nearly equal/consistent across the CA FFA regions and Texas FFA areas. Regardless of where a teacher chooses to teach, a similar need in school-based agricultural education exists.

RQ 2.4

AFNR teachers wear many hats—as FFA advisors, classroom teachers, and SAE supervisors but specifically in the classroom. AFNR teachers may teach in many different areas of the AFNR curriculum. The purpose of research question 2.4 was to describe and evaluate how AFNR teachers spend their time between the many different pathways to which they could potentially be assigned by local school administrators. Teachers self-reported a breakdown of their teaching load by pathway. Respondents indicated what percentage of their day was spent in each pathway. Their totals had to equal 100% for this question on the survey. In addition to state-recognized AFNR pathways, the instrument also included a choice to indicate how much time was spent in an administrative appointment.

In California, 461 respondents identified the breakdown by pathway of their day in the AFNR classroom. The pathway with the greatest number of teachers indicating that they spent some amount of time during their day in was the Agriscience pathway (*f*

= 280, 60.7%). Whereas teachers who indicated that they spent some amount of time teaching in Agricultural Mechanics spent the greatest percentage of their day in that pathway (M = 66.5%). While the Forestry and Natural Resources pathway had the fewest number of teachers indicate that they spent time teaching in the pathway (f = 13, 2.8%). The Agricultural Business pathway had the lowest mean percentage of time spent in the pathway outside of the administrative appointment option. The administrative appointment option received the greatest number of responses (f = 443, 96.1%) but had the smallest mean percentage of time spent in administration (M = 10.9%).

Table 43

Summary of AFNR Teacher Time by Pathway Assignments in CA (n = 461)

	f	%	M percentage of time
California AFNR Pathways			
Agribusiness	83.0	18.0	26.1
Agricultural Mechanics	160.0	34.7	66.5
Agriscience	280.0	60.7	53.4
Animal Science	136.0	29.5	31.5
Forestry and Natural Resources	13.0	2.8	31.2
Ornamental Horticulture	130.0	28.2	36.6
Plant and Soil Science	73.0	15.8	31.5
Administrative Duties	443.0	96.1	10.9

Note. Mean is based on the self-reported percentage of time AFNR teachers spent in that pathway or in administrative duties.

In Texas, 1,248 respondents identified the breakdown by pathway of their day in the AFNR classroom. The pathway with the greatest number of teachers indicating that they spent some amount of time during their day in was the Animal Science pathway (*f* = 650, 52.1%). Whereas teachers who indicated that they spent some amount of time teaching in Applied Agricultural Engineering spent the greatest percentage of their day in that pathway (M = 57.8). While the Food Science and Technology pathway had the fewest number of teachers indicating that they spent time teaching in the pathway (*f* =

56, 4.5%). The Agricultural Business pathway had the lowest mean score of time spent in the pathway outside of the administrative appointment option (M = 24.7). The administrative appointment option received the greatest number of responses (*f* = 898, 71.9%) while having a small mean value of time spent in administration (M = 28.9). Table 44 provides a summary of AFNR teacher time by pathway assignment in Texas.

Table 44

Summary of AFNR Teacher Time by Pathway Assignments in TX (n = 1248)

	f	%	M
Texas AFNR Pathways			
Agribusiness	89.0	7.1	24.7
Animal Science	650.0	52.1	46.5
Applied Agricultural Engineering	371.0	29.7	57.8
Natural Resources	136.0	10.9	28.5
Food Science Technology	56.0	4.5	30.5
Plant Science	277.0	22.2	42.7
General AFNR	307.0	24.6	47.0
Administrative Duties	898.0	71.9	28.9

Note. Mean is based on the self-reported percentage of time AFNR teachers spent in that pathway or in administrative duties.

Discussion of RQ2.4

Research question 2.4 aimed to describe the amount of time AFNR teachers spent in their different assigned pathways. Through the analysis of the available data, the researchers believe the following to be notable implications in research question 2.3. The following section will outline the practical impacts the data revealed to the authors.

It is understood that there are different levels of intensity and time commitment that AFNR teachers expend on different pathways. There are many differences in positions including how much time is spent or assigned in each of the different pathways. Some teachers spend 100% of their time in the General AFNR pathway of Texas and some teachers have their time evenly split between two or more pathways.

In California, I found that teachers who were assigned to teach in the agricultural mechanics pathway had the greatest amount of time spent in that pathway with an average of 66.5% of their day spent in the agricultural mechanics pathway. The frequency of teachers assigned to the agricultural mechanics pathway was second to the agriscience pathway. Teachers assigned to the agriscience pathway had an average of 53.4% of their time spent in that pathway.

In Texas, I found that teachers who were assigned to teach in the applied agricultural engineering pathway had the greatest amount of time spent in that pathway with an average of 57.8% of their day spent in the applied agricultural engineering pathway. The frequency of teachers assigned to the agricultural mechanics pathway was second to the animal science pathway. Teachers assigned to the animal science pathway had an average of 46.5% of their time spent in the pathway.

The practical implications of these findings reside in the preparation of entry-level AFNR teachers. As pre-service teachers are prepared, they must have a firm understanding of what the positions available will entail. Whereas 29.7% of TX AFNR teachers and 34.7% of CA AFNR teachers report teaching in the agricultural mechanics pathway or program of study, those who do teach in agricultural mechanics spend a majority of their day in that pathway. In agreement with the current body of research, many pre-service and early career AFNR teachers do not have the self-efficacy and skillsets to teach in specific pathways, primarily agricultural mechanics-based courses (Blackburn et al., 2015; Burris et al., 2005; Leiby et al., 2013; Shultz et al., 2014; Tummons et al., 2017). Educator preparation programs must be aligned with the needs of the industry they serve.

Respondents were provided an opportunity to indicate if they spent time in administrative duties as part of their contracted day. While the intention was to account for those teachers who also may have held an administrative appointment such as a department head, CTE director, etc. we believe that almost all teachers perceived they had and thus accounted for administrative duties. Over 400 teachers in California and over 900 teachers in Texas responded that they spent time during their day in administrative duties. The researchers found this to be interesting. We believe this to be inaccurate due to a misunderstanding in the questionnaire. It is believed that respondents included general administrative duties they complete that are otherwise considered part of the job such as managing program budgets, registrations for events, and managing required paperwork for an effective school-based agricultural education program instead of actual, formal administrative assignments.

RQ 2.5

Research question 2.5 described perceptions of pathway growth in California and Texas. Study participants were asked to rank order the state-adopted AFNR pathways from the fastest-growing to the slowest growing pathway.

In California, the pathway with the greatest perceived growth was the agriscience pathway with a mean score of 2.60 (*SD* = 1.62). The pathway with the least amount of growth was the forestry and natural resources pathway, with a mean score of 6.15 (*SD* = 1.30). Table 45 provides an analysis of the perceived pathway growth at the local program level by all respondents. Effect size, using Cohen's *d*, was used to describe the practical differences between these pathway rankings. Cohen's *d* was calculated using a pooled standard deviation (*SD* = 1.66) across means. A negligible effect size (*d* = .048) was found between the agriscience and agricultural mechanics pathways. A medium effect size (*d* = 0.663) was found between the animal science and agricultural mechanics pathways indicating a practical difference in rankings. Small effect size was found between animal science and ornamental horticulture (*d* = .241). Negligible effect sizes were found between ornamental horticulture and agribusiness (*d* = .060) and the agribusiness and plant and soil science pathways (*d* = .024). A large effect size (*d* = 1.102) was found between the plant and soil science and forestry and natural resources pathways. Practically the teachers perceived two groups agriscience and agricultural mechanics as growing rapidly, while animal science, ornamental horticulture, agribusiness, and plant and soil science are moderate, and the forestry and natural resources pathways is low in growth.

Table 45

Perceived pathway growth by California agriculture teachers (n = 427)

		Total		
AFNR Pathway	Rank	*M*	*SD*	*d*
Agriscience	1	2.60	1.62	
				0.048
Agricultural Mechanics	2	2.68	1.71	
				0.663
Animal Science	3	3.78	1.59	
				0.241
Ornamental Horticulture	4	4.18	1.73	
				0.060
Agribusiness	5	4.28	1.79	
				0.024
Plant and Soil Science	6	4.32	1.87	
				1.102
Forestry and Natural Resources	7	6.15	1.30	

In Texas, the pathway with the greatest perceived growth was the animal science pathway with a mean rank of 2.20 (*SD* = 1.31). The pathway with the least amount of growth was the food science and technology pathway, with a mean rank of 5.15 (*SD* = 1.47). Table 46 provides an analysis of the perceived pathway growth at the local program level by all respondents. Effect size, using Cohen's *d*, was used to describe the practical differences between these pathway rankings. Cohen's *d* was calculated using a pooled standard deviation (*SD* = 1.69) across means. A small effect size (*d* = .367) was found between the animal science and applied agricultural engineering pathways. A medium effect size (*d* = 0.757) was found between the plant and soil science and applied agricultural engineering pathways indicating a practical difference in rankings. A negligible effect size was found between plant and soil science and agribusiness (*d* = .059). Negligible effect sizes were also found between natural resources and agribusiness (*d* = .183) and the general AFNR and food science and technology pathways (*d* = .071). A small effect size (*d* = .308) was found between the natural resources and general AFNR pathways. Practically the teachers perceived two pathways animal science and applied agricultural engineering as growing rapidly. While agribusiness, plant and soil science, and natural resources are moderate in perceived growth, the general AFNR and food science and technology pathways are low in growth.

Table 46

Perceived Pathway Growth by Texas Agriculture Teachers (n = 427)

AFNR Pathway	Rank	Total		*d*
		M	*SD*	
Animal Science	1	2.20	1.31	
				0.367
Applied Agri. Engineering	2	2.82	1.77	
				0.757
Plant and Soil Science	3	4.10	1.90	
				0.059
Agribusiness	4	4.20	1.76	
				0.183
Natural Resources	5	4.51	1.43	
				0.308
General AFNR	6	5.03	2.23	
				0.071
Food Science and Technology	7	5.15	1.47	

Discussion of RQ2.5

Research question 2.5 aimed to describe perceived local pathway growth AFNR teachers by California and Texas teachers.

Local program growth is driven by student interest and student enrollment. While teachers do have some control over the growth of pathways, it is difficult to argue the impact of student interest on enrollment. In California, the increase in student enrollment in agriculture courses approved for science credit drove the growth of the agriscience pathway. As students could take agriculture courses that they enjoyed and earn science credit it was a win-win for students and program growth (California Department of

Education, 2013). The demand for the a-g approved agriscience courses propelled program growth throughout much of the 2010s in California. The agricultural mechanics pathway was a close second in perceived program growth. While there is no science credit awarded for agricultural mechanics courses, a renewed appreciation in the field of industrial careers has fueled a larger acceptance and embraced the agricultural mechanics pathway as a viable career pathway for students. A finding that should be upsetting to many is the perception of low growth in the forestry and natural resources pathway. The California forestry industry has continued to be at odds with many regulations that have all but crippled the timber and natural resources industry in California.

