ABSTRACT

MISMATCH? THE ALIGNMENT OF AGRICULTURE TEACHER EXPERIENCES AND SBAE PROGRAM COMPONENTS WITH LOCAL AFNR LABOR MARKETS

The purpose of this study sought to describe and compare the alignment of local Agriculture, Food, and Natural Resources labor markets with agriculture teacher experiences and SBAE program components. Where applicable, the dependent variables of this study are the teacher and SBAE program characteristics. The independent variable for this study is the type of alignment relevant to the AFNR pathway way (i.e. aligned vs. unaligned). This causal-comparative study utilized a purposive sample of agriculture teachers that represented themselves as teachers and a liaison of their SBAE programs. 109 agriculture teachers and their programs were studied in California. Data collection involved sending a survey to said agriculture teachers and gathering archival data from a variety of sources. Results of the independent sample t-tests and chi-square tests of independence varied depending on the AFNR pathway and participant characteristic. However, remaining teacher tenure and teacher gender were significantly different in comparing teacher experience alignment. In addition, number of teachers, AFNR classes, and students were significantly different across most AFNR pathways. The California FFA region that SBAE programs resided in was greatly associated between alignment types.

Jonathan S. Moules

May 2023

MISMATCH? THE ALIGNMENT OF AGRICULTURE TEACHER EXPERIENCES AND SBAE PROGRAM COMPONENTS WITH LOCAL AFNR LABOR MARKETS

by

Jonathan S. Moules

A thesis

submitted in partial

fulfillment of the requirements for the degree of

Master of Science in Agricultural Science

in the Jordan College of Agricultural Sciences and Technology

California State University, Fresno

May 2023

APPROVED

For the Department of Animal Sciences and Agricultural Education:

We, the undersigned, certify that the thesis of the following student meets the required standards of scholarship, format, and style of the university and the student's graduate degree program for the awarding of the master's degree.

Jonathan S. Moules
Thesis Author

Steven Rocca (Chair) Animal Sciences and Agricultural Education

Nicole Ray Animal Sciences and Agricultural Education

Sharon Freeman Animal Sciences and Agricultural Education

For the University Graduate Committee:

Dean, Division of Graduate Studies

AUTHORIZATION FOR REPRODUCTION

OF MASTER'S THESIS

_____X______ I grant permission for the reproduction of this thesis in part or in its entirety without further authorization from me, on the condition that the person or agency requesting reproduction absorbs the cost and provides proper acknowledgment of authorship.

____________ Permission to reproduce this thesis in part or in its entirety must be obtained from me.

Signature of thesis author:____

ACKNOWLEDGMENTS

Progressing through a time such as this could not have been possible without a number of individuals that have supported me along the way. Despite coming from a traditional agriculture background, pursuing a career in agriculture education was thanks to a small village of agriculture teachers from Turlock High School. Mr. Joe DiGrazia, Mrs. Randee Prada-Vitorino, Mrs. Heather Nolan, Mr. Nick Traini, Mrs. Tina Nunes, and Mr. Chad Booth have all immensely contributed to molding me into a well-rounded, well-spoken individual with the drive to exceed expectations at all things I do. Their influence and continued mentorship have been instrumental in my personal and professional growth, and I am forever grateful. It was through this time where my passion for research was developed into a path that I excitedly continued into my college experience.

My secondary agriculture education experience is what sparked my interest in research and playing detective on the issues facing agriculture education. Thankfully, entering California State University, Fresno and being taught by, and working alongside a group of diligent teacher educators allowed me to further my goals. Thank you to my committee members and professors Dr. Steven Rocca, Dr. Nicole Ray, and Dr. Sharon Freeman in supporting my career and research intentions. Through teaching classes, working on massive projects, or having discussions about the world of agriculture education, I appreciate your thoughtful consideration in including me in these grand learning opportunities.

As a first-generation American and college student, I have been influenced by my parents' stories of hardship since immigrating from the Azores. Their upbringing in the laborious production agriculture lifestyle was a means of survival – mentally maturing them far beyond their years, which ultimately led them to a prosperous future in America.

My parents laid the foundation where my educational success and roles have launched from. Prominent Portuguese poetry figure, Fernando Pêssoa, wrote the following in the Portuguese translation of his famous collection of work, *Livero do Desassoessego*:

> Agir, eis a inteligência verdadeira. Serei o que quiser. Mas tenho que querer o que for. O êxito está em ter êxito, e não em ter condições de êxito. Condições de palácio tem qualquer terra larga, mas onde estará o palácio se não o fizerem ali?" (1982).
>
> The English translation is as follows:
>
> "To act – that is true wisdom. I can be what I want to be, but I have to want whatever it is. Success consists in being successful, not in having the potential for success. Any wide piece of ground is the potential site of a palace, but there's no palace till it's built" (1982).

Thank you to my parents for not only physically creating a "palace" here in the United States, but allowing me to build my own success in my academic career. It is quite amazing what a Portuguese, immigrant, husband and wife can achieve in the United States and what they can build for their children. I can never thank you enough for instilling in me value-based morals, a strong work ethic, and a boundless faith. With much love, thank you.

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Page

Page

LIST OF FIGURES

INTRODUCTION

Introduction

The agriculture industry has undergone a structural transformation resulting in an industry that is no longer just tied to the traditional work of animal and plant production, but now encompasses multiple industry sectors that reach consumers from farm to table (Alvarez-Cuadrado & Poschke, 2011). The expanding and more intricate competencies needed by the industry are sought after in job applicants that have been trained by experts and have gone through industry-based educational programs (Charlton, 2019; Colclasure, 2020). School-Based Agriculture Education (SBAE) provides a solution to the agriculture industry. With its interrelated three-component model that is led by teachers who have learned various industry skills and knowledge, students entering SBAE programs can be ensured career and college readiness.

Since the reauthorization of Perkins V, Career Technical Education (CTE) programs, like agriculture education, have received annual allocations of state and federal government funding to produce high quality CTE programs that meet local industry needs (Strengthening Career and Technical Education for the 21st Century Act, 2018). Part of this process was the development of structured and concise career clusters and pathways that mirror United States industry sectors. Agriculture, Food, and Natural Resources (AFNR) was adopted as the career cluster that would be recognized by national agriculture education and CTE standards. However, with government funding, comes evidence-based reviews of program efficacy.

Researchers and trade organizations have looked into the alignment of CTE programs with labor market demands as a form of program evaluation. Though a number of studies have explored the trends of AFNR employment and student-course taking, limited conclusive evidence has surface, other than that most authors agree there is little to no relationship between course offerings or student enrollment and employment demands (Carreira, 2008; Hargis, 2011). Some have determined that the number of students enrolled in AFNR education actually surpasses the labor market need (Sublett & Griffith, 2019). An issue arises when reviewing these studies: their definition of what constitutes an "agricultural job" is confined to traditional production agriculture. In addition, these studies have only observed overall career clusters (e.g. AFNR, Transportation, Arts and Media) and not individual pathways within each one of those career clusters (e.g. Agribusiness Systems, Plant Systems, Animal Systems). This study attempts to resolve this gap in the literature.

Employing the Human Capital Theory (Becker, 1994) and the content-based model for teaching agriculture (Roberts & Ball, 2009) as the framework for the study allows the researcher to investigate how teacher experience and SBAE program components (i.e. classroom, SAE, FFA) align to their individual local AFRN labor markets. Teacher backgrounds and experiences have demonstrated to be influential factors on how SBAE programs are structured (Rice & Kitchel, 2017). Through college coursework, informal-educational programs, extra-curriculars, and professional development, teachers mold a program's functions and opportunities (Rice & Kitchel, 2017). In addition, SBAE programs themselves exist to provide relevant industry skills, knowledge, and experiences to students whether they enter the agriculture industry after program completion or not (National Council for Agricultural Education, 2017).

The agriculture industry, and its related AFNR sectors are searching for competent employees that have the human capital and content knowledge to be successful in the long term. Ensuring that all those facets of the SBAE program and teacher experiences are aligned with AFNR industry demands at a local level results in a value-added educational experience for students. Determining the state of AFNR alignment and the differences that underline alignment types will assist agriculture teachers and SBAE programs alike to exceed industry, government, and local community expectations.

Statement of Problem

To address the demands of the agriculture industry, School-Based Agriculture Education (SBAE) programs must utilize agriculture teacher experiences and build program components that are reflective of the industries and employment prospects within the program's surrounding area. The current literature on program alignment with labor demands has yet to look at the industries that comprise the agriculture industry. At this point, only broad scope analysis has been completed in terms of how labor markets shape course offerings and what courses students take. In addition, these studies have not investigated the individual pathways under each CTE career cluster. With an increased focus on government spending on providing high quality CTE programs so that students mirror local employment skills, agriculture education cannot be left behind on meeting these metrics.

This study was conducted to examine the state of alignment between teacher training experiences and SBAE program components, and their individual local AFNR labor markets. By uncovering the level of alignment and the differences between aligned and unaligned experiences and components, efforts can be made to reevaluate what teachers and programs should be focusing on.

Purpose of Study

The purpose of this study is two-fold: 1) explore and describe the alignment of local AFNR labor markets between SBAE program components and teacher experience; and 2) compare the alignment between local AFNR labor markets and teacher experiences and SBAE program components.

Research Objectives

1. Describe teacher characteristics in the sample.
2. Describe SBAE program characteristics in the sample.
3. Determine the alignment between teacher experiences and their local AFNR labor markets.
4. Determine the alignment between SBAE program components and local AFNR labor markets.
5. Compare teacher characteristics between aligned and unaligned teacher experiences.
6. Compare SBAE program characteristics between aligned and unaligned program components.

The objectives guided the following research hypothesis:

$$H_0: \mu_{\text{Aligned Teacher Characteristics}} = \mu_{\text{Unaligned Teacher Characteristics}}$$

$$H_A: \mu_{\text{Aligned Teacher Characteristics}} \neq \mu_{\text{Unaligned Teacher Characteristics}}$$

$$H_0: \mu_{\text{Aligned SBAE Characteristics}} = \mu_{\text{Unaligned SBAE Characteristics}}$$

$$H_A: \mu_{\text{Aligned SBAE Characteristics}} \neq \mu_{\text{Unaligned SBAE Characteristics}}$$

H_0: Teacher Characteristics are independent of AFNR alignment

H_A: Teacher Characteristics are dependent of AFNR alignment

H_0: SBAE Characteristics are independent of AFNR alignment

H_A: SBAE Characteristics are dependent of AFNR alignment

Definition of Terms

A number of essential terms appear throughout the study. To ensure these terms are comprehendible and understood within the study's context, the following operational definitions were applied.

1. Career Technical Education (CTE) – "A program of study that involves a multiyear sequence of courses that integrates core academic knowledge with technical and occupational knowledge to provide students with a pathway to postsecondary education and careers" (Career Technical Education - Teaching & Learning [CA Dept of Education], n.d.)
2. Agriculture education – a "systematic program of instruction available to students desiring to learn about the science, business, and technology of plant and animal production and about the environmental and natural resources systems" (National Council for Agricultural Education, n.d.)
3. School-Based Agriculture Education (SBAE) – see "agriculture education"
4. Class – Classroom and laboratory instruction is where student learning is conducted in the confines of school facilities in which formal instruction, independent practice, and assessment would occur in structured classes such as horticulture, food science, or agriculture mechanics (Croom, 2008).
5. Supervise Agriculture Experience (SAE) – a "student-led, instructor supervised, work-based learning experience that results in measurable outcomes within a predefined, agreed upon set of Agriculture, Food and Natural Resources Technical Standards and Career Ready Practices aligned to a career plan of study" (National Council for Agricultural Education, 2017).
6. National FFA Organization (FFA) – "An intracurricular student organization for those interested in agriculture and leadership." It provides a path to

achievement in "premier leadership, personal growth and career success through agricultural education" (National FFA Organization, 2022).

7. Agriculture, Food, and Natural Resources (AFNR) – "The AFNR Career Cluster Content Standards provide state agricultural education leaders and educators with a high-quality, rigorous set of standards to guide what students should know and be able to do after completing a program of study" (National Council for Agricultural Education, 2015).
8. Animal Systems (AS) – "encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, management and processing, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses and/or poultry" (National Council for Agricultural Education, 2015).
9. Agribusiness Systems (ABS) – "encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), business planning, and sales and marketing" (National Council for Agricultural Education, 2015).
10. Biotechnology Systems (BIOT) – "encompasses the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food and natural resource systems" (National Council for Agricultural Education, 2015).
11. Environmental Service Systems (ESS) – "encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems" (National Council for Agricultural Education, 2015).
12. Food Products and Processing Systems (FPPS) – "encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry and

human behavior in local and global food systems; food selection and processing for storage, distribution and consumption; and the historical and current development of the food industry" (National Council for Agricultural Education, 2015).

13. Natural Resources Systems (NRS) – "encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests and air as natural resources" (National Council for Agricultural Education, 2015).
14. Plant Systems (PS) – "encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as wells as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants" (National Council for Agricultural Education, 2015).
15. Power, Structural, and Technical Systems (PST) – "encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures" (National Council for Agricultural Education, 2015).
16. Teacher pre-service experience – "the student enrolled in a teacher preparation program who must successfully complete degree requirements including course work and field experience before being awarded a teaching license" (Ryan et al., 2017).
17. Teacher in-service experience – "the relevant courses and activities in which a serving teacher may participate to upgrade his professional knowledge, skills, and competence in the teaching profession" (Osamwonyi, 2016).

18. Labor market – Resembles an enclosed area that feeds employees into a workplace or geographical location and the physical connection that workers have to it (Fowler et al., 2018).
19. Alignment – Alignment refers to the extent to which an educational program or institution is connected to and meets the needs of the local or regional labor market (Van Noy & Cleary, 2017).

Limitations

Scholarly work and its results, conclusions, and implications are subject to limitations. These limitations are determined based on the research design utilized to address the research objectives. The following are the limitations of this study:

1. The use of a casual-comparative research terminates any attempt of true cause-and-effect relationships (Ary et al., 2018).
2. The sample of agriculture teachers and their programs was not randomly selected. These agriculture teachers were purposively chosen. Therefore, caution should be raised when attempting to generalize these findings beyond the specific population and time-frame this study was conducted.
3. As the contact information of the purposive sample was gathered from the archival records of the Agricultural Experience Tracker, not all programs and teachers were sent a survey as not all teachers were listed.
4. The instrument used for this study was modified from an existing instrument to meet the research objectives. This is the first time the instrument has been used in this context.

Assumptions

Assumptions have been made prior to and during this study. The assumptions of this study are listed below.

1. The survey can accurately measure characteristics of agriculture teachers and SBAE programs, and the presence of each AFNR pathway within teacher experiences and program components.
2. Participants in this study responded honestly, accurately, and without outside influence.
3. Participant's self-reported presence of AFNR pathways is equitable to the true level of presence of each pathway.
4. Data collection from secondary sources was correctly gathered, inputted, and representative of their respective subject.