In Texas, the animal science program is perceived as the fastest growing pathway, with the applied agricultural engineering pathway a close second. Whereas the food science and technology pathway was perceived to have the lowest amount of growth of the seven pathways in Texas. It may come as no surprise that animal science in Texas is perceived as a fast-growing pathway. The youth livestock industry has experienced tremendous success across the state with hundreds of millions of dollars contributed to the economy each year through youth livestock programs (Hanagriff et al., 2009, 2014). The applied agricultural engineering pathway continues to gain momentum in terms of student enrollment and popularity across the state of Texas. Similarly, the junior agricultural mechanics project shows have grown rapidly since their inception in the early 21st century (Hanagriff et al., 2014). The food science and technology pathway was observed to have perception of little growth among AFNR teachers. A potential barrier to the food science and technology pathway is the need for specialized equipment that requires intensive capital outlay to acquire. The perceptions of growth align with and support the FTE counts and enrollments published by the Texas Education Agency (2022).

Summary of the Results and Discussion

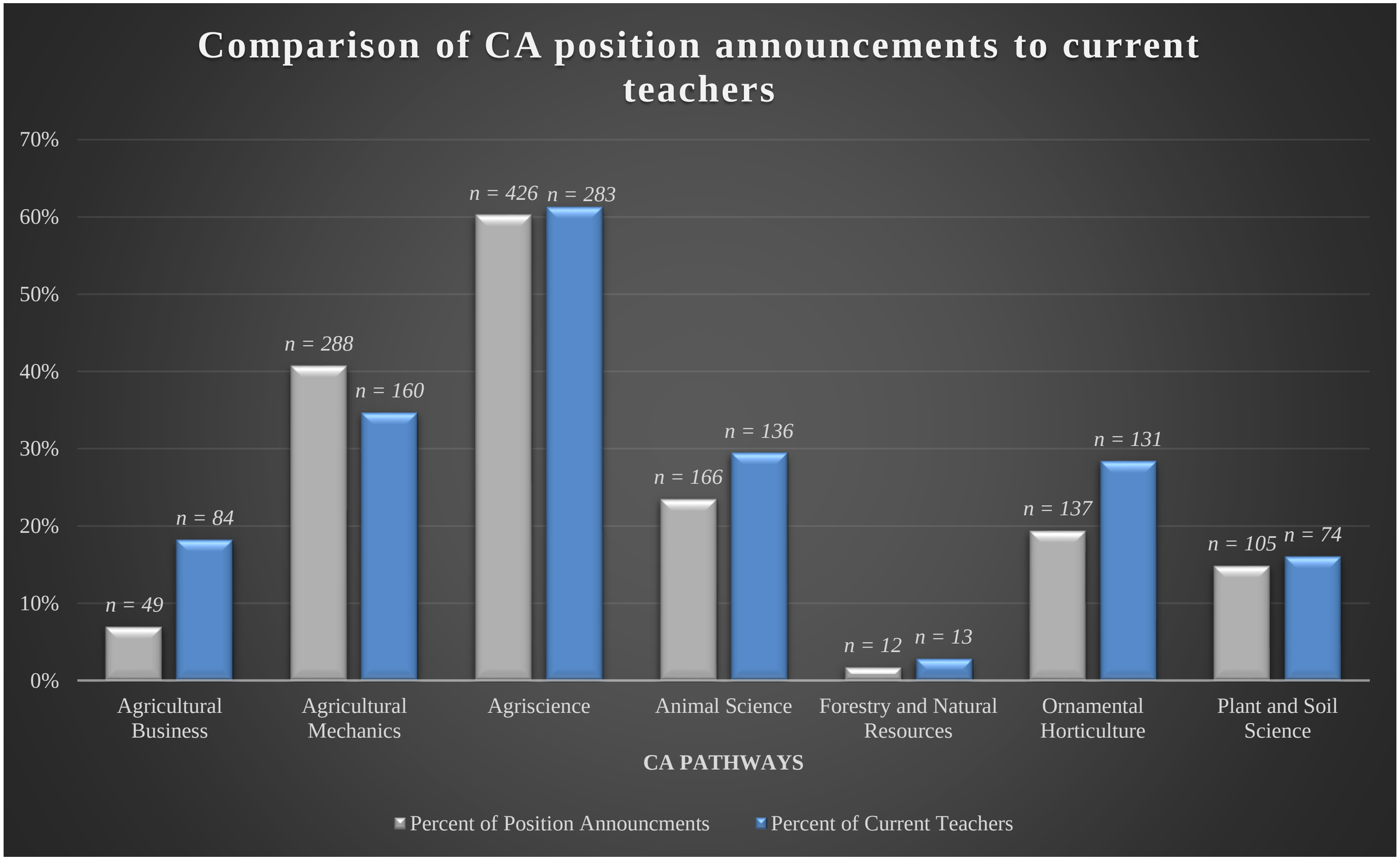
The struggle to fill teaching positions in education is not new. School-based agricultural education is not immune to the teacher shortages facing many areas of education. Dating back to the C.D. Jarvis bulletin by the Department of the Interior (1921), agricultural education has experienced difficulties in filling positions. Many researchers have continued attempting the daunting task of monitoring and measuring school-based agricultural education teacher supply and demand. The focus continues most recently with Foster et al. (2015) conducting similar studies. In this study I sought to provide additional insight to the current issue of the perceived teacher shortage. Two data sets were used to bring together and identify the current status of the demand for teachers in school-based agricultural education. Advertised job positions and the associated announcements, paired with a teacher survey designed to gain an understanding of teacher assignments, allowed me to construct a baseline in light of pathway demand for future programming in teacher certification.

California Agricultural Education –

As the second-largest state in terms of FFA membership, the need for agriculture teachers in California is large (Meyer, 2020). This study sought to be more specific in understanding what skill sets these agriculture teachers need. We found that in California, over the nearly decade-long compilation of job posting advertisements, 707 positions were posted, and of those, 60.3% (n = 426) sought to hire teachers with a skill set or desire to teach in the agriscience pathway. Not far behind the agriscience pathway was the agricultural mechanics pathway with 40.7% (n = 288) of posted positions seeking a candidate with a skill set or desire to teach in this pathway.

Figure 7

Comparison of CA Position Announcements to Current Teachers



The teacher survey of current California AFNR teachers told a similar story with 61.3% (n = 283) of the 461 respondents indicating that they were assigned to teach in the agriscience pathway at least some part of their day. The agricultural mechanics pathway was reported by 34.6% (n = 160) of California teachers as a pathway they were assigned to for some part of their day. Figure 7 provides a side-by-side visual representation of these two data sets for California. A summary of the side-by-side comparison of California position announcements to current teacher assignments is provided in Table 47.

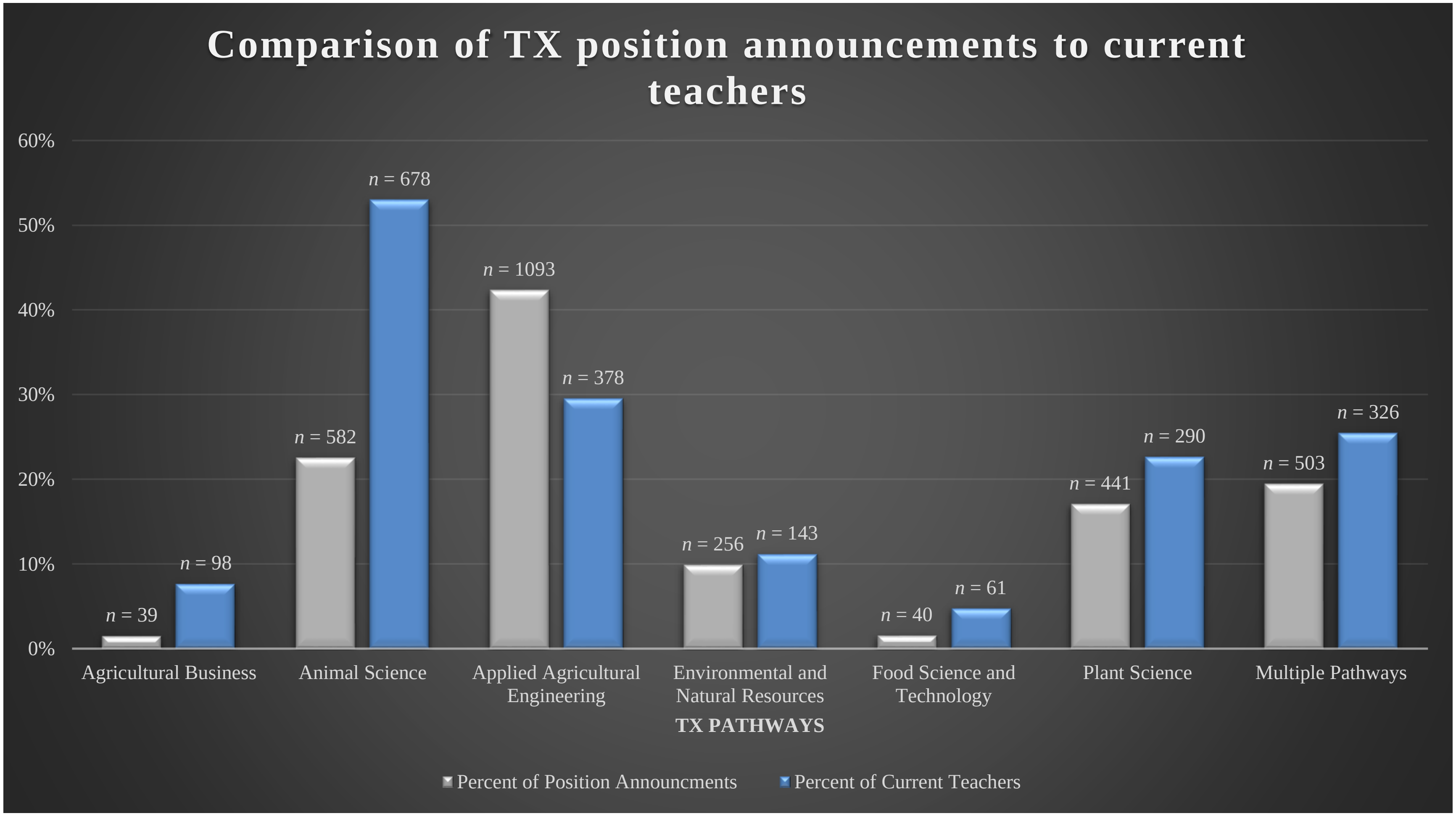
Table 47

Comparison of CA Position Announcements to Current Teacher Assignments

	CA Position Announcements *n* = 707		CA Teacher Assignments *n* = 462	
	f	%	*f*	%
Agricultural Business	49.0	6.9	84.0	18.2
Agricultural Mechanics	288.0	40.7	160.0	34.6
Agriscience	426.0	60.3	283.0	61.3
Animal Science	166.0	23.5	136.0	29.4
Forestry and Natural Resources	12.0	1.7	13.0	2.8
Ornamental Horticulture	137.0	19.4	131.0	28.4
Plant and Soil Science	105.0	14.9	74.0	16.0