LITERATURE REVIEW

Introduction

The following section reviews the body of literature that explores the crucial topics that contextualize the current study of Career Technical Education (CTE), School-Based Agricultural Education (SBAE) components, labor markets, teacher development. The theoretical and conceptual framework are also presented in this section.

Purpose of Study

The purpose of this study is two-fold: 1) explore and describe the alignment of local AFNR labor markets between SBAE program components and teacher experience; and 2) predict the alignment between local AFNR labor markets and SBAE program components and teacher experience.

Research Objectives

The subsequent objectives guided the study:

1. Describe teacher characteristics in the sample.
2. Describe SBAE program characteristics in the sample.
3. Determine the alignment between teacher experiences and their local AFNR labor markets.
4. Determine the alignment between SBAE program components and local AFNR labor markets.
5. Compare teacher characteristics between aligned and unaligned teacher experiences.
6. Compare SBAE program characteristics between aligned and unaligned program components.

Literature Review Methods

The literature that informed the researcher in framing the study was derived from several different search engine outlets. References were gathered from a search utilizing Google Scholar, Google, and the Fresno State library direct search. A search of the following journals was also completed: *Journal of Agriculture Education, Journal of Southern Agricultural Education Research, Journal of Career Technical Education, Journal of Research in Technical Careers, ProQuest, Education Resource Information Center, North American Colleges and Teachers of Agriculture, Journal of Agricultural and Resource Economics, and American Journal of Agricultural Economics.* The following keywords, and a combination thereof, were used in conducting the search: Career Technical Education; School-Based Agricultural Education; classroom; Supervised Agriculture Experience; FFA; Perkins Act; Smith-Hughes Act; program quality and evaluation; Agriculture, Food, and Natural Resources; AFNR pathways; career clusters; 21st-century workforce needs; pre-service teacher education; in-service teacher education; labor markets; and human capital.

21st Century Labor Market Needs

Structural Transformation of Agricultural Labor

Assessing the state of current agricultural labor markets in the United States and its impact on 21st-century labor needs is challenging. Literature dedicated to agricultural labor, business, and economics is saturated with research that is stagnant at the farm level. Economists have come to realize that the volume of literature focused on the entire farm-to-consumer agri-food system is “deplorable,” as stated by Polopolus (1982) (Christiaensen et al., 2021; Reardon et al., 2012).

The agriculture industry can be represented as its own microcosm of diverse enterprises that come with labor supply and demand conditions that differ from other industries (Fisher & Knutson, 2013). Production success is also contingent on time and place dimensions such as weather, biological factors, skill needs, and labor mobility, all of which are unique attributes of their own (Charlton et al., 2021; Fisher & Knutson, 2013).

Emerging needs to study the economic dynamics of agriculture beyond the farm gate were met by long anticipated factors of on and off-farm industrial growth. Declining agricultural labor in developing countries has demonstrated to be a key element of economic affluence (Alvarez-Cuadrado & Poschke, 2011; Charlton et al., 2019; Christiaensen et al., 2020). The industrial revolution of the 1800s attracted people out of rural farming communities where an overwhelming majority of the United States was employed in the agricultural sector, producing half of the country's total gross domestic product (Alvarez-Cuadrado & Poschke, 2011; Charlton, 2019). Over time, the division of labor among agriculture sectors drew people away from the farm and into the city to work in manufacturing and other industries (Charlton, 2019). Today, agriculture, food, and related industries account for about ten percent of U.S. employment, while direct on-farm employment comprises less than two percent. Figure 1 illustrates the distribution of employment with post-farm jobs encompassing the largest share of agriculture related employment (USDA ERS - Ag and Food Sectors and the Economy, 2020).

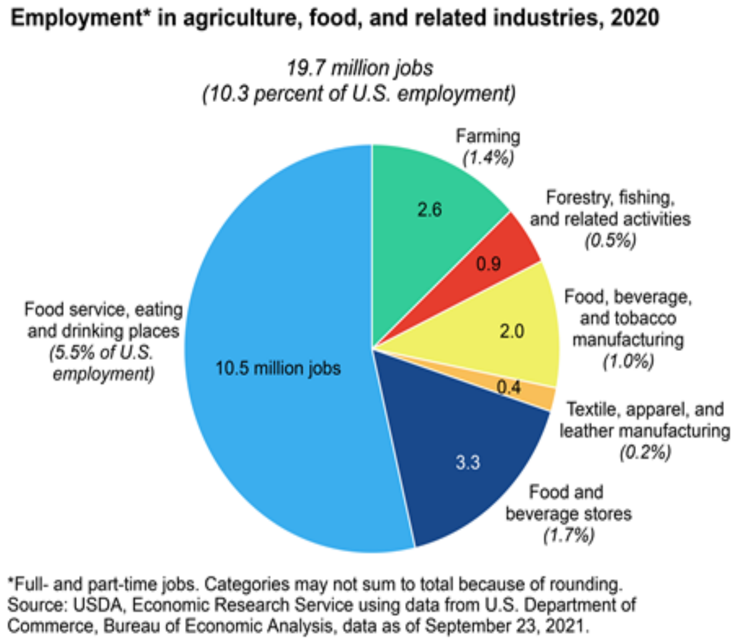

Figure 1. Employment in agriculture, food, and related industries

This attraction of labor to the urban sector led to structural transformation, meaning that the market operation of the United States underwent an intense shift brought on by major economic development (Alvarez-Cuadrado & Poschke, 2011; Lewis, 1954). As described by Alvarez and Poschke, national agriculture employment shares hang in the balance between 1) the improvements in agricultural productivity that stimulate rapid industrialization and, hence, have positive effects on a country's income known as "labor push;" and 2) the improvements in urban industrial income and productivity that sparks profitable, modern technology that shift resources to agriculture known as "labor pull" (2011). Other research echoes these recognized trends summarizing that wages, urban employment growth, and decentralized market-based systems facilitate the division of labor into other sectors in the agri-food chain (Barrett et al., 2020; Tocco et al., 2012).

The agri-food system expands beyond the farm into the sectors of finance, services, processing, and transportation, which have become the main economic power of agriculture (Christiaensen et al., 2020; Polopolus, 1982). On and off-farm labor markets have adapted to the technology and economic changes that have resulted in a growing number of employment options outside the farm; however, these evolving trends are not immune to caveats (Tocco et al., 2012). Structural transformation and technological advancements go hand in hand. In a century where global markets are forced to contend with the digital innovations of their competitors, labor and skill demands need alternatives to reflect the diverse needs of the industry (Charlton, 2019; Christiaensen et al., 2020). The changing structure of migrant farm labor will force pressures on farming methods, research and development, and production (Christiaensen et al., 2020). Anti-immigration sentiments among migrant-receiving and migrant-source countries will also induce the demands for technology to replace hired labor, and therefore providing an opportunity to regulate the income gaps across countries (Christiaensen et al., 2020). Rapid agriculture innovation and diversification also unveil that the current competitive model of the industry is losing its utility, as the industry requires more novel and unsuspected human capital investments in technology skills along all links of the agri-food chain (Rinker et al., 2020; Wilson et al., 2019). To support these efforts, the industry is yearning to support the creation of extensive education and skill training programs that reflect the skills and expertise gap hindering the structural transformation of agriculture (Charlton, 2019; Christiaensen et al., 2020; Polopolus, 1982; Tocco et al., 2012).

Hard Skills

Hard skills, also known as technical skills, refer to the objective vocational-type skills that are attained through schooling, trainings, or work experience (Rinker et al., 2020; Sapp et al., 2019). Agriculture has progressed into a multi-faceted industry that requires specific hard skills for each industry sector. Despite individual needs, skills related to digital competency, data-science, research and development, and technology are perceived as critical growth areas by agriculture employers (Charlton, 2019; Colclasure, 2020; English et al., 2019). Sapp et al. (2019) looked to identify the knowledge, skills, and competencies needed by students with previous training in agriculture and environmental studies. Knowledge of basic industry terminology, writing skills, utilizing the scientific method were main assets of value considered by local agriculture leaders (Sapp et al., 2019). Parallel findings came from studies regarding farm business management and graduates of agriculture and natural resources where general knowledge of agriculture, livestock, grain, and project management, mechanical skills, computer skills, and data interpretation where the basic expectations of employees (Rinker et al., 2020; Wilson et al., 2019). Hard skill development is imperative for the success of both employees and employers.

Though industry-wide skills can transfer from sector to sector, the agriculture industry desires specific skills as well. Professionals in the animal science industry look to those with experience in maintaining facilities, understanding nutritional needs of livestock, recognizing health issues, and animal handling (Albritton & Roberts, 2020; Ramsey, 2009). The ability to propagate, transplant, and irrigate plants as well as conduct greenhouse inventory and using landscape equipment were skills sought after in the horticulture industry (Albritton & Roberts, 2020; Ramsey, 2009). Agriculture mechanics careers found that employees should be competent in installing, calibrating, and troubleshooting precision equipment, welding using different processes, as well as measuring correctly (Erickson et al., 2018; Wells et al., 2021). The food science and production industry concentrates on employees with a working knowledge of food safety, sanitation, and pathogens, quality assurance, and production management (Albritton & Roberts, 2020; Mayor et al., 2015; Ramsey, 2009). Even among “soft science” sectors such as agriculture communications, education, and leadership, written and verbal communication and cultural competence are skills of interest (Scasta, 2018). Hard skills are at the forefront of educational institutions and the credentialism that spans the agriculture labor market, yet employers state that, despite the gap in hard skills between education and employment, these skills can be taught during one's career, instead intangible, personal attribute skills are increasingly essential. (Connell et al., 2014; Gillard, 2009; Matteson et al., 2016; Schneider et al., 2005).

Soft Skills

In a 2017 publication of *The Quarterly Journal of Economics,* David Deming illustrated the progressive significance of soft skills in the labor market summarizing that though computer technology is inevitable in replacing production tasks, computers themselves cannot mimic human interaction, or at least not yet (2017). Job polarization between labor-intense and nonmanual occupations have also intensified the need for soft skills (Deming, 2017). Across industries, the terms "soft skills," "transferable skills," and "employability skills" have shared the limelight as a set of terms used within a wide range of environments (Hillage & Pollard, 1998). Soft skills have become a trendy phrase that is used in all disciplines, but its ambiguous nature and absence of clear taxonomies creates challenges for this concept to gain traction in business practice and research (Matteson et al., 2016).

Matteson et al. compiled multiple sources of definitions within different industries and other areas of research and summarized that soft skills are the ability to complete specific behavioral tasks or use a specific cognitive processes related to a particular task (Matteson et al., 2016). An international effort in measuring and assessing soft skills, known as the MASS project, similarly defines soft skills as intra and inter-personal skills that are essential for personal development, social interaction, and career success (Kechagias, 2011). Others have used the term "employability skills" to describe the behavioral abilities that allow one to gain initial employment, maintain that employment, and obtain new employment if need be. These said abilities rely on personal attributes, beliefs, and knowledge and their manipulation of those abilities depending on the context or task (Hillage & Pollard, 1998). In an effort to structure the desired competencies and foundation skills that should be required of all high school students, the United States Department of Labor developed the Secretary's Commission on Achieving Necessary Skills (SCANS) Report. "Workplace know-how" was the umbrella term for three core elements that shape foundational skills: 1) basic skills such as reading, writing, and math; 2) thinking skills such as problem-solving, decision-making, and creative thinking; and 3) personal qualities such as honesty, sociability, and responsibility (United States Department of Labor Secretary's Commission on Achieving Necessary Skills, 1991). These highlighted skills are extrapolated further among industries that set their own soft skills expectations of their potential hires.

One's ability to harness their critical thinking and problem solving skills will lead the agricultural workforce into the 21st century (Colclasure, 2020; National Research Council, 2012). The agri-food system has evolved into an industry that still values technical abilities; however, employers are looking beyond discipline-specific knowledge and acumen. Interest in agriculture employer research brought Crawford to lead a national soft skills study examining how over 1000 students, faculty, alum, and employers in Landscape Architecture and allied professions rank soft skills (Crawford & Dalton, 2011). This joint study between the Association of Public Land-Grant Universities and the University Industry Consortium had participants force-rank seven soft skills clusters: experiences, team skills, communication skills, leadership skills, decision making, self-management skills, and professionalism skills (Crawford & Dalton, 2011). Crawford and Dalton found that employers ranked communication, self-management, and teamwork as the most important while leadership as the least important or an entry-level position (Crawford & Dalton, 2011). There were discrepancies between employers and students of how they ranked professionalism skills, experiences, and self-management. Figure 2 displays the synopsis of their findings. It is important to note that the rank order of soft skill clusters is to be interpreted as a spectrum, with top clusters representing the foundation for the next and so on. In addition, rankings can be altered depending on the trade-offs employers are willing to accept during hiring decisions (Crawford & Dalton, 2011).

CORE SKILLS
1. Communication
2. Self-Management
3. Teamwork
4. Decision Making / Problem Solving
5. Experiences
6. Professionalism
7. Leadership

COMMUNICATION SKILLS:
1. Listen effectively
2. Communicate accurately and concisely
3. Communicate pleasantly and professionally
4. Effective oral communications
5. Effective written communications
6. Ask good questions
7. Communicate appropriately and professionally using social media

SELF-MANAGEMENT SKILLS:
1. Efficient and effective work habits
2. Self-starting
3. Well-developed ethic, integrity and loyalty
4. Sense of urgency to complete tasks
5. Work well under pressure
6. Adapt and apply appropriate technology
7. Dedication to continued professional development

TEAMWORK SKILLS:
1. Productive as a team member
2. Positive and encouraging attitude
3. Maintains accountability to the team
4. Punctual and meets deadlines
5. Work with multiple approaches
6. Share ideas to multiple audiences
7. Aware and sensitive to diversity

DECISION MAKING / PROBLEM SOLVING SKILLS:
1. Identify and analyze problems
2. Take effective and appropriate action
3. Realize the effect of decisions
4. Transfer knowledge across situations
5. Creative and have innovative solutions
6. Engage in life-long learning
7. Think abstractly about problems

EXPERIENCES:
1. Related work or internship experiences
2. Teamwork experiences
3. Leadership experiences
4. Project management experiences
5. Cross disciplinary experiences
6. Community engagement experiences
7. International experiences

PROFESSIONALISM SKILLS:
1. Effective relationships with customers, businesses and the public
2. Accept critique and direction
3. Trustworthy with sensitive information
4. Understand role, realistic career expectations
5. Deal effectively with ambiguity
6. Maintain appropriate decor and demeanor
7. Select mentor and acceptance of advice

LEADERSHIP SKILLS:
1. See the "big picture" and think strategically
2. Recognize when to lead and when to follow
3. Respect and acknowledge others contributions
4. Recognize and deal constructively with conflict
5. Build professional relationships
6. Motivate and lead others
7. Recognize change is needed and lead the change effort

Figure 2: Employee soft skills ranking

Crawford and Dalton's findings is even mirrored among specific agriculture disciplines. Again, all forms of communication abilities, critical thinking, organization, project management, teamwork, relationship building, and professionalism are sought by the entirety of agriculture employers (Bundy et al., 2021; Hanson & Wachenheim, 2020;

Mayor et al., 2015; Rinker et al., 2020; Sapp et al., 2019; Wilson et al., 2019). Minor differences exist between men and women and those who study "hard" or "soft" science. Women finding more value in fostering connection and working with people, while men orient their skills for achieving work goals and standing out (Dalton et al., 2018). Hard science individuals rank interpersonal relationships as their greatest competency, which differ from soft science individuals that rank listing skills as their most imperative ability (Robinson, 2009). The agriculture labor market needs people with a strong sense of self and the ability to work with others. Training programs at all educational institutions are vital for building these career skills (Charlton, 2019; Tocco et al., 2012).

Evolution of Career Technical Education

Need for CTE

Educating young people to be knowledgeable, skilled, and independent individuals have continued to be the focal point of American education. It is undeniable that general education subjects such as math, English, science, and history have embedded themselves into public school systems. With the United States trailing behind in these subjects (Paige, 2006) in the competitive global market, general education disciplines have remained the priority. However, the modern economy expects more from diploma-holding students, expecting knowledge and skill beyond what is taught in the typical classroom (Brand et al., 2013). Countless studies, trade documents, and economic reviews exclaim that the gap in employee skill and employer demands is expanding with no limits in sight (Hendrix & Morrison, 2018; Rosen et al., 2018). The dominant educational strategy for meeting workforce needs through public education is Career Technical Education. CTE has answered the call to train students to have market-ready employability, academic, and technical skills that culminate into students pursuing postsecondary education and occupations (Brand et al., 2013; Rosen et al., 2018).

Vocational Education and Smith-Hughes Acts

Although Career Technical Education is the modern label of "vocational education" programs, its original intent within its historical evolution into what it is now, serves as a model for what this study is intended to showcase: labor market alignment. Before formal education, traditional work preparation involved organized apprenticeship where young people would learn a skill through a range of work-based fashions including direct supervision and generational preparedness where skills are passed down from parent to child, (Wonacott, 2003). Vocational education was a 20th century invention with the intent of ensuring the capacity to earn a living and own a share of the world's productive work.

A social agreement was understood that vocational education would be suited only for those in non-intellectual fields (Hillison, 1995; Imperatore & Hyslop, 2017). With formal education becoming the norm, World War I hysteria-induced industrial output, and establishing a place for vocational students to benefit from publicly funded education, the Smith-Hughes Act of 1917 was born (LaFollette, 2011; Martin & Kitchel, 2020; Wonacott, 2003). A group of public and private sector individuals, though having antagonistic ideals of one another, gathered to advocate for a separation of students, administrative funds, teacher preparation programs, and school boards with the objective of separating working-class children that were deemed to have no occupational prospects (Gordon & Schultz, 2020; Herren, 1986; Hillison, 1995). Agriculture, labor, and industrial representatives believed that general education was impractical and not serving students enough to be independent citizens (Herren, 1986; Hillison, 1995). The act provided the first federal funds to vocational education as a means to addressing employer needs and the integration of technical skills instruction in an educational setting (Gordon & Schultz, 2020; Smith-Hughes Act, 1917).

Though ambitious, the Smith-Hughes Act made negligible ripples across the United States as its broad spectrum utility, versatility, or financial support was not enough to reach the labor expectations at the time (LaFollette, 2011; Office of Education, 1965). Whereas legislation preceding the Vocational Education Act of 1963 was determined to justify federal monies towards vocational education, legislation for the next thirty years would be targeted at special populations (Dougherty & Lombardi, 2016; Null, 2011).

Carl D. Perkins Acts

Social unrest during the Vietnam War created momentum to address education and workforce inequalities and served those with socioeconomic, academic, or other handicaps that would prevent those from benefiting from regular vocational programs (LaFollette, 2011). This open-to-all approach progressed and concerned itself with creating funding opportunities to specific groups including handicapped, disadvantaged students, adults with training needs, single parents, homemakers, and criminal offenders into the first Carl D. Perkins Vocational Education Act (Carl D. Perkins Vocational Education Act, 1984; LaFollette, 2011). Perkins II in 1990 maintained its efforts to diminish sex bias and stereotypes of single parents, pregnant women, and homemakers among other groups. These programs were later regarded as ineffective (Imperatore & Hyslop, 2017). Financial assistance however was redirected to strengthen the original intent of workforce development by instituting the Tech Prep program. It was built to secure articulation with colleges, professional development for teachers and counselors, and course curriculum (Carl D. Perkins Vocational and Applied Technology Education Act Amendments of 1990, 1990). In addition, states were required to establish and implement performance standards that measured completion and job placement rates among graduates (Carl D. Perkins Vocational and Applied Technology Education Act

Amendments of 1990, 1990). Decentralization of federal funds, though perceived as a remedy to certain political and social issues, had an overall negative effect on state-level research initiatives, teacher training, and coordination with localities to provide technical assistance (Hayward & Benson, 1993; Manley, 2011). Towards the end of the 20th century Perkins III sought to uphold accountable expectations among states by introducing certain indicators of performance that states could negotiate as well sanctions and incentive grants for states that forewent or exceeded performance standards (Carl D. Perkins Vocational and Applied Technology Education Amendments of 1998, 1998).

The emergence of Career Technical Education came about the rebranding of vocational education in 2006 in order to eliminate the negative connotations and stereotypes of its past (Imperatore & Hyslop, 2017). A 21st century perspective shaped the goals of CTE with states and localities required to align their programs of study with up-and-coming industries and professions with a sequence of courses. (Carl D. Perkins Career and Technical Education Improvement Act of 2006, 2006). Authors of the statute built upon preexisting efforts to meet workforce demands by acknowledging professional development needs of CTE teachers, labor market research needs, and recognizing the extensive scope of Career Technical Student Organizations (CTSO) (Granovskiy, 2016).

The reauthorization of Perkins V followed the movement of higher-order thinking, problem solving, employability, and entrepreneurial skills and their contribution to applied learning. This perspective expanded beyond supporting high schools and community colleges and began the integration of CTE programs into middle school programs (Strengthening Career and Technical Education for the 21st Century Act, 2018). The refreshing appeal of CTE made waste of serving special populations and moved onto the chronically unemployed such as the economically disadvantaged, unhoused, and youth who aged out of the foster care system (Granovskiy, 2018).

With each Perkins act, new found techniques of evaluating programs arose to determine the effective use of funds. During the age of vocation education and into the early 21st century, CTE students were traditionally categorized into academic or vocational concentrators for reasons related to perceived intellectual elitism, or lack thereof, and limited prospects of working class students (Aliaga et al., 2014; Wonacott, 2003). Aliaga et al. (2014) looked into the further typological delineation of student CTE course taking as programs were popularized in the United States. They found eight separate typologies of CTE students who demonstrated common course taking habits, in which these students were simplified into low and high intensity CTE students. A similar approach was embedded into Perkins V as evaluation efforts required the noting of "CTE participants" and "CTE concentrators;" concentrators being those that have taken at least two CTE courses (Strengthening Career and Technical Education for the 21st Century Act, 2018). Work is yet to be accomplished as states and localities learn to disseminate funds that strengthen student knowledge and employability skills and that reflects community needs.

Despite it trials and tribulations, Career Technical Education has laid its foundation and is now launching students through the entire succession of industry-backed public education practices. Structured career pathways and clusters were to mirror local labor markets with the help of diverse groups of stakeholders (Granovskiy, 2018). Students have the ability the choose and traverse their own career pathway and enter the workforce with skills that the typical graduate would lack (Brunner et al., 2021; Bozick & Dalton, 2013; Nakao, 2006). Today, three million students are enrolled in CTE programs nationwide with the Agriculture, Food, and Natural Resources pathway being a leader among career clusters offered (A Roadmap to Advancing CTE without Limits, 2021). Despite its broad impact, the future of CTE clings to its localities' ability for measurable influence on student academic and professional outcomes, all of which warrant further investigation.

Agriculture, Food, and Natural Resources

National AFNR and California ANR Standards

Perkins IV founded the National Career Clusters Framework that played the main role in organizing and creating Career Technical Education programs, curriculum, and instruction (Carl D. Perkins Career and Technical Education Improvement Act of 2006, 2006). There are sixteen Career Clusters in the framework including Agriculture, Food & Natural Resources (AFNR), Architecture & Construction, Arts, A/V Technology & Communications, Business Management & Administration, Education & Training, Finance, Government & Public Administration, Health Science, Hospitality & Tourism, Human Services, Information Technology, Law, Public Safety, Corrections & Security, Manufacturing, Marketing, Science, Technology, Engineering & Mathematics (STEM), and Transportation, Distribution & Logistics. These pathways represent seventy-nine career pathways meant to connect secondary education to postsecondary and technical education (Advance CTE, n.d.).

This study concentrates on the AFNR Career Cluster and its eight pathways: Agribusiness Systems (ABS), Animal Systems (AS), Biotechnology (BS), Environmental Service Systems (ESS), Food Products and Processing Systems (FPP), Natural Resource Systems (NRS), Plant Systems (PS), and Power, Structural, and Technical Systems (PST) (National Council for Agricultural Education, 2015). Figure 3 illustrates that these career pathways encircle Career Ready Practices (CRP) Content Standards which are the foundational skills and practices students acquire such as responsibility, productivity, financial literacy, and problem-solving (National Council for Agricultural Education, 2015). The AFNR Content Standards reflect the most up to date knowledge and skills that laboratory instruction, work-based learning experiences, and Career Technical Student Organizations should focus on (CTSO) (National Council for Agricultural Education, 2015). These standards have paved the way to novel methods of program assessment and student outcome research (Advance CTE, n.d.).

Figure 3: Agriculture, Food, and Natural Resource Career Clusters

This study highlights California agriculture education programs and teachers. Though the California Department of Education CTE Standards for Agriculture and Natural Resources (ANR) do fundamentally follow the purpose of the AFNR Content Standards, it slightly strays from the pathways. California ANR Standards pathways include Agricultural Business, Agricultural Mechanics, Agriscience, Animal Science, Forestry and Natural Resources, Ornamental Horticulture, and Plant and Soil Science (California Department of Education, n.d.). The state CTE Model Curriculum and ANR Standards have parallel functions of building sequential agriculture courses aimed at meeting local demands of businesses and industry and the smooth transition of students into postsecondary training and education (California Department of Education, n.d.). At the state level, ANR standards are employed to determine high quality programs and improving student outcomes for the 21st century (California Department of Education, n.d.).

School-Based Agriculture Education

The dawn of formal agricultural education was the result of a variety of social, political, and educational pressures bestowed upon vocational agriculture to fit within school and state curriculum plans that prioritized academic rigor, standardized evaluation, and college entry (Martin & Kitchel, 2020). This, in addition to the renaissance of highly industrialized agriculture production and manufacturing, changes in federal regulation, and the mass emigration to rural America, forced agriculture education to, again, adapt to the changing needs of society and work (Martin & Kitchel, 2020). The organizational change of vocational agriculture into its modern model began with a six-fold increase in vocational agriculture enrollment within forty years. Naturally, the declining accessibility to farms and land pushed a need to rethink vocational agriculture's methods (Martin & Kitchel, 2020). Congressional hearings for the Vocational Education Act of 1963 added another layer to organizational change, as these hearing addressed issues regarding student outcomes. As it was written in the Vocational Education Act, "The panel also found that vocational education programs are not preparing people for enough kinds of jobs. One study found that only 10 boys studied agriculture for every 100 males employed in that field" (Office of Education, 1965). The emerging vision of vocational agriculture was to broaden non-production opportunities (Phipps et al., 2007; Talbert et al., 2007). Though not forfeiting the traditional experiences of vocational education, allowing non-production and supervised placement agriculture experiences was prompted by local community needs, not federal legislation (Martin & Kitchel, 2020).

Modern School-Based Agriculture Education (SBAE) is fueled by "…preparing students for successful careers and a lifetime of informed choices in the global agriculture, food, and natural resources systems" (National Council for Agricultural Education, n.d.). To achieve this mission, SBAE programs are constructed upon an integrated, three-component model that encompass instruction, work-based learning, and leadership development as seen in Figure 4. (Croom, 2008; National Council for Agricultural Education, 2015; Phipps et al., 2007; Talbert et al., 2007). Though this overlapping three-component structure was used in practice and made near the same time frame, it was until 1947 that it was formally recognized and marketed (Croom, 2008; Martin & Kitchel, 2020).

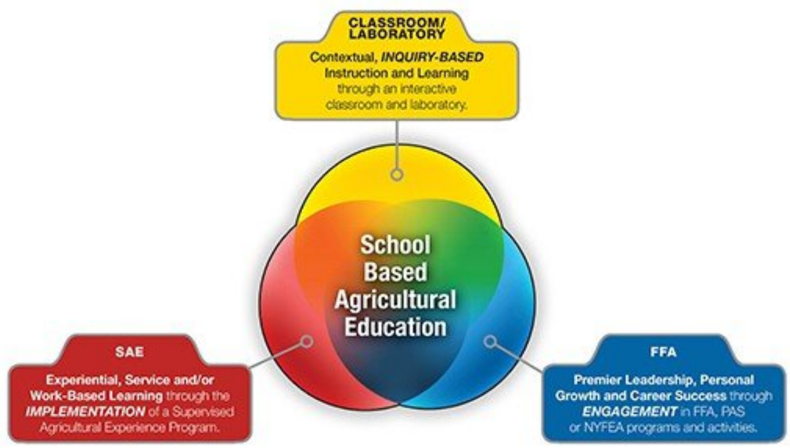

Figure 4: Three-Component Model of School Based Agricultural Education

Classroom and laboratory instruction is where student learning is conducted in the confines of school facilities in which formal instruction, independent practice, and assessment would occur in structured classes such as horticulture, food science, or agriculture mechanics (Croom, 2008). These courses are conducive to contextual, inquiry-based, and investigative student interaction with agricultural concepts and skills (Phipps et al., 2007). Students are able to develop solutions to complex problems that require a controlled setting to practice and apply what is taught in the class (Newcomb et al., 2003; Phipps et al., 2007). Laboratory instruction is instrumental to form and master tangible skills from mere ideas (Newcomb et al., 2003).

The second component, referred to as the FFA component of SBAE, are the leadership opportunities and skill development granted through the National FFA Organization (FFA). Unlike other CTE programs that offer CTSOs, FFA is the largest youth-led agricultural organization, with an overwhelming majority of formal SBAE programs having a charter (National FFA Organization, 2022). Reflective of the overall purpose of agriculture education, "FFA makes a positive difference in the lives of students by developing their potential for premier leadership, personal growth and career success through agricultural education" (National FFA Organization, 2022). At face value, FFA provides a number of award programs, Career and Leadership Development Events, leadership conferences, travel opportunities, and the advancement of leadership and life skills that the other two components of the SBAE three-component model do not always address (Newcomb et al., 2003; "Supporting Full Implementation of the Agricultural Education Model," 2021). The organizational mission and the opportunities offered is supported by a substantial body of work that FFA participation is beneficial in a variety of ways. Townsend and Carter discovered that FFA participation was positively associated with student leadership, cooperation, citizenship, and agriculture skills (1983). Complementary studies observed positive associations in cooperation, work skills, self-esteem, self-actualization, and goal making found in FFA students (Benson, 1982; Carter & Neason, 1984; Rose et al., 2016; Sanok et al. , 2015). In a random sample study of 450,000 National FFA members, Talbert and Balschwied determined that eighty-seven percent of members planned on postsecondary or technical education (2006). Phelps et al.

noted the personal gains in public speaking, life skills, and skill transferability to college and career was attributed to FFA engagement (2012).