Figure 8

Summary of AFNR Position Advertisement Specificity in California and Texas



Texas Agricultural Education –

As the largest state in terms of FFA membership, the need for agriculture teachers in Texas is large (Meyer, 2020). My study sought to be more specific in understanding what skill sets these agriculture teachers need. I found that in Texas, over the nearly decade-long compilation of job posting advertisements, 2,582 positions were posted and of those, 42.3% (*n* = 1,093) sought to hire teachers with a skill set or desire to teach in the applied agricultural engineering pathway. Behind the applied agricultural engineering pathway was the animal science pathway with 22.5% (*n* = 582) of posted positions seeking a candidate with a skill set or desire to teach in this pathway. Additionally, the teacher survey of current Texas AFNR teachers told a slightly different story with 53.0% (*n* = 678) of the 1,279 respondents indicating that they were assigned to teach in the animal science pathway at least some part of their day. Whereas, the applied agricultural engineering pathway was reported by 29.6% (*n* = 378) of Texas teachers as a pathway they were assigned to for some part of their day. Figure 8 provides a side-by-side visual representation of these two data sets for Texas. A summary of the side-by-side comparison of Texas position announcements to current teacher assignments is provided in Table 48.

Table 48

Comparison of TX Position Announcements to Current Teacher Assignments

	TX Position Announcements n = 2582		TX Teacher Assignments n = 1279	
	f	%	*f*	%
Agricultural Business	39.0	1.5	98.0	7.7
Animal Science	582.0	22.5	678.0	53.0
Applied Agricultural Engineering	1093.0	42.3	378.0	29.6
Natural Resources	256.0	9.9	143.0	11.2
Food Science and Technology	40.0	1.5	61.0	4.8
Plant Science	441.0	17.1	290.0	22.7
General AFNR	503.0	19.5	326.0	25.5

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

In the preceding four chapters, I identified and explained the current state of the AFNR teacher shortage. Importantly, the AFNR teacher shortage is more complex than a monolithic problem. Historically, the approach to addressing teacher shortages is simply to train and retain more teachers. However, there is now strong evidence that suggests that educator preparation programs and those entities involved with teacher certification be aware of, and develop policy and programs that address the specific pathways with the greatest demand. The United States workforce depends upon the education system to prepare tomorrow's workforce.

As the workforce continues in the third decade of the 21st century, extensive literature and government policy has addressed the growing skills gap plaguing the United States workforce (P. H. Cappelli, 2015; Christo-Baker et al., 2017; Daggett, 2005; Eisen et al., 2005; Giffi et al., 2014, 2015; Morrison et al., 2011; Toossi, 2013; United States Bureau of Economic Analysis, 2020). Career technical education (CTE) programs have been identified as a valid option for providing the United States workforce with qualified individuals to enter the workforce (G. W. Cappelli, 2014; Charlton et al., 2019; Conneely & Uy, 2009; Rojewski, 2002; Wonacott, 2003). However, the growing teacher shortage impacting the public school system of the United States provides considerable concern that students will not receive the preparation they need to enter the workforce (Castro et al., 2018; Cross, 2017; Goldring et al., 2013; National Center for Education Statistics, 2015; National Research Council, 2010; Sutcher et al., 2016, 2019). School-based agricultural education is not immune to the teacher shortage. The growing need for agricultural education teachers has been studied for many years with similar results coming from each of the studies (California Agriculture Teachers Association, 2020; Camp, 2000; Camp et al., 2002; Craig, 1981; Eck & Edwards, 2019; Foster et al., 2014, 2015, 2020a, 2020c; Kantrovich, 2007, 2010; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; R. Weaver, 2000). However, school-based agricultural education is a broad subject area with many different pathways included in the AFNR career cluster (Advance CTE, 2022; California Department of Education, 2017; Texas Education Agency, 2019, 2022). As school-based agricultural education enrollment and National FFA membership grow, the need for qualified agriculture teachers grows as well (Eck & Edwards, 2019; Meyer, 2020; Sheehan & Moore, 2019). I found that the agricultural education teacher shortage is more complex and cannot be solved with a monolithic approach. The traditional monolithic approach to the agriculture teacher shortage assumes that matching one available position with one prepared candidate solves the agriculture teacher shortage. Throughout the AFNR teacher shortage literature, limited emphasis has been placed on the different pathways within the AFNR career cluster. Before this study, I had extensive anecdotal evidence suggesting that a handful of pathways were contributing to the AFNR teacher shortage at disproportionate rates. I received many requests for AFNR teachers who were prepared and willing to teach in the fields of agricultural mechanics and floriculture (plant science in TX or ornamental horticulture in CA) pathway. Whereas, the number of requests for AFNR teachers prepared and willing to teach in the areas of animal science, horticulture, and general AFNR classes were limited.

Summary

Through careful examination of AFNR position announcements and current AFNR teacher assignments, I sought to gather more information and develop a more specific understanding of the hiring needs of local education agencies as it pertains to school-based agricultural education. The purpose of this study was to evaluate the alignment of pathway skills included in AFNR position advertisements with current teacher assignments by AFNR pathways as it relates to personnel needs of secondary AFNR programs. The following research objectives and questions guided this study:

Research objective 1.0 was to describe, compare, and illustrate trends in CA and TX advertised AFNR job postings between 2011 and 2019. The following research questions were used to support research objective 1.0.

RQ1.1 – Describe AFNR positions advertised between 2011 - 2019 in CA and TX.

RQ1.2 – Are AFNR position advertisements different by pathway in CA FFA Regions and TX FFA Areas?

RQ1.3 – Describe AFNR pathways within positions advertised by year.

Research objective 2.0 was to describe, compare, and illustrate the current status of AFNR teaching assignments by pathway in CA and TX.

RQ2.1 – Describe the demographic characteristics of AFNR teachers in CA and TX.

RQ2.2 – Describe current AFNR teaching assignments by pathway.

RQ2.3 – Are AFNR teacher assignments by pathway different in CA FFA Regions and TX FFA Areas?

RQ2.4 – Describe AFNR teacher assignments by time spent within pathways in CA and TX.

RQ2.5 – Describe teacher perceptions of pathway growth at the local level in CA and TX.

This study was conducted with two research purposes. I achieved those purposes by using separate data sets for each objective. The first section of this study was a content analysis of AFNR position advertisements in California and Texas between 2011 and 2019. The position advertisements were obtained from the entities that house the AFNR job boards for each state. In California, California Polytechnical University-San Luis Obispo managed the position advertisement database. Whereas, in Texas, the Vocational Agricultural Teachers Association of Texas (VATAT) maintained the AFNR careers database. More than 3,500 position descriptions/job announcement made up the data set for California (n = 707) and Texas (n = 2,582). Criteria for including a position announcement in the data set for analysis were as follows:

1. Each position must be for a secondary AFNR position.
2. Each position must be for a position in California if it is in the data acquired for California or a position in Texas if it is in the data acquired for Texas.
3. A job announcement must have a description of skills or pathways in which the teacher would teach.

Additionally, duplicate position advertisements were addressed during the coding phase of the study. A three-step process was used to identify duplicate positions. If a position advertisement was determined to be a duplicate, it was excluded from the study.

After each of the position advertisements was determined to meet inclusion criteria, they were coded based on the researcher's developed coding sheets. The coding sheets identified the variables and the labels associated with each of the variables to measure. The primary variables were state, region (CA) or area (TX), posting year, FTE, and pathways requested. Following the coding of the position advertisements, the data file was uploaded into SPSS v.28 for statistical analysis. The results of the statistical analysis were compiled and reported in chapter four of this dissertation.

The second section of this study used a cross-sectional designed survey research protocol. The identified sampling frame for this study was all current AFNR teachers based on professional organization membership. Membership rosters and a consent to survey were obtained from the California Agricultural Teachers Association and the Vocational Agriculture Teachers Association of Texas. The researcher-developed survey instrument was sent via email to all members listed in the CATA directory in the spring of 2019. Whereas, the survey instrument was included as part of a bi-annual teacher survey conducted by the VATAT in the fall of 2019. The questions asked were the same for both California and Texas respondents except for differences in identified pathways. Qualtrics software survey research platform was used to conduct both of the survey collections. The respondent results from the Qualtrics surveys were then uploaded into SPSS v.28 for statistical analysis. The results of the analysis are reported in Chapter 4 of this dissertation.

The results of this study may be useful and practical for furthering the body of knowledge and current practices in agricultural education and the preparation of future agricultural education teachers.

Research Objective 1.0 – Conclusions

Considering the findings in this study and within the identified limitations, I drew the following conclusions from research objective 1.0:

1. Demand for AFNR teachers by pathway is not equal across the pathways. Specific pathways were desired and more frequently requested in position announcements than others.
2. There are clearly identifiable differences in demand when pathways are compared between FFA regions or FFA areas.
3. Specific pathways experienced growth and demand while others experienced decline between 2011 and 2019.

Conclusion one: Demand for AFNR teachers by pathway is not equal across the pathways. Specific pathways were more frequently requested than others.

Research question 1.1 sought to describe positions advertised for AFNR positions between 2011 and 2019 in California and Texas. California and Texas are not only large states geographically, but also claim the top two spots for National FFA student membership (Meyer, 2020). While California and Texas do represent a large body of National FFA Membership, differences among states warrant caution when generalizing these results broadly across the United States.

Position announcements for AFNR teachers numbered more than 3,200 between 2011 and 2019. With over 700 of those positions coming from California, that left the number one state for National FFA membership, Texas, with a staggering 2,582 positions advertised for AFNR teachers during the same time (Meyer, 2020). There is no doubt that educator preparation programs are important and needed as the need for teachers continues to outpace the supply of new teachers. The data suggest that pathways are not created equal in terms of demand. In Texas alone, 1,093 positions requested perspective candidates who have skill sets in and are willing to teach in the applied agricultural engineering program of study. The 1,093 positions represent more than 42.3% of total positions advertised in Texas. When considering only those positions that specified a pathway or program of study (n = 872), the number of those requesting applied agricultural engineering was 63.9% of advertised positions.