The work-based learning component of the SBAE model is Supervised Agricultural Experience (SAE). With the structural transformation of American agriculture and education, SAE has expanded from agricultural production "home-projects," to adding non-production placement occupational projects, and beyond (Stimson, 1919; Martin & Kitchel, 2020; National Council for Agricultural Education, 2017). Twenty-first century agriculture education has recognized these changes as programs and students have become more diverse; however, SAE has maintained a stronghold on its fundamental purpose as a "student-led, instructor supervised, work-based learning experience that results in measurable outcomes within a predefined, agreed upon set of Agriculture, Food, and Natural Resources (AFNR) Technical Standards and Career Ready Practices aligned to a career plan of study" (National Council for Agricultural Education, 2017). Despite the decline of SAE nationally, they promote contextualization of academic content that reciprocates the expansion of the agricultural industry and the growing needs of employers (Croom, 2008; Rank & Retallick, 2016; Talbert et al., 2007). Though stakeholder and community engagement are vital, teachers are the keystone organizers of SAEs who look to establish connection between a student's interests and daily lives a potential agricultural project (Rank & Retallick, 2016; Rubenstein et al., 2016). Even though SAE implementation and supervision has shown to be a challenge that consequently makes SAE the weakest component of the three-component model, if not incorporated into a well-balanced SBAE program, career related skill advancement would be inherently limited (Newcomb et al., 2003; Rank & Retallick, 2016; Rubenstein et al., 2016; Thiel & Marx, 2019).

Though classroom instruction is essentially the beginning of formal SBAE programs, both FFA and SAE components are intra-curricular components for the full implementation of the SBAE model, and the participation of all three parts is critical to the effectiveness of the program (Phipps et al., 2007; Talbert et al., 2007).

Experiential Learning and Skills

Integrated SBAE programs that are successful in growing students personally and professionally ascribe their achievements to the theoretical basis of SBAE: experiential learning (Baker et al., 2012). The cyclical nature of experiential learning is comparable with National Research Council findings on how people learn. They provided three key findings that influence the relationship between instruction and learning: 1) students have natural preconceived notions about the world before entering an experience; 2) student competency is achieved through the factual mastery of topic and its application beyond the classroom; and 3) once students know the information, they are empowered to take their learning into their own hands; once this is complete the cycle begins again to build skill in more areas (National Research Council, 2012). Kolb's Model of Experiential Learning stems for a constructivist point of view that learning is a process of connecting experiences (Kolb, 2014). Figure 5 visually portrays the four-stage learning cycle that is embodied in SBAE where a student would first encounter a concrete experience, one that would be new situation or experience. After the experience, students would reflect on the new experience in the context of what they already know. Abstract conceptualization encompasses the birth of new ideas or the modification of such, that come from reflecting on the initial experience. The cycle is complete when these novel ideas are used in an applied setting and are tested (Kolb, 1984). The cycle then repeats as each active experimentation is it itself, the next concrete experience.

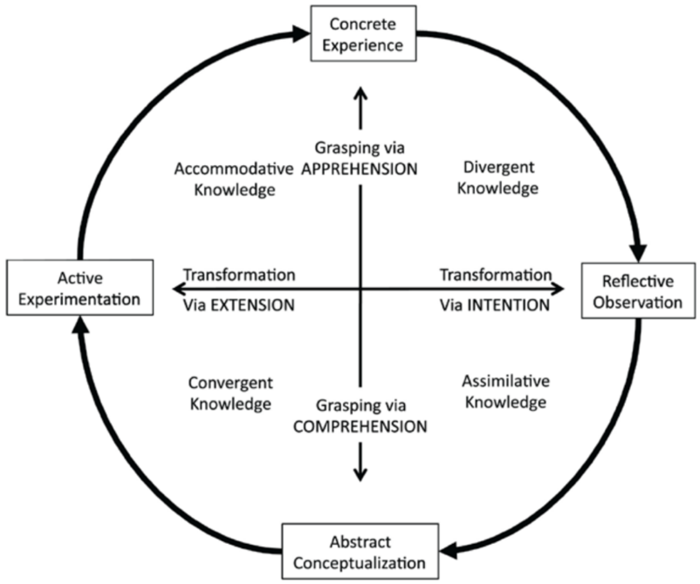

Figure 5. Kolb's Model of Experiential Learning

With SBAE being the vehicle that experiential learning is driven by, students are able to develop skills and knowledge that is absorbed among the components. Despite, their being opportunity for experiential learning in all three components, SAEs have become the main vehicle as they allow for the transfer of planned skills to real world and agriculture related work experiences (Dyer, 1996; Baker et al., 2012; Thiel & Marx, 2019). SBAE programs boast the "learn by doing" expression and to an extent, they are correct, however, the learning terminates there as agriculture educators have shown a disproportionate use of Kolb's model beyond the concrete experience and reflection stages of the cycle (Phipps et al., 2007; Shoulders, 2013). Though SBAE student outcomes are intrinsically tied to the SBAE three-component and Kolb's Experiential Learning model, it would be appropriate to assume that SBAE student skill and knowledge development is dependent on both constructs. In addition to agriculture, experiential learning has been associated with positive outcomes for graduate technical and soft skills and among other disciplines of study (Thiel & Marx, 2019; Cranmer, 2006; Canhoto & Murphy, 2016). Twenty-first century skills and knowledge are first and foremost what educational institutions are advocating for students to acquire to be college, career, and labor market ready.

Teacher Development and Influence

Teacher Effectiveness

Agriculture teachers are the trailblazers for SBAE program growth, and their capabilities as a classroom teacher and program developer hinges on their effectiveness. However, there is a general lack of consensus on the characteristics of good agriculture teachers due to the subjectivity and objectivity of identifying quality teaching practices that are dependent on student outcomes (Williams, 2019). Numerous studies have illustrated the factors that impact agriculture teacher effectiveness including teacher competency in various aspects of SBAE including, but not limited to, instruction, FFA, SAE, marketing, program planning, community relationships, professionalism, CDE preparation, and evaluation of student achievement (Roberts et al., 2006; Roberts & Dyer, 2004). While there have been similar results measuring the expectations of agriculture teachers, a pressing need for working with diverse student groups has emerged (Adams, 2010; Roberts et al., 2020; Roberts & Dyer, 2004). Among all the responsibilities that build an effective teacher, prioritizing one's ability to be an efficacious teacher takes precedence (Roberts & Dyer, 2004).

Pre-Service Training

Effectiveness is built upon human capital, gained through academic coursework, work experience, and specialized training (Rice & Kitchel, 2015; Snider et al., 2021). As previously mentioned, agriculture teachers take on an abundance of tasks, in which teacher education and pre-service programs strive to prepare prospective teachers for those responsibilities (Smalley et al., 2019; Smalley & Hainline, 2021). However, as

Lytle (2000) stated, “Clearly, it is unrealistic to assume that any preservice teacher education program can prepare prospective teachers for the wide array of tasks awaiting them as teachers.” The student teaching experience is the hallmark of pre-service preparation in terms of improving teacher self-efficacy, teacher attitude, and general awareness of work duties (Rice & Kitchel, 2015; Sorensen et al., 2018). The environment in which pre-service teachers are staged in can alone impact their development. Juergensen (1996) argues that student teachers should be placed in an environment that is commiserate with their technical competencies, rather than attempting to mold the teacher to excel in a uninterested field. Snider et al. (2021) exemplified this in their study of Oklahoma student teachers who, despite rating all AFNR pathways as important, had high competence in Animal Systems and Plant Systems possibly due to the state’s emphasis on animal and plant agriculture and popular enrollment in such courses.

The variability of pre-service agriculture teacher preparation in different programs and states is reflected in the varying levels of preparedness reported by teachers after completing their training. In a study conducted by Adams (2010), it was found that newly-minted teachers felt least prepared in teaching diverse groups, creating assessment tools, and implementing equitable grading structures, while they felt most prepared in general curriculum and instruction, understanding students, and planning. A separate study by Wolf, Foster, and Berkenholz (2010) found that although students had a positive view of their preparation, they had lower levels of self-efficacy. Rice and Kitchel (2015) completed a qualitative investigation where students expressed a general dissatisfaction with the majority of the agriculture courses in terms of quality, quantity, and transferability of the content to high school level education within the context that teachers are expected to experts in all AFNR subjects. There seems to be room for improvement in the preparation of agriculture teachers to effectively teach a diverse range of subjects.

In-Service Professional Development Needs

Teacher training does not terminate after graduating as professional development experiences allow teachers to strengthen their skills as educators and program managers. Agriculture teachers have an obligation to promote technical agriculture skills and 21st century practices within their students, both of which are consistently needing refinement. Evidence has revealed that, despite pre-service preparations, teachers still fall short of attaining adequate competence and knowledge regarding biotechnology, aquaculture, veterinary medicine, agriculture business, mechanics, and integrating current agriculture advancements into curriculum (Christensen et al., 2009; Duncan et al., 2006; Peake et al., 2007; Roberts et al., 2020; Smalley et al., 2019). Other non-agricultural and technical professional development needs concern digital technology use, SBAE program management, fundraising, utilizing laboratories and facilities, and the development and supervision of SAE projects (Cannon et al., 2012; DiBenedetto et al., 2018; Smalley et al., 2019; Weeks et al., 2020).

In the literature on 21st century skills professional development there seems to be general agreement that agriculture teachers are desiring training on teaching critical thinking, collaboration, motivation, problem solving, decision making, and effective communication (Cannon et al., 2012; Davis & Jayaratne, 2015; Duncan et al., 2006; Sanok et al., 2015; Smalley et al., 2019; Weeks et al., 2020). Over the past two decades, there has been an emergence of new competencies in the area of integrating diverse groups in SBAE programs, such as students with special needs or Individualized Education Plans (IEPs) (Coleman et al., 2020; DiBenedetto et al., 2018; Smalley et al., 2019). This indicates that agriculture education and its teachers are now instructing a broader range of students than what has historically been the case.

Teacher Influence

Several variables influence how SBAE programs are shaped, one such factor is the diverse agriculture backgrounds that teachers bring to the program, which in turn molds the program's functions and opportunities (Rice & Kitchel, 2015; Snider et al., 2021). Secondary agriculture teachers cultivate agriculture education competencies through college, work experience, at-home study, or on-the-job training (Findlay, 1992). Findlay (1992) points out that teachers actually possess greater competence in agriculture skills that were garnered from the aforementioned experiences than from student teaching itself. Against this backdrop, teachers utilize these experiences to become knowledgeable in select agriculture disciplines of interest, despite viewing all AFNR pathways to be of equal importance, or, as Snider (2021)and others put it, "experience leads to competence" (Rice & Kitchel, 2015) . However, initial competence stems from a combination of personal experiences, professional experiences, and valuing certain subjects. Teachers are then more likely to pursue expertise and teaching opportunities with those same agriculture subjects. (Rice & Kitchel, 2015; Snider et al., 2021). Moser and McKim explored this idea where teachers gauged their individual interest in Agriculture, Food, and Natural Resource (AFNR) subject areas compared to the curriculum that they taught in their programs. Teacher interest exceeded most of the AFNR pathways indicating personal interest was higher than the presence of curriculum with their program (Moser & McKim, 2021). Teacher beliefs about the purpose of SBAE also influence the quality components of their practice (Williams, 2019). Teachers who are career preparation oriented may emphasize physical skills and abilities compared to those who aim to increase agriculture literacy and the attainment of knowledge (Rice & Kitchel, 2017). Alternatively, teachers might concentrate on each individual student's goals and differentiate instruction to meet those targets (Rice & Kitchel, 2017).

Labor Market Alignment

Creating Aligned Programs

Alignment refers to the extent to which an educational program or institution is connected to and meets the needs of the local or regional labor market (Van Noy & Cleary, 2017). Industry alignment is essential to student success and the value that education bestows (Clearly & Van Noy, 2014). Both peer-reviewed and trade-type literature are quite clear on the factors that educational programs should adhere to that ensure industry alignment. Among all the building blocks that make secondary and post-secondary programs a place of learning, program selection, curricula, instructional strategies, enrollment, student advising, and co-curricular activities should be tailored to meet the needs of surrounding labor markets (Clearly & Van Noy, 2014). Proper alignment is a multifaceted process that incorporates a number of collaborative personnel to achieve such as feat, as illustrated in Figure 6.

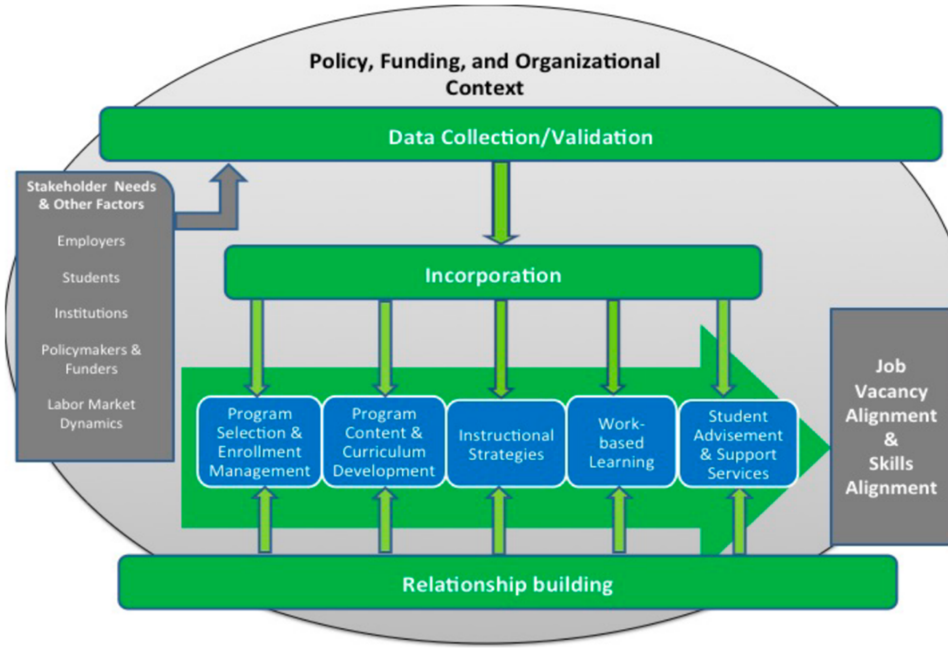

Figure 6: Framework for Understanding Alignment Activities and Outcomes

In order to align educational programs with the needs of the local labor market, it is necessary to consider a range of factors such as institutional goals, local industry data, and labor market trends. This process often involves phasing out programs of study that are no longer in demand and replacing them with ones that better reflect the credentials, skills, and job vacancies of local businesses (Clearly & Van Noy, 2014; Suffren & Mezera, 2018). Economically informed institutions rely on local public and private sector stakeholders and advisory committees that guide all aspects of secondary and post-secondary programs to meet in-demand competencies (Atwell et al., 2022; Clearly & Van Noy, 2014; Suffren & Mezera, 2018; Tuttle-Huff, 2015). A number of district superintendents in one qualitative study admitted that they should be communicating more with stakeholders and neighboring career centers, however they believe that “advisories open up opportunities for businesses to find experienced and qualified students that fill an economic need” (Tuttle-Huff, 2015). Tuttle-Huff (2015) also noted that advisory committees also are embedded into endorsing CTE budgets, equipment purchases, and program evaluations.