California and Texas experienced similar results for the pathways that exhibited the least amount of demand or specific request in advertisements. The forestry and natural resources, agribusiness, and food science and technology pathways experienced low demand for teachers with skill sets in these fields. In California, the agricultural business and forestry and natural resources pathways accounted for 8.6% of all the positions posted. Whereas in Texas, agricultural business and food science and technology accounted for just 3.0% and environmental and natural resources accounted for another 10%. These findings support student enrollment and FTE counts from state data (California Department of Education, 2017; Texas Education Agency, 2019, 2022).

Educator preparation programs are charged with preparing teachers for the demands of the classroom. A significant factor in determining fit for a local education agency is the ability or the perceived ability of a candidate to facilitate learning in a specific subject area. Just as a science teacher may not be well prepared to teach physics, AFNR teachers are not necessarily interchangeable between pathways. The findings from this study strongly support the anecdotal evidence available before this study. Agricultural mechanics/applied agricultural engineering positions were harder to fill and therefore, more demand for these positions existed. Over 46% of positions in California and over 63% of positions in Texas that identified a pathway in their request specifically sought to hire a teacher in the agricultural mechanics/applied agricultural engineering pathway or program of study. These figures are staggering and demonstrate a tremendous need for further preparation of pre-service teachers in this pathway or program of study.

The number of positions posted in California and Texas represents a large demand for AFNR teachers. There are other indicators of differences that were found in the data that are important to the industry. In 2018, Texas FFA Association underwent a massive project to realign the 10 Texas FFA Area Associations into 12 more equitable areas. The data collected and analyzed for this study validated the need for addressing the unequal distribution of membership between the Texas FFA Area Associations. Between 2011 and 2019 of the 2,582 positions posted in Texas 488 (18.9%) of those positions were in the Texas FFA Area 3 Association. This represents nearly twice as many positions as the other area associations. The three largest areas were the primary focus of the area realignment process in 2018, which included Area 3, Area 7, and Area 8. While the California FFA Association has not undergone any wide-sweeping realignments, there are regions in California that represent a larger population of students and therefore teachers. In California, the Central Region and San Joaquin region make up more than 55% of the states advertised AFNR positions.

Over the nearly decade span that job position data were collected, 707 positions were posted in California with 2,582 positions posted in Texas. In California, the 2015 hiring year observed the greatest number of positions advertised. Whereas in Texas, a slight growth trend was observed during the 2019 hiring cycle bringing the greatest number of posted advertisements (f = 382). The findings from this section of the study align with the projections and growth estimates presented in the current and historical body of literature (Camp, 2000; Camp et al., 2002; Craig, 1981; Cross, 2017; Eck & Edwards, 2019; Foster et al., 2014, 2015, 2020c, 2020a; Kantrovich, 2007, 2010; National Center for Education Statistics, 2015; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; Sutcher et al., 2016, 2019; Woodin, 1967).

I also included part-time and full-time data in the analysis of advertised positions. Overwhelmingly, the positions advertised were full-time positions. Very few part-time positions were available in California and Texas. I observed just 27 part-time positions of the 707 posted advertisements in California. While in Texas, I observed 2 part-time positions of the 2,582 posted advertisements. Temporary positions, those positions advertised with specific start and end dates, were advertised primarily to fill maternity leave absences and semester-long personnel needs. In California, 57 of the 707 positions advertised were temporary positions. Whereas, 14 of the 2,582 positions advertised in Texas were temporary positions.

The goal of educator preparation programs is to prepare teachers to obtain employment as a teacher and be successful in their teaching career. However, as it is well documented in AFNR teacher supply and demand studies, a significant portion of newly trained teachers choose not to enter the profession (Camp, 2000; Camp et al., 2002; Craig, 1981; Cross, 2017; Eck & Edwards, 2019; Foster et al., 2014, 2015, 2020c, 2020a; Kantrovich, 2007, 2010; National Center for Education Statistics, 2015; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; Sutcher et al., 2016, 2019; Woodin, 1967). While the factors that go into these decisions have not been studied, the results from my study can help pre-service teachers make decisions regarding possible employment. As pre-service teachers explore possible positions, data including pathway demand, and pathway demand in specific regions or areas can lead to an increase in pre-service teachers filling positions. Additionally, as teachers accept positions with more information available job satisfaction can increase from identifying a proper fit which would ultimately lead to an increase in teacher retention. Multiple studies have identified teacher retention as the strongest solution for solving the teacher shortage (Cross, 2017; Eck & Edwards, 2019; Sutcher et al., 2016, 2019)

Conclusion two: There are clearly identifiable differences in demand when pathways are compared among FFA regions (CA) or FFA areas (TX).

Research question 1.2 sought to compare AFNR position pathway advertisements in California FFA regions and Texas FFA areas. Both California and Texas are large states both geographically and in population. With large states such as these, differences in labor market and demand can vary considerably. This research question allowed me to determine if there were significant differences regionally.

Eleven chi-square analyses were conducted to answer research question 1.2. Six chi-square tests were conducted with data from California and five chi-square tests were conducted with data from Texas. Chi-square tests were not conducted for the food science and technology and agribusiness pathways in Texas because data did not meet minimum cell size requirements. Additionally, a chi-square test was not conducted for the environmental and natural resources pathway in California for the same reason.

A statistically significant chi-square statistic was observed in each of the 11 tests of independence. Additionally, a contingency coefficient was calculated for each of the significant tests. In California, the animal science pathway by region had the largest contingency coefficient ($C = .321$) suggesting a modest relationship. The remaining pathways by region analyses experienced small portions of shared variance with less than 5.5% in each of the pathways by region analyses. Whereas, the coefficient suggested small effects of less than 4% of the shared variance in each of the pathways by area analyses in Texas. While a statistically significant chi-square value was observed in each of the pathways, the large sample size of this study permitted small relationships to be identified as statistically significantly different than no relationship. Therefore, caution should be exercised in making dramatic policy or programmatic changes based on these findings. While no other studies have addressed teacher demand in this manner, the findings of significant relationships between pathways and geographical regions of states align with and support broader research that shows regional and state differences in the current teacher shortage (Castro et al., 2018; Cross, 2017; Goldring et al., 2013; Sutcher et al., 2016, 2019).

Conclusion three: Specific pathways experienced growth and demand while others experienced decline between 2011 and 2019.

The aim of research question 1.3 was to investigate AFNR position advertisements in California and Texas on an annual basis. In California, a higher demand for teachers in the agriscience pathway was observed in 2012 and 2013 compared to other years. The increase in demand during this time period can be explained by the adoption of the integrated agriscience curriculum that was adopted by the California State Board of Education in 2011 (California Department of Education, 2013). Position advertisements in Texas between 2011 and 2019 demonstrate a growing need for applied agricultural engineering teachers. The demand for teachers specifically in the applied agricultural engineering program of study grew from approximately 32% of all position advertisements in 2011 to 40% of all position advertisements in 2019. While no other studies are available to compare results, the increasing demand for teachers in the applied agricultural engineering program of study can be explained by the reduction of course requirements in baccalaureate programs focusing on this program of study (Easterly et al., 2018). This reduction in course requirements in this field can lead to lower self-efficacy and willingness to teach in this pathway or program if study (Blackburn et al., 2015; Burris et al., 2005, 2010; Leiby et al., 2013; Shultz et al., 2014; Tummons et al., 2017; Wells et al., 2013).

Lower demand and even decline for specific pathways was particularly of concern in the areas of agribusiness, food science and technology, and environmental and natural resources. In Texas, the decline of the natural resources program of study aligns with the decision the Texas Education Agency made to remove specific courses from the most recent version of the Texas Education Agency Programs of Study framework (Texas Education Agency, 2019). The agribusiness and food science and technology pathways did not show a decline in demand. However, the demand for these pathways remained extremely low between 2011 and 2019, making up just over 2.5% of all advertised positions. Texas Education Agency data support this finding with very few teachers currently teaching in these pathways (Texas Education Agency, 2022). Although, the most recent framework for pathway maintained a strong focus on agribusiness courses at the secondary level (Texas Education Agency, 2019).

Research Objective 2.0 – Conclusions

With consideration of the findings in this study and within the identified limitations, the following conclusions from research objective 2.0 were drawn. A discussion of these conclusions will follow.

1. Teaching assignments for AFNR teachers by pathway are not equal across all of the pathways. Specific pathways were assigned more frequently than others.
2. Extremely small differences are present in AFNR teacher assignments when pathways are compared between FFA regions (CA) or FFA areas (TX).
3. Teachers assigned to teach in the agricultural mechanics/applied agricultural engineering pathway spend more time in that pathway or program of study than teachers assigned to other pathways.
4. Teacher perceptions of pathway growth align with teacher assignments in both California and Texas.

Conclusion one: Teaching assignments for AFNR teachers by pathway are not equal across the pathways. Specific pathways were assigned more frequently than others.

The purpose of research question 2.2 was to describe AFNR teacher assignments by pathway or program of study in California and Texas. Demand for AFNR teachers is more complex than placing an available AFNR teacher in any needed pathway or program of study assignment. There is a wide variety of needed skill sets and competencies across the AFNR pathways (Blackburn et al., 2015; Burris et al., 2005, 2010; Eck et al., 2019; Eck & Edwards, 2019). Teacher assignments are driven by local program planning and student enrollments in the offered courses within each of the pathways (Hyslop, 2018). In this study, I found that teacher assignments are not equal across the pathways. In California, teachers were more frequently assigned to the agriscience and agricultural mechanics pathways. Over 60% of the respondents indicated being assigned to teach some portion of their day in agriscience, and over 34% were assigned to teach in the agricultural mechanics pathway. Whereas, just 2.8% of respondents indicated that they were assigned to teach in the forestry and natural resources pathway.

Teacher assignments in Texas were similar to those of California. In Texas, 678 or 54.2% of respondents indicated that they were assigned to teach in the animal science program of study. The applied agricultural engineering program of study was observed to have the second greatest number of teachers assigned to the program of study with 378 or 30.2% of respondents. Whereas, the food science and technology program of study accounted for just 4.9% of respondents' assigned teaching assignments. These findings are supported by the FTE count data in Texas (Texas Education Agency, 2022). It should be noted that student enrollment for the applied agricultural engineering program of study ranks fourth behind general AFNR, animal science, and plant science, but it (agricultural engineering) accounts for the second most number of teachers. This can be attributed to the need for smaller class sizes in the applied agricultural engineering program of study because of student safety issues and perhaps availability of equipment to teach hands-on skills.