Programs that actively strive for industry alignment also follow labor market and economic data (Atwell et al., 2022; Clearly & Van Noy, 2014; Sublett, 2019). Deliberate use of such data, including data from program graduates and industry representatives, led to the investigation of various community colleges that epitomize alignment; Shasta College in California is one example (Atwell et al., 2022). Due to labor market data, advisory committee advocacy, and a recognition of community needs, school officials secured funding from the California Department of Forestry and Fire Protection, 45,000 acres of forest land for hands-on education in forest health, and a forestry student apprenticeship program (Atwell et al., 2022). Establishing aligned programs at all levels of education will continue to be under the dominion of federal and state policy; however, innovative and meticulous use of data and local stakeholders lead to promised and positive student outcomes (Atwell et al., 2022; Stevens et al., 2019; Xu & Trimble, 2016).

State of CTE Alignment

The alignment of CTE programs with local or regional labor has become a topic of interest within the past two decades. Policy makers are hungry to follow up on CTE programs relishing on state and federal funds meant to reinvigorate the connection between education and local economies (Imperatore & Hyslop, 2017). Nevertheless, the degree to which CTE programs align with their local labor markets vary as much as the local workforce and educational institutions are diverse. Simply described, there are extensive discrepancies among number of students trained for specific industries and the relative number of related occupations (Carreira, 2008). Across the nation, only a sixth of high schools concentrate in CTE, regardless of pathway (Sublett & Griffith, 2019). Local labor markets have demonstrated to shape the curriculum that schools offer partially due to the relationships that are built and where school resources are allocated from (Sutton, 2017). Schools in geographical areas that are economically driven by a higher concentration of sub-baccalaureate jobs will in turn devote a greater share of courses to CTE and a smaller share to advanced college-preparatory classes (Sutton, 2017). Sublett and Griffith (2019) and Dalton et al. (2021) provided parallel empirical evidence that high school students were more likely to take CTE courses, including AFNR, when there were more related local jobs and skill demand was high, in spite of mixed results regarding other alignment factors.

Though these results entertain positive outcomes, the remaining body of literature has highlighted the misalignment of educational institutions and labor market projections. Few authors across the board would dispute that there is little to no relationship between program enrollment or course offerings with current or projected job demands (Carreira, 2008; Dalton et al., 2021; Hargis, 2011; Harris et al., 2020; Sublett, 2019; Sublett & Griffith, 2019). In the case of Western Virginia and Kentucky's Appalachian Region's CTE programs, broad inconsistencies between job growth and course-taking stemmed from certain industries being in great demand for skills and people, yet student enrollment was quite minimal (Hargis, 2011; Harris et al., 2020). On the other hand, where course-taking exceeded labor market demand, agriculture CTE programs have shown to be in a precarious state.

Agriculture, STEM, and communications account for a negligible share across all regions of the United States (Sublett, 2019; Sublett & Griffith, 2019). Yet, students in the Midwest and southern regions earn three to four times as many credits in AFNR than those in the northeast, while the western part of the U.S. earns five times more (Sublett & Griffith, 2019). Essentially, AFNR course taking surpasses agriculture employment shares. In fact, agriculture employment is considered to be unrelated all together to student-course taking (Sublett, 2019). From a state level point of view, student agriculture certificates where given to four-percent of students though only a half-percent of jobs required such a credential (Dalton et al., 2021). Prospective funding opportunities may also be at stake as exemplified by an Arizona county where the agribusiness and agriscience sector were deemed to have an over allocation of resources compared to county job projections (Carreira, 2008). The gaps in these studies hinder the full generalizability of their findings considering that the jobs classified as part of the agriculture industry were not clearly defined, which could lead to a narrow interpretation the agricultural labor market. Furthermore, none of the studies analyzed the specific career paths within each CTE program. This lack of information may limit the usefulness of these studies for researchers and practitioners in AFNR education.

Theoretical Framework

The theoretical framework that guided this study was Human Capital Theory (HCT). Human capital refers to the "the skills, knowledge, and qualifications of a person, group, or workforce considered as economic assets" (*Human Capital Definition & Meaning - Merriam-Webster*, n.d.). Among scholars, human capital is the procurement of skills, knowledge, education, and experiences with the objective of receiving a return on said investment through monetary, nonmonetary, cognitive, or noncognitive income at an individual or society scope (Altonji et al., 2012; Becker, 1994; Schultz, 1961; Smith, 2010; Smylie, 1997; Sweetland, 1996). Capital can be categorized by investments into one's health, on-the-job training, formal education, study programs, or migration-induced job opportunities (Schultz, 1961), with HCT mostly dedicated to career and educational attainment (Becker, 1994; Schultz, 1961).

Flourishing western societies have attributed human capital to the expansion of scientific and technical knowledge that elevated the production of goods and labor outputs (Becker, 1994). Modern industry and agriculture could not have produced outputs without great investment in humans (Becker, 1994). Nobel Prize winning economic scientist Theodore Schultz (1961) retrospectively described the relationship of human capital and technology as follows:

> "Compelling evidence of the link between human capital and technology comes from agriculture. Education is of little use in traditional agriculture because of farming methods and knowledge are then readily passed on from parents to children. Farmers in countries with traditional economies are among the least educated members of the labor force. By contrast, modern farmers must deal with hybrids, breeding methods, fertilizers, complicated equipment, and intricate futures markets for commodities. Education is of great value since it helps farmers adapt more quickly to new hybrids and other new technologies. Therefore, it is no surprise that farmers are about as well education as industrial workers in modern economics."

Managers, scientists, scholars, and farmers become the embodiment of human capital as an immense increase in industrial production influences the value of all systems of formal and in-formal education (Becker, 1994).

The value of specialized education and training in specific-industry sectors, such as agriculture, are at the whim of human capital determinants of labor markets and divisions (Smith, 2010). Persons concentrate in training that are reflective of their experiences and prior education. Depending on the relationship between aligned and misaligned industry sectors, the makeup of human capital, production output, and distribution of income are effected (Altonji et al., 2012; Smith, 2010). People may also professionally develop their skills in response to progressing abilities, personal preference, and market demands and switch sectors all together, which can be costly (Altonji et al., 2012; Smith, 2010). Aligning education, training, and career prospects generate greater specialization and income disparities between well aligned and poorly aligned human capital investments. (Smith, 2010).

Returns on human capital education investment from secondary institutions is difficult to measure as student course-taking choices are directed to meet general education requirements; subjecting students to heterogenic outcomes (Altonji et al., 2012; Sweetland, 1996). Sweetland (1996) mentions that parents not only want educators to provide students with diplomas, but with job skills that contributed to the economy. At the same time, industrialists want educators at local levels to promote children who have demonstrated the productivity needed to be in competitive labor markets (Sweetland, 1996). There are a plethora of nuances that factor into educational attainment: student preference, innate ability, type of education program, and the skills that are influenced by surrounding occupations (Altonji et al., 2012). Promising financial outcomes come from vocational classes for non-college going students as well as advanced courses (Altonji et al., 2012). Ensuring prime educational experiences requires competent educators that continue to sharpen skills through post-baccalaureate trainings (Smylie, 1997). Human capital suggests in order for schools to be most effective, teachers should "respond to changes in the characteristics, conditions, and learning needs of students" (Smylie, 1997). Teachers should also create practices that showcase novel subject matter knowledge regarding teaching, learning, and industry (Smylie, 1997).

In School-Based Agriculture Education, the knowledge, skills, and education acquired is contextualized around the three-component model of agriculture education (Becker, 1994; Talbert et al., 2007). The three-component model allows SBAE teachers to develop students in classroom settings, applied experiences in Supervising Agricultural Experiences, and soft skill development through FFA (Talbert et al., 2007). Human capital is practically innate in SBAE programs in order to prepare college and career ready students for returns on their investment (Roberts & Ball, 2009).

Conceptual Framework

Complementary to Human Capital Theory, Roberts and Ball (2009) conceptualized the interrelated components of the agriculture industry, teacher experience, curricula and it cyclical outcomes. At its core, the model is based on behaviorism, in which an observable change in behavior was the result of acquiring certain skills and knowledge that were congruent with industry (Roberts & Ball, 2009). Agriculture teachers are in a unique position as not only the expert that students are led by, but the communicator of emerging agricultural skills and technologies (Roberts & Ball, 2009). Figure 7 illustrates the Roberts and Ball's (2009) content-based model for teaching agriculture and is described as follows:

> "It begins with the agricultural industry, which provides the basis for the curricula taught and for the teacher preparation. In turn, teachers utilize the curricula to provide industry-relevant instruction that results in observable skills acquisition. The end result is skilled workers that are ready for successful employment in the agricultural industry."

School-based agriculture is becoming increasingly contextually-driven, as conceded by Roberts and Ball (2009), since vocation agriculture's inception. Nevertheless, the longevity of content-centered agriculture education hinges on meeting the contemporary needs of industry (Roberts & Ball, 2009). It is well-established that local labor markets are a key source of information regarding the skills and knowledge required for success within the agriculture industry. As such, these markets serve as major contributors to the development of the agriculture workforce. Moreover, SBAE programs and teachers that adapt to these requirements will be conducive for the skilled workers that industry yearns for (Roberts & Ball, 2009).

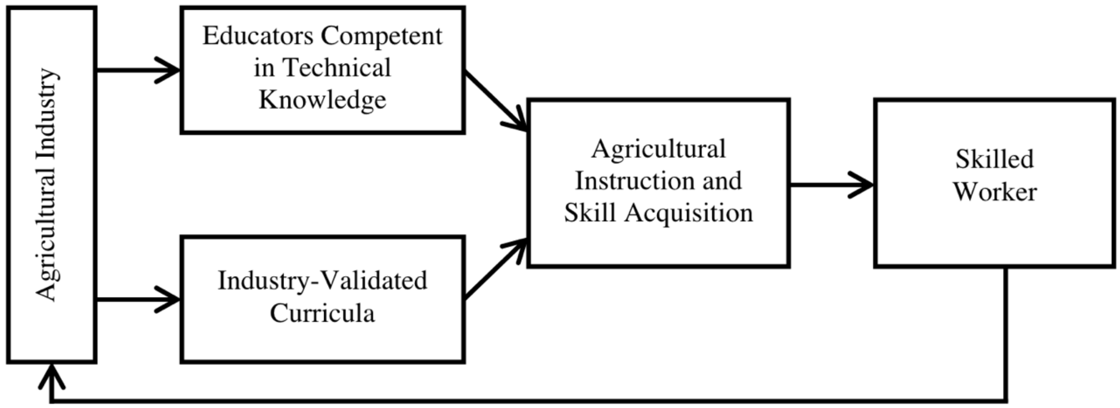

Figure 7: Content-based model for teaching agriculture.

Summary

Section two provided extensive insights on the agricultural, industrial, and educational dynamics that led to investigating alignment of SBAE programs and teachers. This section addressed the evolution of the agriculture industry and its sought-after skills, emerging objectives of CTE legislation, AFNR education and SBAE programs structures, development of agriculture teachers, and the variables of labor market alignment. Furthermore, the Human Capital Theory and the content-based model for teaching agriculture (Roberts & Ball, 2009) were presented as the foundations for the study. Evaluating the alignment of SBAE program components and teacher experiences is initiated by addressing the research objectives. Methodology will be the subject of the subsequent section where topics include research design, data collection, populations, instrumentation, and data analysis.

METHODOLOGY

Introduction

The previous chapters outlined the need for the study and the gaps in the literature regarding labor market alignment in AFNR pathways. Such a lack of AFNR focused research led to a deeper dive into the current state of alignment of California agriculture teachers and SBAE programs and the characteristics associated with aligned individuals and programs. In order to reconcile the absence of research, section three describes the methods and procedures used to conduct this study. Research design, instrumentation, participant recruitment, and data analysis are explained and justified. The study was descriptive and comparative in nature by employing a causal-comparative design composed of survey and archival data collection methodology.

Purpose of the Study

The purpose of this study is two-fold: 1) explore and describe the alignment of local AFNR labor markets between SBAE program components and teacher experience; and 2) compare the alignment between local AFNR labor markets and teacher experiences and SBAE program components.

Research Objectives

1. Describe teacher characteristics in the sample.
2. Describe SBAE program characteristics in the sample.
3. Determine the alignment between teacher experiences and their local AFNR labor markets.
4. Determine the alignment between SBAE program components and local AFNR labor markets.

5. Compare teacher characteristics between aligned and unaligned teacher experiences.
6. Compare SBAE program characteristics between aligned and unaligned program components.

Research Design

The researcher subscribed to a causal-comparative design (Gall et al., 1996). Attempting to uncover possible cause-and-effective relationships between variables underlines this type of quantitative research. Once a given variable effects another, the relationship or possible causes can be measured: commonly referred to as ex post facto research (Gall et al., 1996). Within the context of this study, the dependent variables have already exerted their influence on labor market alignment. Though a causal-comparative design is less conducive to outputting strong, convincing causal evidence between variables than truly experimental methods, the employed method can still produce similar relational information (Ary et al., 2018). The studied dependent variables cannot be controlled, therefore striking the randomization and manipulative aspects of experimental dependent variables, and leading to cautionary inferences about the causal relationships (Ary et al., 2018). However, the investigative properties of a causal-comparative design still allow the examination of potential relationships between variables.

Descriptive and comparative measures were taken under the research design (Johnson & Christensen, 2019; Privitera, 2022). In order to describe the individual agriculture teacher and SBAE program characteristics of the study's participants, a descriptive approach was used. Comparative tests were completed to compare characteristics between aligned and unaligned AFNR pathways.

Institutional Review Board

Research on human subjects could not have been initiated without the agreement of federal mandates embedded in California State University, Fresno Institutional Review Board (IRB) policies. An application was submitted to the California State University, Fresno Committee for the Protection of Human Subjects for review. This study, identified as Protocol #1347, received official approval on May 26, 2022 (see Appendix A).

Population, Sample, and Participants

The study utilized a purposive sample of California school-based agriculture education program department chairs. Purposive sampling, also known as judgment sampling, is “the deliberate choice of an informant due to the qualities the informant possesses. It is a nonrandom technique that does not need underlying theories or a set number of informants” (Tongco, 2007). The predefined objectives of the study inform the type of participant data that will need to be collected from knowledgeable and experienced individuals. As such, caution should be used to generalize beyond the studied participants (Tongco, 2007). Moore (1994) said, “There are times when selecting purposive samples would do more to advance the profession than selecting random samples. At times we need to identify the best programs, best teachers, and best FFA Chapters and study them in detail.” It was also suggested to study schools and teachers who are experienced in incorporating agricultural and academic education (Moore, 1994). SBAE program department chairs were selected to tackle two responsibilities in the study simultaneously: 1) provided their individual agriculture teacher information regarding personal and professional characteristics that embody the population of California agriculture teachers; and 2) served as proxies of their respective SBAE program, presumably, as the most knowledgeable individual of their program components and characteristics.

Purposive sampling eliminates any prerequisite of the number of participants, as long as the needed information is gathered (Bernard, 2002). In fact, Seidler (1974) examined varying sampling sizes of purposively selected informants and found that at least five informants were needed for data to be reliable. The sampling frame (N = 302) included all California SBAE agriculture teachers that were noted as "department chairs" in the California agriculture teacher directory found in the Agricultural Experience Tracker (AET) during the 2021-2022 academic year. Surveys were sent to department chairs via email communication in which, at the end of the recruitment period, 109 (*n* = 109) respondents provided usable data, resulting in a 36.09% response rate. Department chairs were characterized as agriculture teachers or SBAE teachers in this study.

Instrument Distribution

After the sample frame was determined, the instrument was distributed to California SBAE agriculture teachers using electronic mail. Names and email addresses were retrieved from AET of agriculture teachers that were identified as "department chairs." The survey was constructed and sent through the Qualtrics® Survey Software to 302 individuals on May 30, 2022. An informed consent page was included prior to participants beginning the survey that outlined their rights as study participants (see Appendix B). Teachers were instructed to indicate their informed consent by proceeding to the first page of the survey instrument.

Survey design and electronic communication adhered to the Tailored Design Method (Dillman et al., 2014). Careful consideration of electronic feasibility and accessibility across multiple devices ensured proper performance across mediums. Dillman (2014) also emphasized the timeliness, incentives, and personalization of survey communication. The initial recruitment Qualtrics email and survey was sent on May 30, 2022 with a reminder distributed every two weeks for approximately two months with the last reminder sent on July 25, 2022 and the survey closing on August 5, 2022. (see Appendix D). To enhance the effectiveness of communication and bypass potential obstacles such as spam folders and suppression by other emails, a strategy was employed that involved sending emails in the morning and slightly altering the content of each reminder (Dillman et al., 2014). All emails include personalized contacts, researcher background, a monetary incentive drawing for participants, Qualtrics survey link, and researcher's personal contact information. Confidentiality standards were met as each agriculture teacher and their corresponding SBAE program were assigned an identification number (Dillman et al., 2014). These protocols were completed for every reminder after the initial correspondence to enhance response rate (Dillman et al., 2014).

Instrumentation and Primary Data Collection

A researcher-modified version Moser and McKim's (2021) curriculum scale was commissioned to investigate alignment with local AFNR labor markets. After revision, the final instrument consisted of 57 items, including 11 questions describing the participant's and SBAE program's characteristics, 18 items regarding the presence of each AFNR pathway within the teacher's training, and 27 items about the presence of each AFNR pathway within SBAE program's components of classroom, FFA, and SAE (see Appendix C). The following sections present a detailed account of collecting all such data.

Moser and McKim (2021) Curriculum Scale

The initial survey instrument by Moser and McKim was employed to investigate the content interest and AFNR curriculum taught through the lens of curriculum congruence (Moser & McKim, 2021). Research on teacher connectivity branched out to connection to the community, curriculum, school and other SBAE teachers in addition to certification path, curriculum congruence, and teacher experience (Moser & McKim, 2021). Moser and McKim (2021) refer to curriculum congruence as the alignment or balance or "between the presence of, and interest in teaching Agriculture, Food, and Natural Resources (AFNR) pathways or programmatic elements."

Two curriculum scales were presented in the data collection survey in which respondents indicated the presence of 11 pathways or programmatic elements within the SBAE program (Moser & McKim, 2021). These include the nine agriculture pathways (i.e. Agribusiness; Animal Science; Biotechnology; Natural Resources; Food Products and Processing; Environmental Science; Plant/Soil Science; Power, Structural and Processing; General Agriculture) and two programmatic element (i.e. SAE and leadership) (Moser & McKim, 2021). Curriculum presence was rated on a scale from 0 (*Area not present in the curriculum I teach*) to 100 *(Area encompasses all the curriculum I teach*) (Moser & McKim, 2021). A similar scale was used to gauge interest in teaching the 11 pathways or programmatic elements in which 0 represented "No Interest" to 100 signifying "Extremely High Interest" (Moser & McKim, 2021). From here, the data was used to calculate curriculum congruence. Teachers exemplifying curriculum congruence would be one who experience congruence in plant systems if they enjoyed crop production and botany. Otherwise, if a teacher disliked welding and fabrication, but a large portion of their curriculum concentrated on mechanics and construction, this teacher would personify curriculum incongruence.

<u>Research Setting</u>

The study was conducted with participants and SBAE programs from California. Though California agriculture education does not strictly reflect the AFNR framework, the essential purpose of California's Agriculture and Natural Resource (ANR) standards does. AFNR standards and the state CTE Model Curriculum have congruent functions of assembling agriculture pathways and opportunities to meet local labor demands and support student transition into college (California Department of Education, n.d.).

The researcher used AFNR pathways and standards instead of the California ANR Standards as AFNR is, in general, universally integrated at the national scale, serves as the agricultural foundation for Supervised Agriculture Experiences, FFA, and classroom pathways, and recognized as common nomenclature among agriculture education professionals (National Council for Agricultural Education, n.d.). To mold agriculture teachers' mindset while responding to the researcher-modified pathway scales, a simple standards alignment table (see Appendix E) was included in the survey providing the descriptions of both ANR and AFNR pathways and their aligned pathways. Document analysis of between ANR and AFNR standards was subject to Ary et al. (2018) inter-rater reliability. Reliability was established as pathway standards were assessed for similarities while differences were reconciled through consensus. Table 1 provides a simplified crosswalk without pathway descriptions. In the case where two pathways in one set of standards align with a single pathway in another, the pathway scale gives the participant discretion on how their experiences or program opportunities are delineated. Three agriculture education faculty reviewed and approved the crosswalk table prior to survey distribution, ensuring clear similarities between pathways.

Table 1. California ANR, AFNR Pathway Crosswalk

California Agriculture & Natural Resources (ANR)	→	**Agriculture, Food, and Natural Resources (AFNR)**
Agricultural Business	→	Agribusiness Systems
Agricultural Mechanics	→	Power, Structural, and Technical Systems
Agriscience	→	Biotechnology Systems
	→	Food Products and Processing Systems
Animal Science	→	Animal Systems
Forestry and Natural Resources	→	Environmental Service Systems
	→	Natural Resource Systems
Ornamental Horticulture	→	Plant Systems
Plant and Soil Science	→	
Other	→	Other

Note: California ANR (California Department of Education, n.d.). AFNR (National Council for Agricultural Education, n.d.).

Researcher-Modified Pathway Scale

The instrument used for this study mirrors the general conceptualization of congruence, or in this case alignment, in which a balance between the presence of AFNR pathways in courses, SAE, and FFA opportunities, and the presence of AFNR-type occupations in local labor markets. The researcher-modified pathway scale requested respondents to indicate the presence of the eight Agriculture, Food, and Natural Resources pathways: Agribusiness Systems (ABS), Animal Systems (AS), Biotechnology Systems (BTS), Environmental Service Systems (ESS), Food Products and Processing Systems (FPPS), Natural Resources Systems (NRS), Plant Systems (PS), Power, Structural, Technical Systems (PSTS). A ninth "Other" (OTH) pathway was included for agriculture experiences and program opportunities that are unfit to be categorized into AFNR.

To investigate the alignment of teacher experiences, both pre and in-service, AFNR pathway presence was rated on a scale of 0% (*No Experience*) to 100% (*Much Experience*). To facilitate alignment data collection of each program component, classroom/curriculum, SAE, and FFA, AFNR pathway presence was rated on a scale of

0% (*Not Present*) to 100% (*Highly Present*). The summative total across all pathways in each distinct survey item must total 100%.

Instrument Validity and Reliability

Face and content validity were evaluated by three agriculture education faculty members. These members are deemed professionals in the field of agriculture education based on their past agricultural industry and education experience and faculty appointment. All faculty members served as high school SBAE teachers prior to receiving a terminal degree and teaching at the university level. A pilot test of the original Moser and McKim (2021) instrument was conducted with 118 business teachers in Michigan. The curriculum construct was estimated to be unreliable in the pilot; however, in the original study, "it was recommended to keep the construct for data collection as the target population differed from the pilot population in regard to teacher relationships to their curriculum" (Moser & McKim, 2021). *Post hoc* reliability analyses implied that curricular connectivity was reliable with an alpha coefficient of .72 (Moser & McKim, 2021).

Archival Data Collection

Remaining information to collect stemmed from archival data. An archival method allows the researcher to use existing data "in which events or behaviors are described based on a review and analysis of relevant historical or archival records (Privitera, 2022). The study utilized existing data from the Agricultural Experience Tracker, California Department of Education (CDE), and the Employment Development Department (EED) of the State of California to accurately assess the independent and dependent variables in the study. The next sections describe the data collected and its source.

SBAE Program Characteristics

With the assistance of the California State Supervisor of Agriculture Education and Family and Consumer Sciences, student and program data was queried and extracted from AET. By way of the archival research technique (Privitera, 2022) AET data extraction included the number of teachers per SBAE program, number of courses taught per SBAE program, and the number of students per program and their demographics.

A systematic and proven method of categorizing schools in which SBAE programs are established into locales was also sought. The National Center for Education Statistics (NCES) Education Demographic and Geographic Estimates (EDGE) program creates geographic data to illustrate the relationship between educational institutions and the communities they reside in (Geverdt, 2019). The locale classification is a general geographic indicator that categorizes United States territory into four basic types of areas: city, suburban, town, and rural (Geverdt, 2019). Schools are assigned based on the proximate physical location of the school, not necessarily the entire school service area (Geverdt, 2019). The NCES provides a multitude of files containing the delineation of school locales. This study used open-sourced spreadsheets that listed schools and their assigned NCES EDGE locale.

In addition, California agriculture education programs have the potential to apply to and be awarded the Agriculture Career Technical Education Grant, also known as Agriculture Incentive Grant (AIG). Funds are provided to local educational agencies to improve the quality of their agriculture CTE programs (*RFA: 2022-23 Agricultural Career Technical Education Incentive Grant [CA Dept of Education]*, n.d.). In order to produce a constant source of competent, educated, and employable workforce, AIG funds garner high-quality, comprehensive SBAE programs (*RFA: 2022-23 Agricultural Career Technical Education Incentive Grant [CA Dept of Education]*, n.d.). Though other government funding is available to SBAE programs in California, including but not limited to Perkins, Career Technical Education Incentive Grant (CTEIG), Local Control and Accountability Plan (LCAP), or K12 Strong Workforce, Agriculture Incentive Grants are awarded directly to school districts and are only used by the SBAE program. Funding results were collected from the California Department of Education 2021-2022 archives that provided the dollar amount each SBAE program received (*Funding Results - Finance & Grants [CA Dept of Education]*, n.d.; Privitera, 2022).

Local Labor Market Information

Labor Market Information (LMI) used in the study encompasses the defining of spatial and geographical areas that California SBAE programs dwell and the employment figures of each AFNR industry. Data collection continues to reflect Privitera's (2022) archival approach in an effort to use preexisting government data that has been processed by individuals with extensive statistical expertise.

Labor-Sheds and Commuting Zones

Labor markets are important units for regional and geographical analysis (Fowler et al., 2018). However, the phrase "labor market" varies in how research operationalizes it (Fowler et al., 2018; Goodman, 1970; Sutton, 2017). As Goodman states, "[T]he labour market is a term which is often used loosely, and which suggests a unity in practice" (Goodman, 1970). Spatial labor market analysis has demonstrated to be valuable in government research such as the relationship between education and employment (Killian & Parker, 1991; Sutton, 2017). Numerous delineations of labor have been unsuccessful including metropolitan statistical areas (MSA), core based statistical areas (CBSA), labor market areas (LMA), and economic areas (Fowler et al., 2018). To remedy the issue, Fowler et al. (2018) differentiated the value of each and their umbrella classifications under MSA, LMA, and labor-sheds.

Labor-sheds resemble an enclosed area that feeds employees into a workplace and the physical connection that workers have (Fowler et al., 2018). Furthermore, this classification focuses on where employees *could* potentially look for work. Motivated by connecting rural communities to employment hotspots, the United States Department of Agriculture (USDA) Economic Research Service (ERS) Commuting Zones (CZs) exemplify how this labor-shed definition has extrapolated its utility (Chetty et al., 2014; Fowler & Kleit, 2014; Gibbs & Bernat Jr, 1997).

In this study, local labor markets are the characterization of Community Zones that the SBAE program is geographically stationed. CZs allow researchers the equitable representation of urban and rural area contribution to economic systems across county and state lines (Tolbert & Killian, 1987). In this study's context, Agriculture, Food, and Natural Resource industries inhabit both rural and metropolitan areas. Following Fowler et al. (2016), Commuting Zones represent the grouping of counties based on commuting patterns. Figure 8 (Fowler et al., 2018) illustrates the 16 different California Commuting Zones that will be operationalized in this study representing the local labor markets where county-level employment data will be aggregated. Commuting Zone identification numbers, states, and counties and their Federal Information Processing System (FIPS) codes within those zones are summarized in Appendix G.

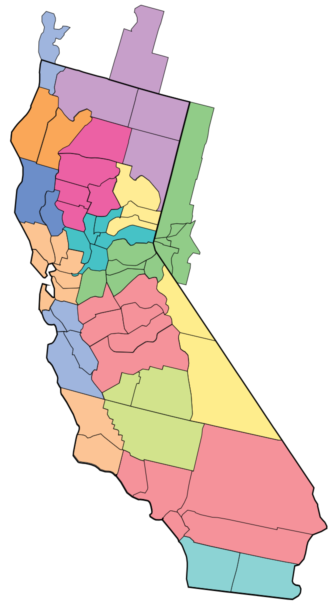

Figure 8: California Commuting Zones

Labor Market Data and AFNR Industry Classifications

The study sought to examine the alignment of local AFNR labor markets and teacher experiences and SBAE program components through multiple means of analysis. To capture the share of employment in different AFNR labor markets, the researcher aggregated county-level employment data from the Quarterly Census of Employment and Wages (QCEW) developed by the California Employment Development Department (EDD). Two counties in Oregon and five counties in Nevada are embedded into the two California Commuting Zones (Fowler et al., 2018). Representative AFNR employment data was collected from the Nevada Department of Employment, Training and Rehabilitation (DETR) and the State of Oregon Employment Department QCEW. All employment numbers were delivered as an average of the 2021 year, reflective of the 2021-2022 school year in which the study was conducted.