California and Texas AFNR teachers are assigned in similar proportions in the area of agricultural mechanics/applied agricultural engineering. While the pathway or program of study with the greatest number of teachers assigned differs, the large takeaway from these findings is the demand for teachers in agricultural mechanics/applied agricultural engineering remains high and consistent across the two states.

Conclusion two: Extremely small differences are present in AFNR teacher assignment when pathways to which teachers are assigned are compared among FFA regions or FFA areas.

Research question 2.3 aimed to compare AFNR pathway teacher assignments by California FFA regions and TX FFA areas. AFNR pathway teacher assignments were compared within each pathway in the different FFA regions and areas. The findings in this research question returned two statically significant results out of the 14 tests conducted. Of the two statistically significant tests, the two corresponding contingency coefficients were indicative of very small portions of shared variance. Practically, the results from this section led me to conclude that the differences in teacher assignments by pathway were not practically important between regions and areas. Specifically, it would not be prudent to make policy or programmatic decisions based on this data.

Programs across the country are guided by state and federal standards. The lack of significant differences between regions and areas suggests that the frameworks put into place by state policy are designed to provide a certain level of equity across the state

(California Department of Education, 2013; Texas Education Agency, 2019). School-based agricultural education programs, whether small or large, can impact students in different pathways.

Conclusion three: Teachers assigned to teach in the agricultural mechanics/applied agricultural engineering pathway spend relatively more of their time in that pathway or program of study than teachers assigned to other pathways.

AFNR teachers wear many hats as FFA Advisors, classroom teachers, and SAE supervisors, but specifically in the classroom. AFNR teachers teach in many different areas of the AFNR curriculum. The purpose of research question 2.4 was to describe and evaluate how AFNR teachers spend their time relatively among the many different pathways that they could potentially be assigned to by local school administration.

In both California and Texas, teachers indicated overwhelmingly that teachers assigned to teach in agricultural mechanics/applied agricultural engineering spent a larger percentage of their time in that pathway than teachers assigned to other pathways. In California, teachers in the agricultural mechanics pathway spent on average 66.5% of their day in the pathway. In Texas, a similar result was observed with teachers assigned to the applied agricultural engineering program of study spending on average 57.8% of their day in the pathway.

Not all pathways experience the same level of time commitment as shown above. Specifically, in California, teachers in the agribusiness pathway spent just 26.1% of their day in the pathway. In Texas, teachers assigned to the agribusiness program of study reported a percentage of time similar to that of California, with Texas teachers spending 24.7% of their time in the program of study.

New and seasoned teachers alike should be aware of the differences in the relative time commitments current teachers have concerning the different pathways. Several of the pathways require that teachers are well-rounded and have skill sets in multiple areas as the teachers are likely to spend time in multiple pathways. For example, the agribusiness, animal science, forestry and natural resources, and plant and soil sciences pathways in California observed smaller time commitments. In Texas, the agribusiness, natural resources, and food science and technology pathways observed smaller time commitments.

Conclusion four: Teacher perceptions of pathway or program of study growth align with current teacher assignments in both California and Texas.

The purpose of research question 2.5 was to describe teacher perceptions of pathway or program of study growth at the local level. Local program decisions are driven by various factors. However, one of the most consistent factors of program growth is student enrollment in pathways. In this study, I found that teacher perceptions of growth or lack of growth in specific pathways aligned with their current teacher assignments. For example, in California, the agriscience and agricultural mechanics pathways were the top two pathways for teacher assignments. Overwhelmingly, teachers indicated these two pathways as those with the greatest amount of growth at the local level. Once again, the impact of the adopted integrated agriscience curriculum is supported by these results (California Department of Education, 2013). On a similar note, California teachers ranked agribusiness, plant and soil science, and forestry and natural resources as pathways with the least amount of growth. Growth of the forestry and natural resources pathway was significantly less than the reported growth of the plant and soil science pathway, with a large effect size of 1.102 between the reported growth of the two pathways. While outside the scope of this study, an investigation of the significant decline of the forestry and natural resources pathway should be conducted.

In Texas, similar findings support conclusion four. The animal science pathway and the applied agricultural engineering pathways- were identified by teachers as faster growing than the other pathways. The animal science industry is extremely popular not only in student enrollment but also in student involvement through supervised agricultural experiences across the state. The popularity and growth of the animal science program of study align closely with studies conducted in this field (Hanagriff et al., 2009, 2014). Additionally, growth of the applied agricultural engineering program of study is strongly aligned with student enrollment, participation in supervised agricultural experiences in applied agricultural engineering, and ultimately the need for AFNR teachers in this program of study (Hanagriff et al., 2014). While the pathways perceived by teachers to have the greatest growth align well with other studies, so do the pathways perceived to have little growth. Food science and technology is perceived to have the least amount of growth at the local level. Enrollments, FTE counts, teacher assignments, and position advertisements all support this program of study having low growth (Texas

Education Agency, 2022). One caveat to the perceptions of growth rank order is the general AFNR program of study which includes the principles of agriculture, food, and natural resources course, which is a foundational course. It is possible that teachers do not see this as a program of study with growth because it is less specific. However, with the structure of Texas AFNR pathways, the principles of agriculture, food, and natural resources course was observed to be the course with the greatest student enrollment (Texas Education Agency, 2022). Program planning at the local level will remain a critical component of programmatic success. Not only will student interest and enrollment be a consideration, but also the ability to recruit and retain teachers in the high-demand pathways will continue to be an important factor in program planning.

Recommendations

The following recommendations are based on the conclusions from this study. Recommendations for additional research and changes to practice are reported below.

Recommendations for research

Expand the Study to More States and More Factors

While I studied the two largest states in terms of National FFA student membership (Meyer, 2020), one should not generalize these results outside of California and Texas. I recommend replications of this study; future studies should include examine critically and thoroughly teacher shortages in other states or nationally. Other states should use the approach used in this study to develop a more targeted understanding of

AFNR teacher demand within each state. The data collected from this type of study has powerful implications to improve the preparation of pre-service AFNR teachers across the country.

A relatively recent trend (within the past 40 years) has been an influx of female teachers in SBAE. Before about 1980, the percentage of female teachers in SBAE was single digit (Camp, 2000). Historically, females were often hired in Texas to teach floral design courses. On the other hand, males were perceived to be more skilled in agricultural mechanics. Conducting additional studies to determine the pathways in which males and females teach would be instructive.

Intuitively, one may expect there to be a difference in concentration/amount of time spent in one (or perhaps two) pathway(s) based on the number of teachers in the local program. So, determining the number of pathways in which a teacher teaches in light of the number of teachers in the program would be valuable.

Targeted Interviews with Hiring Officials

An additional study should target school hiring officials. We need to gain a deeper understanding of the hiring process. In doing so, we should be able to answer the question “Was the local education agency able to hire the type of candidate they initially desired?” Local education agencies ultimately extend an offer of employment to the best candidate from the pool of applicants they receive. However, the pool may not have contained the type of candidate they initially set out to find. This approach might triangulate the demand portion of the process and provide a strong addition to the body of literature.

Clarification of Administrative Appointment/Administrative Activities of Teachers

As noted in Chapter 4, I identified a concern with the survey research portion of the study. In one section of the survey, the respondents were asked to identify the different pathways they were currently assigned to teach. To account for teachers who may have administrative appointments, a category for “Administrative Duties” was included. In the data analysis, over 96% of California respondents and over 71% of Texas respondents indicated a portion of their day was spent completing administrative duties. This finding warrants additional research. While the category was created to identify formal appointments in administration (e.g., CTE director, assistant principal, etc.), I believe teachers reported the burden of administrative tasks being placed on teachers. The respondents may have included all administrative duties that are otherwise normally associated with the duties of an AFNR teacher. Anecdotally, it has been reported to me that many of these duties have increased dramatically over the past decade. These duties have historically included: attendance, purchasing, grading, travel, roster management, applications, etc. These duties now require greater documentation, occur at a greater frequency, and are more transparent to the public. It is recommended that future studies clarify the duties teachers perceive as administrative in nature, and the time teachers spend completing these tasks.

Pre-service Teacher Factors for Position Acceptance

Pre-service teachers account for a significant portion of the pool needed to fill the annual AFNR teacher vacancies across the United States. This study has provided a strong addition to the body of literature concerning the AFNR teacher shortage and demand profile. However, the complement of the demand side is the supply of new teachers to apply for and accept AFNR teacher positions. Future research is needed to describe pathways in which new graduates have self-efficacy; another need is to explore and develop a robust understanding of the reasons pre-service teachers accept or reject a particular position offered to them. Similar to the knowledge we now have regarding the demand for certain pathways, we need to understand what pathways prospective new teachers identify as their efficacious areas and what factors make positions more or less desirable when pre-service teachers are applying for their initial teaching positions.

Local Education Agency Hiring Needs

As producers of commodities, it is important to understand the demand customers have for specific goods and services. Educator preparation programs are producers of teachers. Therefore, it is necessary that educator preparation programs thoroughly investigate the needs of local education agencies as it relates to teacher preparation. The AFNR teacher shortage continues to be of concern for many local education agencies across the country (Camp, 2000; Camp et al., 2002; Craig, 1981; Cross, 2017; Eck & Edwards, 2019; Foster et al., 2014, 2015, 2020c, 2020a; Kantrovich, 2007, 2010; National Center for Education Statistics, 2015; A. R. Smith et al., 2018, 2019; Smith, Amy R. et al., 2017; Sutcher et al., 2016, 2019; Woodin, 1967). Educator preparation programs have the opportunity to identify the needs of early career teachers from the perspective of local education agencies and adapt current program models. The modifications or adaptations can significantly contribute to solving the teacher shortage by developing teachers that are prepared for the challenges associated with the profession. The modifications in program elements have the potential to increase self-efficacy in early career teachers which is an identified element that contributes significantly to teacher success and teachers' decisions to stay in the profession (Blackburn et al., 2015; Burris et al., 2005, 2010; Leiby et al., 2013; Shultz et al., 2014; Tummons et al., 2017; Wells et al., 2013).

Recommendations for changes to practice

Recruitment Into Agricultural Education

It is important to understand the needs of pre-service teachers and the needs of local education agencies. The identified needs of both teachers and schools should drive the planning for teacher education preparation programs. However, a growing concern is shrinking enrollments in teacher education programs (Bowling & Ball, 2018; Castro et al., 2018; Eck & Edwards, 2019; National Research Council, 2010; Sutcher et al., 2016, 2019). Without students enrolled in teacher education preparation programs, the content of those programs is a moot point. Recruitment efforts to encourage and support future teachers must continue to be emphasized. Specifically, the greatest recruitment efforts must come from secondary school-based agricultural education programs. Current

AFNR teachers are needed to continue to encourage and support secondary students in exploring career opportunities including teaching school-based agricultural education. In addition, students who wish to teach and who have interests and experiences in agriculture—whether they participated in SBAE programs in high school—should be recruited.