What is classified as an Agriculture, Food, and Natural Resource industry or occupation has demonstrated to be either narrowly defined or contradictory. The nation's primary source of occupation knowledge, Occupational Information Network (O*NET®), references the National Career Cluster stating that AFNR "is focused on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources including food, fiber, wood products, natural resources, horticulture, and other plant and animal products or resources" (*Agriculture, Food & Natural Resources | Advance CTE*, n.d.). Despite this definition, the O*NET® list of occupations under each AFNR pathway is incomprehensive (National Center for O*NET Development, n.d.). On the other hand, the North American Industry Classification System describes the Agriculture, Forestry, Fishing, and Hunting Sector as having "establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats" (U.S. Census Bureau, 2022). This study's labor market analysis will define the industries that fall under each AFNR pathway, ensuring agriculture employment is reflective of the aforementioned career cluster definition of AFNR.

Despite its surface level definition of the agriculture industry, the North American Industry Classification System (NAICS) was used to sort industries into AFNR pathways. NAICS is a comprehensive system that accounts for all economic activity, and groups establishments into industries based on like production processes (U.S. Census Bureau, 2022). Initial development was intended to specify common definitions for industries in Canada, Mexico, and the United States where statistical agencies in those countries produce information on a variety of econometric characteristics, including employment (U.S. Census Bureau, 2022). NAICS is composed of a hierarchal structure in which all economic activities are classified into 20 sectors; assigning each NAICS sector their own code ranges (see Appendix F) (U.S. Census Bureau, 2022). The 20 sectors utilized in

NAICS (U.S. Census Bureau, 2022) are subject to a six-digit coding system to classify industries and their ordinal placement. NAICS (U.S. Census Bureau, 2022) describes the hierarchical structure stating:

> "The first two digits of the code designate the sector, the third digit designates the subsector, the fourth digit designates the industry group, the fifth digit designates the NAICS industry, and the sixth digit designates the national industry. A zero as the sixth digit generally indicates that the NAICS industry and the U.S. industry are the same."

Six-digit national industries that were deemed appropriate and agriculturally relevant were reclassified into the AFNR career pathways. Document analysis was systematically conducted to review each AFRN career pathway content standards, performance indicators, and sample measurements. In addition, the title, description, and any cross-reference for each six-digit national industry was reviewed. Evaluation of both documents produced a group of national industries that were classified under each Agriculture, Food, and Natural Resource career pathway (see Appendix F). Employment data transferred from the QCEW will be of the average number employees in 2021 year at the six-digit national industry level, and by extension, its respective AFNR pathway. Following Ary et al. (2018), inter-rater reliability was established for document analysis by comparing industry classification and resolving differences through consensus.

Selected Agriculture Teacher Characteristics and Demographics

Agriculture teacher characteristics were collected through the distributed survey instrument containing seven items regarding their personal career and demographical information. They included teacher age, gender, ethnicity, home locale, highest degree, number of years teaching SBAE, and remaining teacher tenure.

Teacher Age. Participants were asked for the numeric value of their age.

Gender. One item asked participants their gender with options comprising of male, female, decline to answer, and an other option. Respondents who selected other were prompted to write their gender if desired.

Ethnicity. One survey item inquired about the agriculture teacher's ethnicity. Options included white or Caucasian, black or African American, American Indian/Native American or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, decline to answer, and other. Though not required, respondents who selected other were asked to write their ethnicity.

Childhood Home Locale. One question requested participants to indicate what best described the geographic location of their childhood home. Possible choices: rural-on a farm, rural-not on a farm, suburban, urban.

Highest Degree. Agriculture teachers were asked the highest level of education they have obtained. Associate's degree, bachelor's degree, master's degree, Ph.D., and other the provided responses. Teachers had the option of stating the level of education if other was selected.

Certification Type. Teachers were asked to select which certification licensure type that they have received. Traditional, alternative, and other were the provided options. If other was selected, a text box for further description was provided but not required.

Number of Years Teaching SBAE. One inquiry asked how many years they taught high school agriculture. Participants were to respond with a numerical value.

Remaining Teacher Tenure. Respondents were requested to provide how many more years they intended to teacher agriculture. Numerical values were required.

Selected SBAE Program Characteristics and Demographics

School-based agriculture education characteristics were gathered through a variety of data collection means, such as survey and archival (Privitera, 2022). One survey item inquired about their home California FFA Region, while another asked the enter the zip code of the SBAE program. The Agricultural Experience Tracker, NCES Education Demographic and Geographic Estimate, and California Department of Education contained the crucial secondary SBAE program data. Data included: number of teachers, California FFA Region, number of AFNR courses taught, AIG funding, program NCES EDGE locale, number of students, number of students per gender, and number of students per ethnicity.

California FFA Region. In the distributed survey, agriculture teachers were prompted to indicate the FFA Region their SBAE program was located. California FFA Regions consisted of Superior, North Coast, Central, San Joaquin, South Coast, and Southern.

SBAE Program Locale. Participating teachers were asked enter the zip code of the program or school. Zip codes were then matched with school locale classifications structured by the NCES Education Demographic and Geographic Estimate. SBAE programs were categorized into either city, town, suburban, or rural locales (Geverdt, 2019).

Agriculture Incentive Grant Funding. Yearly funding award results for each SBAE that applied to AIG were collected from the California Department of Education (*RFA: 2022-23 Agricultural Career Technical Education Incentive Grant [CA Dept of Education]*, n.d.). Award results were in dollar amounts.

AET Queries. With the assistance of the state agriculture education advisor, queries were entered into the AET program in order to extract the number of AFNR courses taught, number of students, number of students per gender, and number of students per ethnicity.

Data Analysis

Proceeding all forms of data collection and organization, a unique number was assigned to each agriculture teacher and SBAE program to ensure confidentiality (Dillman et al., 2014). The Statistical Package for the Social Sciences (SPSS®), Version 29 for Mac OS X™, was used for data analysis encompassing descriptive and inferential statistics. The characteristics, variables, and corresponding statistical processes for each research question are outlined in Table 2.

Table 2. Data Analysis and Corresponding Research Objections and Variables

Research Objectives	Independent Variable	Dependent Variable	Analysis
1. Describe teacher characteristics in the sample.	N/A	N/A	Descriptive Statistics
2. Describe SBAE program characteristics in the sample.	N/A	N/A	Descriptive Statistics
3. Determine the alignment between teacher experiences and their local AFNR labor markets.	N/A	N/A	Descriptive Statistics; Discrepancy Calculations; Assign alignment category
4. Compare teacher characteristics between aligned and unaligned teacher experiences.	N/A	N/A	Descriptive Statistics; Discrepancy Calculations; Assign alignment category
5. Determine the alignment between teacher experiences and their local AFNR labor markets.	Pre-Service Teacher Experience Alignment; In-Service Teacher Experience Alignment	Teacher Characteristics	Independent Samples t-Test; Chi-Square Test of Independence
6. Compare SBAE program characteristics between aligned and unaligned program components.	Class Alignment; SAE Alignment; FFA Alignment	SBAE Characteristics	Independent Samples t-Test; Chi-Square Test of Independence

Research Objective 1 and 2

To address research objectives 1 and 2, univariate descriptive statistics were used to summarize data characteristics. Means, standard deviations, frequencies, and percentages were computed to describe agriculture teacher and SBAE program characteristics and demographics.

Research Objectives 3 and 4

To meet research objective two and three, descriptive statistics were computed including means, standard deviations, frequencies, and percentages. Categorical measures of alignment were determined in accordance to Moser and McKim (2021). For each of the nine total AFNR pathways, the percent presence score (i.e. teacher experience or SBAE component) was compared to the percent of local AFNR labor market employment for each particular pathway (Moser & McKim, 2021). In the case that the discrepancy between presence and employment scores had an absolute difference of ten percent or less, the participating teacher experience or SBAE program component would be categorized as "aligned" for that AFNR pathway (Moser & McKim, 2021). If the difference between scores was greater than ten percent, they were noted as "unaligned," creating a dichotomous outcome. The two categories that were the result of discrepancy calculations were inputted as dependent variables for research objectives five and six.

Research Objectives 5 and 6

Research objectives 5 and 6 call for comparative analysis. Using the categories created in research objectives 3 and 4, alignment was designated as the dependent variable where comparisons were made between "aligned" and "unaligned" programs and teachers.

Numerical teacher and SBAE program characteristics were analyzed using independent sample t-tests with an alpha level of .05 (Agresti & Finlay, 2009). To further describe significant results, Cohen's d was assessed for each comparison, with d = .05 indicating a medium effect size and d = .08 indicating a large effect size (Agresti & Finlay, 2009).

The remaining nominal characteristics in both research objectives were studied using a Chi-Square Test of Independence using an alpha level of .05 (Agresti & Finlay, 2009). Effect sizes were computed for each comparison using Cramer's V once a statistical significance was found (Agresti & Finlay, 2009). Table 3 illustrates the effect sizes needed for small, medium, and large effects depending on the degrees of freedom (Agresti & Finlay, 2009).

Table 3. Cramer's V Effect Sizes by Degrees of Freedom

*df**	*small*	*medium*	*large*
1	.10	.30	.50
2	.07	.21	.35
3	.06	.17	.29
4	.05	.15	.25
5	.04	.13	.22

Threats to Validity and Reliability

Studies cope with challenges to validity and reliability on a regular basis including errors coming from sampling, coverage, survey, measurement, and non-response (Dillman et al., 2014). Following the Tailored Design Method (TDM) helped to overcome such threats and increase high response rates with low amounts of errors (Dillman et al., 2014). A $25 gift card incentive for four randomly drawn respondents who completed the survey was used to encourage response.

Sampling error was reduced as an exact list of department chairs (serving as representatives of agriculture teachers and their SBAE programs) was collected from the Agriculture Experience Tracker. Three hundred two agriculture teacher names and email contacts were noted as "department chairs." Study recruitment was sent to these teachers. Though it can be assumed that all California SBAE programs had a department chair during the 2021-2022 school year, only 302 were identified in AET resulting in over 85% of the SBAE department chairs and programs in the state being included in the sample frame (N = 302), limiting sampling error.

Coverage error expresses concern that not all members of a population having equal accessibility to participate (Dillman et al., 2014). Every teacher with an email address was sent study related information including the survey, ensuring equal opportunity to participate.

Dillman et al. (2014) provided recommendations on how one can reduce measurement error. For this study, email communication was personalized with each respondent's name. Designing the survey on Qualtrics® allowed for multi-platform and device use with all surveys having a welcome and closing screen, similar page layouts, and allowing respondents to start and stop the survey on their own. Adhering to these suggestions helped produce more accurate data (Dillman et al., 2014).

Lindner et al. (2001) addressed the harm and potential presence of non-response anytime the response rate is below 100%. Controlling for non-response begins with following the universal procedures of research implementation as discussed above (Dillman et al., 2014). Handling of non-response lends itself to the procedure of comparing early to late respondents (Lindner et al., 2001). Late respondents can be defined as those who responded "in the last wave of respondents in successive follow-ups to a questionnaire, that is, in response to the last stimulus" (Lindner et al., 2001). If in reality the last wave of respondents does not accumulate to 30 or more responses, then Linder et al. (2001) recommends the researcher "'back up' and use responses from the last two stimuli as his or her late respondents." The final wave of survey respondents resulted in 7 participants. Therefore, the threshold in which the two groups were operationalized as early or late respondents was the third stimulus. Eight nine participants were noted as early respondents (n = 89), and the remaining classified as late respondents (n = 21).

Once early and late groups were established, "Comparison, then, would be made between early and late respondents on primary variables of interest" (Lindner et al., 2001). A chi-square test of independence was used to compare teacher demographics between groups. Table 4 illustrates that no significant differences were found between

California FFA Region χ^2 (5, n = 110) = 6.792, *p* = 0.237, gender χ^2 (1, n = 110) = 0.039, *p* = 0.843, ethnicity χ^2 (3, n = 110) = 3.224, *p* = 0.358, home locale χ^2 (3, n = 110) = 4.459, *p* = 0.216, highest degree χ^2 (1, n = 110) = .145, *p* = 0.704, or certification type χ^2 (1, n = 110) = 1.302, *p* = .254.

Table 4. Chi-Square Results of Comparing Early (*n* = 88) to Late (*n* = 21) Respondent Characteristics

	df	χ^2	*p*
CA FFA Region	5	6.792	0.237
Gender	1	0.039	0.843
Ethnicity	3	3.224	0.358
Childhood Home Locale	3	4.459	0.216
Highest Degree	1	0.145	0.704
Certification Type	1	1.302	0.254

Summary

Chapter 3 encompassed the methods operationalized to achieve the research objectives. The research design, sample frame, and instrumentation were discussed. In addition, primary and archival data collection methods were explained and justified. This causal-comparative design employs descriptive and comparative statistical techniques to investigate local AFRN labor alignment. The following chapter demonstrates the methodology in effect that produce results for each research objective.

FINDINGS

Introduction

Section IV presents the findings of the study by describing the participants, determining alignment, and comparing participants characteristics by alignment. A causal-comparative design with various forms of data collection was operationalized to assess SBAE teacher experiences and program components.

Purpose of the Study

The purpose of this study is two-fold: 1) explore and describe the alignment of local AFNR labor markets between SBAE program components and teacher experience; and 2) compare the alignment between local AFNR labor markets and teacher experiences and SBAE program components.

Research Objectives

1. Describe teacher characteristics in the sample.
2. Describe SBAE program characteristics in the sample.
3. Determine the alignment between teacher experiences and their local AFNR labor markets.
4. Determine the alignment between SBAE program components and local AFNR labor markets.
5. Compare teacher characteristics between aligned and unaligned teacher experiences.
6. Compare SBAE program characteristics between aligned and unaligned program components.

Findings for Research Objective One

The intent of research objective one was to describe the SBAE teachers that participated in the study (see Table 5). Among the 109 teachers that provided usable responses, the mean age of the respondents was 41.69 (*SD* = 11.93) with a nearly 15-year long career and 14 years left (*SD* = 10.01, *SD* = 9.56 respectively). Most of the teachers were female (59.63%), white (84.40%), and came from a rural farming locale (36.70%). In terms of education, 72 teachers (66.06%) have received a Master's degree and have completed a traditional teacher licensure certification process (88.07%).

Table 5. Agriculture Teacher Characteristics

Variable	*M*	*SD*		Frequency (*n*)	Proportion (%)
Age	41.69	11.93			
Years Teaching	15.39	10.01			
Remaining Teaching Tenure	14.52	9.56			
Gender					
Male				44	40.37
Female				65	59.63
			Total	109	
Ethnicity					
White				92	84.40
Hispanic				6	5.50
American Indian/Native				4	3.67
Other				7	6.42
			Total	109	
Childhood Home Locale					
Rural - On a Farm				40	36.67
Rural - Not on a Farm				26	23.85
Suburban				32	29.36
Urban				11	10.09
			Total	109	
Highest Degree					
Bachelor's Degree				37	33.94
Master's Degree				72	66.06
			Total	109	
Certification Type					
Traditional				96	88.07
Alternative				13	11.92
			Total	109	

Note. n = 109

Findings for Research Objective Two

The purpose of research objective two was to describe the SBAE programs that the 109 teacher participants purposively represented. Table 6 outlines characteristics of these SBAE programs. SBAE programs were mainly operated by about 3 teachers (*SD* = 2.09) with a mean of 17.37 (*SD* = 9.78) classes were taught among the respondents. In the 2021 AIG funding cycle, the SBAE programs were awarded a mean of $12,906 with a standard deviation of $7056. An equal number of SBAE programs were represented from the Central and San Joaquin regions (25.69%) with Southern region following at 18.35%. Most SBAE programs were located in a suburban area (37.61%) or town (27.52%).