Educator Preparation Program Planning

Educator preparation programs have a responsibility to ensure that program requirements align with and meet state licensure regulations. Additionally, educator preparation programs should know needs of local schools. Local education agencies are the end-user of the product (teachers) that educator preparation programs are creating. This study has outlined the demand using a more targeted approach than what is currently available in the literature. In California, educator preparation programs need to address the need for teachers in the agriscience and agricultural mechanics pathways. In Texas, educator preparation programs need to address the need for teachers in the applied agricultural engineering program of study. The aforementioned pathways may be areas of current need, but I am not implying that the other pathways be eliminated from programmatic content in teacher education. Opportunities for students to add a specialization in high need areas should be created within program degree plans. While specializations may help address the growing demand for specific pathways, a well-rounded AFNR teacher should remain the goal for educator preparation programs.

Perhaps the ideal would be a well-rounded AFNR-teacher who also has the opportunity to specialize in one or more pathways.

The adoption of micro credentialing or in-major certificates of specialization should be considered by educator preparation programs. Easterly et al. (2018) study of baccalaureate programs across the United States demonstrated the relative consistency among teacher preparation programs. Given credit-hour limits, current degree programs offer little flexibility and room for students to specialize or earn micro-credentials. While challenges do exist, educator preparation programs should explore the opportunity for students to develop areas of specialization through course selection within their program. The option for specialization can assist students in identifying the pathways of greatest need and preparing appropriately.

Early Career Professional Development and Support

Teaching is an art and a craft; quality educators are those who continue to push themselves and seek out ways to improve in their art and craft of teaching. Professional development and support are critical components to the success of early-career teachers. Considerable literature exists on the professional development needs of early career and pre-service AFNR teachers. Given the findings of this study, a continued emphasis on providing professional development opportunities in the area of agricultural mechanics/applied agricultural engineering is needed. Over 46% of positions in California and over 63% of positions in Texas need teachers to be competent in agricultural mechanics/applied agricultural engineering. Most educator preparation programs are offering six to nine-semester units of instruction in agricultural mechanics/applied agricultural engineering (Easterly et al., 2018). With limited formal instruction in a high-demand pathway such as agricultural mechanics/applied agricultural engineering, early-career teachers will need substantial support. Professional development opportunities should be developed to allow early career teachers to improve pathway-specific skills and increase teacher self-efficacy in different pathways.

If schools hire the best candidates available to fill their teaching positions, but the individual hired may not have the skills, abilities, and experiences originally desired, then the school must provide firm-specific training/professional development. Aligning with the Human Capital Investment theory, investments in firm specific training benefit the local education agency. The investment in firm specific training can also provide benefit to the individual hired as some but not all firm specific training can be transferrable to similar local education agencies (Becker, 1964, 1994). Local education agencies should plan to accommodate firm specific training for newly hired teachers.

AFNR Program Planning

Teacher churn and turnover are considerable obstacles that local education agencies face each year. Many challenges stem from teacher churn and turnover including student achievement, fiscal difficulties, and program planning. Career technical education courses are considerably more expensive courses to offer. In Texas, Career Technical Education courses are funded 35% higher than general education courses (Texas Education Agency, 2019). However, even with additional funding, challenges still exist when teachers leave their teaching positions. It should be noted that local education agencies and agricultural science departments have a strong understanding of program planning and how they will adapt and overcome if teachers leave their program. Many local education agencies face difficulties hiring for high-demand positions. Recruitment and retention practices should focus on strategies to reduce turnover and address recruitment when vacancies exist. Filling agriscience and agricultural mechanics positions will be more difficult than filling other positions in California, similarly, in Texas filling applied agricultural engineering positions is a challenge. Human resource departments and those in leadership roles with local education agencies need a firm understanding of the challenges associated with hiring high-demand fields. Additionally, retention of high-quality teachers can significantly reduce associated costs, increase student achievement, and grow career technical education programs.

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APPENDIX A

IRB APPROVAL LETTER – JOB POSTINGS

DIVISION OF RESEARCH

TEXAS A&M UNIVERSITY

NOT HUMAN RESEARCH DETERMINATION

October 16, 2018

Type of Review:	Initial Review
Title:	Analysis of agriculture education job postings
Investigator:	Timothy Murphy
IRB ID:	IRB2018-1306
Reference Number:	083423
Documents Received:	IRB Application Version 1.1

Dear Timothy Murphy:

The Institution determined that the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.

Further IRB review and approval by this organization is not required because this is not human research. This determination applies only to the activities described in this IRB submission and does not apply should any changes be made. If changes are made you must immediately contact the IRB about whether these activities are research involving humans in which the organization is engaged. You will also be required to submit a new request to the IRB for a determination.

Please be aware that receiving a ‘Not Human Research Determination’ is not the same as IRB review and approval of the activity. You are not to use IRB consent forms or templates for these activities.

If you have any questions, please contact the IRB Administrative Office at 1-979-458-4067, toll free at 1-855-795-8636.

Sincerely,

IRB Administration

750 Agronomy Road, Suite 2701

1186 TAMU
College Station, TX 77843-1186

Tel. 979.458.1467 Fax. 979.862.3176
http://rcb.tamu.edu

APPENDIX B

IRB APPROVAL LETTER – PATHWAYS DMRDL

DIVISION OF RESEARCH

TEXAS A&M UNIVERSITY

APPROVAL
CONTINUING REVIEW OF RESEARCH
Using Expedited Procedures

November 06, 2018

Type of Review:	Continuing Review
Title:	Digital Media Research and Development
Investigator:	Billy R McKim, Ph.D.
IRB ID:	IRB2013-0109D
Reference Number:	083853
Funding:	Star of Texas Fair and Rodeo
Documents Approved:	IRB Continuing Review Form Version 7.1; Consent with Recordings Version 1.6; General Consent Version 1.4; pre&reminderpostcardsdraft2 041013 Version 1.2; interviewscript 051413 Version 1.3; appendix_N_web consent Version 1.2; appendix_W_information sheet Version 1.2; appendix_X_information sheet Version 1.2; appendix_Y_information sheet Version 1.2; Amendment_DOMBInformationSheet Version 1.2; irb2013-0109d-interview questions v1.1 2-15 Version 1.3 (not re-stamped due to iRIS stamping error); irb2013-0109d-survey forms v1.1 2-15 (not restamped due to iRIS stamping error)
Special Determinations:	Waiver of documentation of consent approved under 45 CFR 46.117 (c) 2

Risk Level of Study:	Minimal Risk

The IRB approved the continuing review of this research on 11/06/2018.

It is recommended that you submit your next continuing review by 10/05/2019 to avoid a lapse in approval. Your study approval will end on 11/05/2019. Your study must maintain an **approved status** as long as you are interacting or intervening with living individuals or their identifiable private information or identifiable specimens.

Obtaining identifiable private information or identifiable specimens includes, but is not limited to:

1. using, studying, or analyzing for research purposes identifiable private information or identifiable specimens that have been provided to investigators from any source; and
2. using, studying, or analyzing for research purposes identifiable private information or identifiable specimens that were already in the possession of the investigator.

In general, OHRP considers private information or specimens to be individually identifiable as defined at 45 CFR 46.102(f) when they can be linked to specific individuals by the investigator(s) either directly or indirectly through coding systems.

If you have any questions, please contact the IRB Administrative Office at 1-979-458-4067, toll free at 1-855-795-8636.

Sincerely,

IRB Administration

APPENDIX C

RANDOM NUMBER GENERATOR DOCUMENTATION

3/31/22, 9:37 AM Random Number Generator

.net

FINANCIAL FITNESS & HEALTH MATH OTHER

home / math / random number generator

Random Number Generator

This version of the generator creates a random integer. It can deal with very large integers up to a few thousand digits.

Lower Limit 1

Upper Limit 100

Generate Clear

Comprehensive Version

This version of the generator can create one or many random integers or decimals. It can deal with very large numbers with up to 999 digits of precision.

Result

13
16
39
81
99
111
130
149
170
171
198
210
219
248
251
307
364
365
373
432
438
473
517
521
557
573
604
616
639
693

Search

Math Calculators

Scientific Fraction
Percentage Triangle
Volume Standard Deviation
Random Number Generator More Math Calculators

Financial | Fitness and Health | Math | Other

Lower Limit 3

Upper Limit 709

Generate 30 numbers

Allow duplication in results?

○ Yes ○ No

Sort the results?

○ Ascend ○ Descend ○ No

Type of result to generate?

○ Integer ○ Decimal

Generate Clear

A random number is a number chosen from a pool of limited or unlimited numbers that has no discernible pattern for prediction. The pool of numbers is almost always independent from each other. However, the pool of numbers may follow a specific distribution. For example, the height of the students in a school tends to follow a normal distribution around the median height. If the height of a student is picked at random, the picked number has a higher chance to be closer to the median height than being classified as very tall or very short. The random number generators above assume that the numbers generated are independent of each other, and will be evenly spread across the whole range of possible values.

A random number generator, like the ones above, is a device that can generate one or many random numbers within a defined scope. Random number generators can be hardware based or pseudo-random number generators. Hardware based random-number generators can involve the use of a dice, a coin for flipping, or many other devices.

A pseudo-random number generator is an algorithm for generating a sequence of numbers whose properties approximate the properties of sequences of random numbers. Computer based random number generators are almost always pseudo-random number generators. Yet, the numbers generated by pseudo-random number generators are not truly random. Likewise, our generators above are also pseudo-random number generators. The random numbers generated are sufficient for most applications yet they should not be used for cryptographic purposes. True random numbers are based on physical phenomena such as atmospheric noise, thermal noise, and other quantum phenomena. Methods that generate true random numbers also involve compensating for potential biases caused by the measurement process.

.net FINANCIAL FITNESS & HEALTH MATH OTHER

home / math / random number generator

Random Number Generator

This version of the generator creates a random integer. It can deal with very large integers up to a few thousand digits.

Lower Limit 1
Upper Limit 100
Generate Clear

Comprehensive Version

This version of the generator can create one or many random integers or decimals. It can deal with very large numbers with up to 999 digits of precision.

Result

838
850
903
959
1142
1189
1268
1301
1304
1525
1716
1725
1755
1778
1841
2061
2272
2274
2300
2326
2328
2416
2462
2596
2746
2749
2865
3245
3274
3279

Search

Math Calculators

Scientific | Fraction
Percentage | Triangle
Volume | Standard Deviation
Random Number Generator | More Math Calculators

Financial | Fitness and Health | Math | Other

Lower Limit 710

Upper Limit 3291

Generate 30 numbers

Allow duplication in results?

○ Yes ○ No

Sort the results?

○ Ascend ○ Descend ○ No

Type of result to generate?

○ Integer ○ Decimal

Generate Clear

A random number is a number chosen from a pool of limited or unlimited numbers that has no discernible pattern for prediction. The pool of numbers is almost always independent from each other. However, the pool of numbers may follow a specific distribution. For example, the height of the students in a school tends to follow a normal distribution around the median height. If the height of a student is picked at random, the picked number has a higher chance to be closer to the median height than being classified as very tall or very short. The random number generators above assume that the numbers generated are independent of each other, and will be evenly spread across the whole range of possible values.

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APPENDIX D

VARIABLE CODING MANUAL

Content Analysis of AFNR Position Announcements Coding Manual

The purpose of this study is to describe AFNR position announcements. Announcements contain different elements. Therefore, within the scope of this study, the following variables are identified and coded according to the following rules established by the research team.

Research Objective 1.0 Variable Coding Schema

Variable ID	Variable Label	Variable Type	Coding Schema	Notes
J0001	Posting ID	String	N/A	
J0002	Posting Year	String	N/A	
J0003_1	CA Agribusiness	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0003_2	TX Agribusiness	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0004_1	CA Agricultural Mechanics	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0004_2	TX Applied Agricultural Engineering	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0005_1	CA Agriscience	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0005_2	TX General AFNR	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0006_1	CA Animal Science	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0006_2	TX Animal Science	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	

J0007_1	CA Forestry and Natural Resources	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0007_2	TX Environmental and Natural Resources	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0008_1	CA Ornamental Horticulture	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0008_2	TX Food Science and Technology	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0009_1	CA Plant and Soil Science	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0009_2	TX Plant Science	Nominal	1 = Pathway Requested; Blank = Pathway Not Requested	
J0019	FTE	Scale	Integer	1.0 FTE = 1 Full Time Equivalent, T = Temporary
P0003	State Code	Nominal	1 = CA; 2 = TX	
P0004	School Name	String	N/A	
P0050	CA FFA Region	Nominal	CA (1 = Central Region, 2 = North Coast, 3 = San Joaquin, 4 = South Coast, 5 = Southern, 6 = Superior)	
P0051	TX FFA Area	Nominal	TX (1 = Area 1, 2 = Area 2, 3 = Area 3, 4 = Area 4, 5 = Area 5, 6 = Area, 7 = Area 7, 8 = Area 8, 9 = Area 9, 10 = Area 10)	TX FFA transitioned to 12 areas in 2018. All Data was converted to the old framework with 10 areas.

Coding Rules

The following coding rules were established a priori for this study. The rules were used as a guide for the research team to accurately code the data in accordance with the established methods and procedures identified in the planning stage of this study. The coding rules were used in the post hoc reliability testing process of the study.

Rule 1 – Determine if the position announcement meets the inclusion criteria of the study. Inclusion criteria for this study include the following:

1. Each position must be for a secondary AFNR position.

2. Each position must be for a position in California if it is in the data acquired for California or a position in Texas if it is in the data acquired for Texas.

3. Job advertisements with no description will be excluded from the study.

Rule 2 – Carefully assign a Position ID (J0001) to each of the included positions. Position ID should be assigned in numerical order by the date of posting.

Rule 3 – Carefully read the position and corresponding posting date. Code the Posting Year (J0002) as a single four-digit integer in the YYYY format (e.g., 2015). The cut off range for dates is November 1 – October 31. This range aligns with the data values available in the data set.

Rule 4 – Carefully read the position and corresponding location. Code the following variables P0003 – State Code; P0050 - CA FFA Region or P0051 - TX FFA Area.

Rule 5 – Carefully read the position description paying careful attention to text indicating a preference to hire candidates in the identified pathways. Use a 1 in the coding sheet to identify a pathway requested in the corresponding position description. If no specific pathway is requested no values need to be placed on the coding sheet. Some positions may have no pathways requested while other positions could have all of the pathways requested. Pathway selection is not mutually exclusive, more than one pathway may be selected.

Rule 6 – Carefully read the position description and code the position in reference to the FTE requested for the position. A 1.0 is the equivalent to a full-time position. Positions may be assumed to be full-time unless otherwise specified. Part time positions should be coded with the decimal value of the requested percentage of a full contract (e.g., 60% = .60, 80% = .80). If a position specifies that it is a temporary or limited term basis a code of "T" is to be used (e.g., maternity leave, long term substitute, medical leave).

APPENDIX E

AFNR PATHWAYS CA INSTRUMENT

Demographic

According to the information I was provided by CATA, your name is ${e://Field/T0004_1} ${e://Field/T0004_2}. Is this correct?

- ○ Yes
- ○ No

What do you prefer to go by?

First ______

Last ______

According to the information I was provided by CATA, you teach at ${e://Field/T0005_1} High School. Is this correct?

- ○ Yes
- ○ No

What school do you teach at?

School Name ______

What is your gender?

- ○ Male
- ○ Female
- ○ Prefer not to answer

What year were you born? (YYYY)

______

Teaching Experience

What year was your first year teaching in agricultural education? (YYYY)

[ ]

Teaching Experience Confirmation

Just to confirm, you said your first year teaching agricultural education was ${q://QID5/ChoiceTextEntryValue}, which means you've been teaching for **${e://Field/T0010_C} years**.
Is that correct?

- ○ Yes
- ○ No

Including this school year, 2018-2019, how many years of agricultural education teaching experience do you have?

[ ]

Teaching Duties

Are you a full-time or part-time teacher?

- ○ Full-time
- ○ Part-time

You indicated that you are part-time, what is your percentage of a full-time contract?

0 10 20 30 40 50 60 70 80 90 100

	0	10	20	30	40	50	60	70	80	90	100
Part-time percentage											

Do you teach courses outside the agriculture department? (e.g. English, mathematics, engineering, etc)

- ○ Yes
- ○ No

You indicated that you teach outside of the agriculture department for some portion of your day. What is your percentage of time spent teaching outside of the department?

	0	10	20	30	40	50	60	70	80	90	100
Time outside of the Ag department											

Which pathways do you currently teach agriculture courses in? Please select all that apply.

- ☐ Agricultural Business
- ☐ Agricultural Mechanics
- ☐ Agriscience
- ☐ Animal Science
- ☐ Forestry and Natural Resources
- ☐ Ornamental Horticulture
- ☐ Plant and Soil Science

What percentage of your time contracted to the agriculture department is spent teaching in each pathway or spent completing assigned administrative duties? The total must equal 100%

Do you have an extended contract?

- ○ Yes
- ○ No

Is your extended contract based on days or salary percentage?

- ○ Days
- ○ Salary percentage
- ○ Other

How is your extended contract calculated?

How many days is your extended contract?

Number of days

What percentage of your salary is your extended contract?

Salary percentage

Education

Please review the diploma and degree options, below. Select all that apply.

	Yes
GED	☐
High School Diploma	☐
Associate of Arts or Science	☐
Bachelor of Arts or Science	☐
Master of Arts or Sciences or Education	☐
Ph.D, Ed.D, or other doctorate	☐
Other	☐

Please review the credential options, below. Select all that apply.

	Yes
Clear single subject - agriculture	☐
Clear single subject - agriculture specialist	☐
Designated subjects	☐
University intern	☐
District Intern	☐
Special education	☐

What institution or organization recommended you for your Clear single subject - agriculture credential?

- ○ California Polytechnic State University - Pomona
- ○ California Polytechnic State University - San Luis Obispo
- ○ California State University Chico
- ○ California State University Fresno
- ○ University of California Davis
- ○ Other

What institution organization recommended you for your Clear single subject - agriculture credential?

What institution or organization recommended you for your Clear single subject - agriculture specialist credential?

- California Polytechnic State University - Pomona
- California Polytechnic State University - San Luis Obispo
- California State University Chico
- California State University Fresno
- University of California Davis
- Other

What institution or organization recommended you for your Clear single subject - agriculture specialist credential?

What institution or organization recommended you for your Designated subjects credential?

- California Polytechnic State University - Pomona
- California Polytechnic State University - San Luis Obispo
- California State University Chico
- California State University Fresno
- University of California Davis
- Other

What institution or organization recommended you for your Designated subjects credential?

What institution or organization recommended you for your University intern credential?

- California Polytechnic State University - Pomona
- California Polytechnic State University - San Luis Obispo
- California State University Chico
- California State University Fresno
- University of California Davis
- Other

What institution or organization recommended you for your University intern credential?

What institution or organization recommended you for your District Intern credential?

- California Polytechnic State University - Pomona
- California Polytechnic State University - San Luis Obispo
- California State University Chico
- California State University Fresno
- University of California Davis
- Other

What institution or organization recommended you for your District Intern credential?

What institution or organization recommended you for your Special education credential?

- California Polytechnic State University - Pomona
- California Polytechnic State University - San Luis Obispo
- California State University Chico
- California State University Fresno
- University of California Davis
- Other

What institution or organization recommended you for your Special education credential?

Did you complete an alternative certification program to earn your teaching credential?

- Yes
- No

What was the name of the alternative certification program you completed?

Did your preparation program include coursework in agricultural education program management?

- Yes
- No
- I do not remember

Did your preparation program include coursework in methods of instruction for agricultural education settings?

- Yes
- No
- I do not remember

How many courses did you take in your preparation program related to agricultural mechanics?

- None

- 1
- 2
- 3
- 4
- 5 or more

How many courses did you take in your preparation program related to floral design?

- None
- 1
- 2
- 3
- 4
- 5 or more

Pathway growth opinion

In your opinion, what are the fastest growing pathways in your community/school? Please rank the pathways. This question uses a drag n' drop approach. Please drag the different pathways into the rank/order you believe best fits your community/school.

Agricultural Business

Agricultural Mechanics

Agriscience

Animal Science

Forestry and Natural Resources

Ornamental Horticulture

Plant and Soil Science

Department Head

Do you serve in a department head capacity at ${e://Field/T0005_1} High School?

- ○ Yes
- ○ No

Who serves as the agriculture department head at ${e://Field/T0005_1} High School?

First Name	
Last Name	
Email Address	
Phone Number (NNN)NNN-NNNN	

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APPENDIX F

AFNR PATHWAYS TX INSTRUMENT

Demographic

Welcome to the 2019 VATAT membership survey. We thank you for your response. This survey should take approximately 10 minutes to complete.

What is your gender?

- ○ Male
- ○ Female
- ○ Prefer not to answer

What year were you born? (YYYY)

[ ]

In which Texas FFA Area do you teach?

- ○ Area 1
- ○ Area 2
- ○ Area 3
- ○ Area 4
- ○ Area 5
- ○ Area 6

- Area 7
- Area 8
- Area 9
- Area10
- Area 11
- Area 12

Are you the department head in your program?

- Yes
- No

What is your district UIL classification?

- 1A
- 2A
- 3A
- 4A
- 5A
- 6A

Excluding any Special or Master's stipends, what is your annual salary?

What is your contract length?

- 12 months
- 11.5 months
- 11 months
- 10.5 months
- 10 months

- [ ] Other

Which statement best describes your ag teacher/FFA stipend?

- Nothing
- $1 - $1000
- $1001 - $2000
- $2001 - $3000
- $3001 - $4000
- $4001 - $5000
- >$5001
- [ ] Other

Which statement best describes the Master's stipend at your school?

- Nothing
- $1 - $1000
- $1001 - $2000
- $2001 - $3000
- >$3001

If you have left a previous job, what was your primary reason for leaving?

- Not applicable
- Contract length
- Salary/stipend
- Closer to home/family
- Administrative issues
- Teaching partner issues
- Better program opportunities
- [ ] Other

Teaching Experience

What was your first year of teaching in agricultural education? (YYYY)

[ ]

Teaching Experience Confirmation

Just to confirm, you said your first year teaching agricultural education was ${q://QID124842690/ChoiceTextEntryValue}, which means you've been teaching for **${e://Field/T0010_C} years**.
Is that correct?

- ○ Yes
- ○ No

Including this school year, 2019-2020, how many years of agricultural education teaching experience do you have?

[ ]

Teaching Duties

Are you a full-time or part-time teacher?

- ○ Full-time
- ○ Part-time

You indicated that you are part-time, what is your percentage of a full-time contract?

0 10 20 30 40 50 60 70 80 90 100

	0	10	20	30	40	50	60	70	80	90	100
Part-time percentage											

Do you teach courses outside the agriculture department? (e.g. English, mathematics, engineering, etc.)

- Yes
- No

What courses do you teach outside of the agriculture department?

You indicated that you teach outside of the agriculture department for some portion of your day. What is your percentage of time spent teaching outside of the department?

	0	10	20	30	40	50	60	70	80	90	100
Time outside of the Ag department											

Education

Please indicate which degrees you have earned. Select all that apply.

	Yes
GED	☐
High School Diploma	☐
Associate of Arts or Science	☐
Bachelor of Arts or Science	☐
Master of Arts or Sciences or Education	☐
Ph.D, Ed.D, or other doctorate	☐
Ed. Admin	☐

Yes

Other ☐

Did you complete an alternative certification or a nontraditional university certification program to earn your teaching credential?

- ○ Yes
- ○ No

What was the name of the alternative certification program you completed?

What university did you earn your certificate through?

- ○ Angelo State University
- ○ Sam Houston State University
- ○ Stephen F. Austin State University
- ○ Sul Ross State University
- ○ Tarleton State University
- ○ Texas A&M University
- ○ Texas A&M University - Commerce
- ○ Texas A&M University - Kingsville
- ○ Texas State University
- ○ Texas Tech University
- ○ West Texas A&M University
- ○ Other

Did your preparation program include coursework in agricultural education program management?

- ○ Yes

- No
- I do not remember

Did your preparation program include coursework in methods of instruction for agricultural education settings?

- Yes
- No
- I do not remember

How many courses did you take in your preparation program related to agricultural mechanics?

- None
- 1
- 2
- 3
- 4
- 5 or more
- I do not remember

How many courses did you take in your preparation program related to floral design?

- None
- 1
- 2
- 3
- 4
- 5 or more
- I do not remember

School Status

Which of the following courses do you currently teach? Check all that apply.

- ☐ Advanced Animal Science
- ☐ Advanced Energy and Natural Resources Technology
- ☐ Advanced Floral Design
- ☐ Advanced Plant and Soil Science
- ☐ Agricultural Equipment Design and Fabrication
- ☐ Agricultural Laboratory and Field Experience
- ☐ Agricultural Leadership, Research and Communications
- ☐ Agribusiness Management and Marketing Lab
- ☐ Agricultural Mechanics and Technologies
- ☐ Agricultural Power Systems
- ☐ Agricultural Structures Design and Fabrication
- ☐ Career Preparation I/II
- ☐ College and Career Readiness
- ☐ Energy and Environmental Resources Technology
- ☐ Extended Practicum in Agriculture, Food, and Natural Resources
- ☐ Floral Design
- ☐ Food Processing
- ☐ Food Technology and Safety
- ☐ Forestry and Woodland Ecosystems
- ☐ Greenhouse Operation and Production
- ☐ Investigating Careers
- ☐ Landscape Design and Management
- ☐ Livestock Production
- ☐ Mathematical Applications in AFNR
- ☐ Oil and Gas Production I
- ☐ Oil and Gas Production II
- ☐ Practicum in Agriculture, Food, and Natural Resources
- ☐ Principles of AFNR
- ☐ Range Ecology and Management
- ☐ Small Animal Management

- [ ] Turf Grass Management
- [ ] Veterinary Medical Applications
- [ ] Wildlife, Fisheries, and Ecology Management
- [ ] ______ Other

Which of the following recently adopted Programs of Study will your school most likely offer? Check all that apply.

- [ ] Agribusiness
- [ ] Animal Science
- [ ] Applied Agricultural Engineering
- [ ] Environmental and Natural Resources
- [ ] Food Science and Technology
- [ ] Plant Science
- [ ] Regionally adopted Program of Study

Which statement best describes your school's transportation policy?

- ○ The school provides no vehicle and no vehicle stipend-mileage only
- ○ The school provides a vehicle stipend
- ○ School vehicles are available to be checked out when needed
- ○ School vehicles are driven home regularly and are used for after school responsibilities
- ○ School vehicles are available for regular use and do not have to be checked out
- ○ ______ Other

Which statement best describes your school's class schedule?

- ○ A/B Block
- ○ A modified block schedule
- ○ A six period day
- ○ A seven period day
- ○ An eight period day

- ○ A nine period day
- ○ [   ] Other

Which statement best describes your daily schedule?

- ○ One conference period
- ○ Two conference periods
- ○ One conference period and a visitation/supervision period
- ○ One conference period and two visitation/supervision periods
- ○ I have given up my conference period and I receive payment for it
- ○ [   ] Other

What is your average class size?

- ○ <10 students per class
- ○ 11-15 students per class
- ○ 16-20 students per class
- ○ 21-25 students per class
- ○ 26-30 students per class
- ○ > 30 students per class

How many total students do you teach daily?

[   ]

Which statement best describes your teaching workload over the last two years?

- ○ Decreased
- ○ Stayed the same
- ○ Increased by up to 10%
- ○ Increased by 11 - 25%
- ○ Increased by 26 - 40%

- Increased by over 40%

Which of the following statements describes your budget?

- Budget meets all programmatic needs
- Adequate to teach the way we would like
- Additional funding is needed to meet programmatic needs

Which statement best describes your total department budget over the last two years?

- Increased
- Stayed the same
- Decreased by up to 10%
- Decreased by 11 - 25%
- Decreased by 26 - 40%
- Decreased by over 40%

Which statement best describes your travel budget over the last two years?

- Increased
- Stayed the same
- Decreased by up to 10%
- Decreased by 11 - 25%
- Decreased by 26 - 40%
- Decreased by over 40%

Are you being asked to restrict travel compared to two years ago for FFA meetings, contests, stock shows, animal projects, SAE supervision, etc.?

- Yes
- No
- Maybe

VATAT

Are you being asked to restrict travel for the Ag Teacher's Conference next summer?

- ○ Yes
- ○ No
- ○ Maybe

Which statement best describes your situation concerning VATAT dues and conference registration? Select all that apply.

- ☐ My school will not pay either conference registration nor membership dues.
- ☐ My school will pay for conference registration
- ☐ My school will pay for membership dues

How would you prefer the VATAT Newsletter be provided?

- ○ As it is now; mailed to all members and available on-line
- ○ Available online only
- ○ Mailed to members who prefer, and on-line to everyone else

Would you be interested in online training or professional development if offered by the VATAT?

- ○ Yes
- ○ No
- ○ Maybe

Would you be interested in attending workshops throughout the school year?

○ Yes
○ No
○ Maybe

What types of workshops would you be interested in?

Does your school require you to participate in a yearly 6 hour GT training?

○ Yes
○ No

Would you be interested in attending a GT training on the Monday of conference?

○ Yes
○ No

What do you perceive to be the most important function of VATAT?

○ Advocacy/lobbying
○ Providing member benefits
○ Keeping members informed on current issues
○ Hosting the summer conference

How satisfied are you with the VATAT and the services we provide?

○ Extremely satisfied
○ Somewhat satisfied
○ Neither satisfied nor dissatisfied

○ Somewhat dissatisfied
○ Extremely dissatisfied

As a first year teacher, did you participate in any type of mentoring program?

○ Yes
○ No

What type of mentoring program did you participate in? Select all that apply.

☐ Local or District Program
☐ Region Service Center Program
☐ VATAT Mentoring Program

How beneficial was the Local or District Program to your success as a first year teacher?

	Not beneficial							Very beneficial			
	0	1	2	3	4	5	6	7	8	9	10
Local or District Program											

How beneficial was the Region Service Center Program to your success as a first year teacher?

	Not beneficial									Very beneficial	
	0	1	2	3	4	5	6	7	8	9	10
Region Service Center Program											

How beneficial was the VATAT Mentoring Program to your success as a first year teacher?

	0 0	1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10
VATAT Mentoring Program											

Lund Study Questions

Select the AFNR pathways in which you teach. Please select all that apply.

- ☐ Agricultural Business
- ☐ Animal Science
- ☐ Applied Agricultural Engineering
- ☐ Environmental and Natural Resources
- ☐ Food Science and Technology
- ☐ Plant Science
- ☐ Multiple Pathways - Comprehensive Curriculum (i.e. Principles, Math Applications, Practicum, etc.)

What percentage of your contracted time is spent teaching in each pathway or completing assigned administrative duties? The total must equal 100%

	Agricultural Business	Animal Science	Applied Agricultural Engineering	Environmental and Natural Resources	Food Science and Technology	Plant Science	Pa Com C
${e://Field/T0004_6} ${e://Field/T0004_7}	0	0	0	0	0	0	

In your opinion, what are the fastest growing pathways in your community/school? Please rank the pathways by dragging each pathway into your preferred ranking.

Agricultural Business

Animal Science

Applied Agricultural Engineering

Environmental and Natural Resources

Food Science and Technology

Plant Science

Multiple Pathways - Comprehensive Curriculum (i.e. Principles, Math Applications, Practicum, etc.)