Table 6. SBAE Program Characteristics

Variable	*M*	*SD*		Frequency (*n*)	Proportion (%)
Number of Teachers	3.36	2.09			
Number of Classes	17.37	9.78			
2021 AIG Funding	12905.99	7055.95			
California FFA Region					
North Coast				10	9.17
Superior				12	11.01
Central				28	25.69
San Joaquin				28	25.69
South Coast				11	10.09
Southern				20	18.35
			Total	109	
NCES Locale					
City				16	14.68
Suburban				41	37.61
Town				30	27.52
Rural				22	20.18
			Total	109	

Note. *n* =109. AIG = Agriculture Incentive Grant (in dollar amount). NCES = National Center of Education Statistics.

The demographic makeup of students within SBAE programs was also described (see Table 7). SBAE programs had a mean of 311 students with a standard deviation of 204.12 students. Cumulative SBAE program student demographics showed that most students were male and Hispanic (51.18%, 49.03% respectively) with white female students trailing behind (44.48%, 26.26% respectively).

Table 7. SBAE Program Student Demographics

Variable	*M*	*SD*		Frequency (*n*)	Proportion (%)
Number of Students	311.64	204.12			
Gender					
Males	159.50	110.67		17385	51.18
Females	138.62	90.49		15110	44.48
Non-Binary	3.63	3.45		396	1.17
No Answer	9.89	16.99		1078	3.17
			Total	33969	
Ethnicity					
White	76.77	69.38		8368	26.26
Hispanic	143.34	133.48		15624	49.03
Black	6.12	8.59		667	2.09
Asian/Pacific Islander	10.45	17.50		1139	3.57
Native American	4.93	5.42		537	1.69
Two of More Races	25.02	20.39		2727	8.56
No Answer	25.70	26.13		2801	8.79
			Total	31863	

Note. *n* =109

Findings for Research Objective Three

Research objective three sought to describe Agriculture, Food, and Natural Resource Pathway presence among pre-service and in-service experiences. Local labor market shares of each pathway were also described. Discrepancy scores were calculated between labor market shares and teacher experience in which the proportion of teacher experiences that were aligned with their local labor market were noted (see Table 8). Local AFNR labor markets mostly comprised of Agribusiness Systems-type industries (M = 28.75) with Plant Systems industries at a mean of 23.28. With only a mean of 2.54 of industry shares, Natural Resource System industries were the least prevalent.

Both pre-service and in-service experiences had the highest mean presence level of Animal Systems (*M* = 34.99, *M* = 27.64 respectively). OTH, also known as Other Agriculture, was the lowest mean percentage for both types of experiences (*M* = .91, *M* = 3.54) despite have the highest proportion of teachers having experiences aligned with that pathway's labor market (*M* = 96.33, *M* = 90.83). Animal Systems alignment had the lowest percentage of aligned teacher experiences with pre-service at a mean of 19.27 and in-service at 28.44.

Table 8. Teacher Experience, AFNR Labor Market Shares, and Alignment

	Labor Market Shares (%)		Pre-Service Presence (%)		Pre-Service Alignment	In-Service Presence (%)		In-Service Alignment
Pathway	*M*	*SD*	*M*	*SD*	Proportion (%)	*M*	*SD*	Proportion (%)
AS	6.51	1.89	34.99	21.43	19.27	27.64	20.88	28.44
ABS	28.75	10.44	13.11	15.91	25.69	10.10	13.43	20.18
BIOT	8.21	9.83	3.80	8.61	65.14	5.76	10.10	61.47
ESS	11.62	8.36	3.08	5.95	61.47	3.72	6.82	61.47
FPPS	7.04	4.23	3.34	6.24	87.16	5.96	10.09	78.90
NRS	2.54	4.51	5.33	10.12	81.65	6.28	10.64	77.98
PS	23.28	8.15	19.94	16.52	42.20	21.83	19.21	41.28
PST	5.58	2.66	15.50	17.52	55.96	15.17	19.64	57.80
OTH	6.47	2.22	0.91	3.89	96.33	3.54	12.66	90.83

Note. n =109. AS = Animal Systems; ABS = Agribusiness Systems; BIOT = Biotechnology Systems; ESS = Environmental Service Systems; FPPS = Food Products and Processing Systems; NRS = Natural Resources Standards; PS = Plant Systems; PST = Power, Structural, Technical Systems; OTH = Other Agriculture. Labor marker shares were calculated as the proportion of employment dedicated to each AFNR pathway. Teacher experience presence was rated from 0 (*No Experience in Pathway*) to 100 (*All Experience in Pathway*).

Findings for Research Objective Four

Descriptive statistics, discrepancy calculations, and alignment were completed to investigate research objective four. The same labor markets were utilized to establish the proportions of SBAE program components that are aligned with their individual local labor market (see Table 9).

Table 9. SBAE Program Components, AFNR Labor Market Shares, and Alignment

	Labor Market Shares (%)		Classroom Presence (%)		Classroom Alignment	SAE Presence (%)		SAE Alignment	FFA Presence (%)		FFA Alignment
Pathways	*M*	*SD*	*M*	*SD*	%	*M*	*SD*	%	*M*	*SD*	%
AS	6.51	1.89	19.73	14.91	42.20	47.25	25.12	10.09	27.83	23.38	37.61
ABS	28.75	10.44	8.13	11.80	18.35	6.54	8.68	18.35	11.76	12.82	23.85
BIOT	8.21	9.83	10.91	13.03	65.14	1.44	3.82	69.72	2.53	6.28	66.06
ESS	11.62	8.36	6.89	12.38	65.14	1.25	2.93	53.21	2.53	5.74	46.79
FPPS	7.04	4.23	4.90	8.04	83.49	3.47	5.84	89.91	4.51	7.87	82.57
NRS	2.54	4.51	4.61	7.23	84.40	2.66	10.22	89.91	4.94	12.07	83.49
PS	23.28	8.15	20.17	14.44	53.21	24.45	20.67	37.61	17.54	20.22	31.19
PST	5.58	2.66	22.97	18.53	31.19	12.30	13.93	64.22	13.52	14.39	54.13
OTH	6.47	2.22	1.70	5.50	94.50	0.64	3.24	97.25	14.82	28.01	77.06

Note. *n* =109. Same labor market shares brought forward for visual comparison. Teacher experience presence was rated from 0 (*Not Present in Program Component*) to 100 (*Encompasses All of Program Component*).

PST and PS pathways had the highest mean presence in the classroom component of SBAE programs (M = 22.97, M = 20.17 respectively) while falling short of OTH, NRS, FPSS disciplines (*M* = 1.70, *M* = 4.61, *M* = 4.90 respectively). However, these three pathways had the greatest proportion of SBAE program classes that were aligned with the labor markets they geographically resided.

In terms of SAE presence, Animal Systems had the largest mean of 47.25 and largest standard deviation of 25.12. Smallest mean percentage was calculated, ending with ESS and OTH (*M* = 1.25, *M* = 0.64 respectively). Again, the SAEs related to OTH, NRS, and FPPS pathways were the most aligned (*M* = 97.25, *M* = 89.91, *M* = 89.91 respectively).

FFA opportunities and activities related to Animal Systems was the most profound across SBAE programs (*M* = 27.83) with Plant Systems following behind (*M* = 17.84). NRS and FPPS AFNR pathways were the most aligned with their local labor markets (*M* = 83.49, *M* = 82.57).

Findings for Research Objective Five

Addressing research objective five lead the researcher to perform comparative analysis between aligned and unaligned teacher experiences throughout the AFNR pathways. Independent sample t-tests were completed and reported with the mean and standard deviation of each numerical metric of pre-service teacher experiences and teacher characteristics (sese Table 10). There was not a significant effect for most of the comparisons. However, remaining teaching tenure was significantly lower for aligned pre-service Biotechnology Systems experiences (M = 13.14, SD = 9.19) than unaligned pre-service experiences (M = 17.11, SD = 9.83), $t(107) = 2.09$, $p = .04$. There was also a significantly longer remaining teaching tenure for unaligned OTH experiences (M = 25.76, SD = 5.38) compared to aligned (M = 14.10, SD = 9.44), $t(107) = 2.45$, $p = .02$, with an large effect size ($d = 1.25$).

Table 10. Comparison of Aligned and Unaligned Pre-Service Experiences of SBAE Teacher Characteristics by AFNR Pathway

		AS			ABS			BIOT			ESS			FPPS			NRS		
Characteristic		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	t(107)	*M*	*SD*	*t*(107)
Age	Unaligned	41.86	12.05	0.31	42.54	11.86	1.28	40.68	12.39	-0.64	44.33	12.74	1.85	42.36	9.97	0.22	43.65	13.00	0.81
	Aligned	40.95	11.65		39.21	11.98		42.23	11.72		40.03	11.16		41.59	12.23		41.25	11.70	
Years Teaching	Unaligned	15.97	10.20	1.24	15.56	9.61	0.30	14.16	9.98	-0.94	16.95	10.84	1.30	16.36	10.00	0.39	14.45	9.46	-0.46
	Aligned	12.95	8.96		14.89	11.25		16.04	10.03		14.40	9.40		15.24	10.05		15.60	10.17	
Remaining Tenure	Unaligned	13.75	9.18	-1.74	13.98	9.43	-1.02	17.11	9.83	2.09*	14.33	9.98	-0.16	13.64	8.45	-0.37	10.80	6.98	-1.95
	Aligned	17.76	10.67		16.11	9.94		13.14	9.19		14.64	9.37		14.65	9.75		15.36	9.89	

* p = < .05; ** p = < .01; *** p < .001
\+ Cohen's d > .5; ++ Cohen's d > .8.

Table 10 Continued

Characteristic		PS			PST			OTH		
		M	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
Age	Unaligned	41.97	12.18	0.29	41.17	12.29	-0.40	36.50	12.90	-0.89
	Aligned	41.30	11.69		42.10	11.72		41.89	11.91	
Years Teaching	Unaligned	15.24	10.26	-0.18	14.92	10.60	-0.43	12.00	12.52	-0.69
	Aligned	15.59	9.77		15.75	9.59		15.51	9.95	
Remaining Tenure	Unaligned	14.17	9.62	-0.44	15.58	10.86	1.03	25.75	5.38	2.45^{*++}
	Aligned	15.00	9.58		13.69	8.40		14.10	9.44	

$^{*}p$ = < .05; $^{**}p$ = < .01; $^{***}p$ < .001
$^{+}$ Cohen's *d* > .5; $^{++}$ Cohen's *d* > .8.

Nominal forms of data were inputted into chi-square tests of independence to examine the relationship between alignment categories and various teacher characteristics (see Table 11). Among them, highest education and AS alignment are related in the sample X^2 (1, N = 109) = 4.48, p = .03. The proportions of degree attainment are not the same for different values of alignment. The relation between childhood home locale and BIOT alignment was also significant X^2 (3, N = 109) = 10.62, p = .01 with a large effect size (V = .31). Suburban locales were disproportionate compared to other locales. Certification and NRS alignment categories were additionally associated at a significant level X^2 (1, N = 109) = 3.99, p = .04. Finally, a significant relationship was determined between teacher gender and PST pre-service experience alignment X^2 (1, N = 109) = 14.32, p < .001 with a large effect size (V = .36). Females were disproportionately aligned to their local PST labor markets.

Table 11. Comparison of Aligned and Unaligned Pre-Service Experiences of Teacher Nominal Characteristics by AFNR Pathway

		AS		ABS		BIOT		ESS		FPPS		NRS		PS		PST		OTH	
		n	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$
Gender			0.07		3.70		3.16		0.61		0.93		0.00		0.03		14.32***		0.16
Male	Unaligned	35		37		11		15		4		8		25		29		2	
	Aligned	9		7		33		29		40		36		19		15		42	
Female	Unaligned	53		44		27		27		10		12		38		19		2	
	Aligned	12		21		38		38		55		53		27		46		63	
Ethnicity			1.84		0.84		1.19		0.45		2.28		1.76		1.31		2.07		5.69
White	Unaligned	74		67		31		36		11		15		54		38		3	
	Aligned	18		25		61		56		81		77		38		54		89	
Hispanic	Unaligned	4		5		3		2		1		2		3		4		0	
	Aligned	2		1		3		4		5		4		3		2		6	
Native American	Unaligned	4		3		2		1		0		1		3		2		1	
	Aligned	0		1		2		3		4		3		1		2		3	
Other	Unaligned	6		6		2		3		2		2		3		4		0	
	Aligned	1		1		5		4		5		5		4		3		7	
Childhood Home Locale			5.94		1.87		10.62**++		1.09		1.86		1.73		0.35		3.77		0.65
Rural - on a farm	Unaligned	32		32		8		16		4		6		23		13		2	
	Aligned	8		8		32		24		36		34		17		27		38	
Rural - not on a farm	Unaligned	24		18		9		8		5		7		14		12		1	
	Aligned	2		8		17		18		21		19		12		14		25	
Suburban	Unaligned	22		22		18		14		3		5		19		17		1	
	Aligned	10		10		14		18		29		27		13		15		31	
Urban	Unaligned	10		9		3		4		2		2		7		6		0	
	Aligned	1		2		8		7		9		9		4		5		11	
Highest Degree			4.48*		0.48		0.15		0.275		1.85		1.34		2.19		0.28		0.15

78

Bachelor's Degree	Unaligned	34		26		12		13		7		9		25		15		1	
	Aligned	3		11		25		24		30		28		12		22		36	
Master's Degree	Unaligned	54		55		26		29		7		11		38		33		3	
	Aligned	18		17		46		43		65		61		34		39		69	
Certification Type			1.26		0.20		0.08		0.000		0.09		3.99*		0.79		2.63		0.68
Traditional	Unaligned	79		72		33		37		12		15		54		45		3	
	Aligned	17		24		63		59		84		81		42		51		93	
Alternative	Unaligned	9		9		5		5		2		5		9		3		1	
	Aligned	4		4		8		8		11		8		4		10		12	

Note. n = 109. NCES = National Center for Educational Statistics

$^{*}p$ = < .05; $^{**}p$ = < .01; $^{***}p$ < .001

$^{+}$ medium effect size; $^{++}$ large effect size

Alignment of in-service teaching experiences was compared across SBAE teacher characteristics using independent sample t-tests. Means, standard deviations, and test statistics are illustrated in Table 12. There were no significant associations across the variables.

Table 12. Comparison of Aligned and Unaligned In-Service Experiences of SBAE Teacher Characteristics by AFNR Pathway

		AS			ABS			BIOT			ESS			FPPS			NRS		
Characteristic		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	t(107)	*M*	*SD*	*t*(107)
Age	Unaligned	42.00	11.91	0.42	41.32	11.48	-0.64	42.52	12.41	0.58	43.80	12.54	1.41	40.58	11.93	-0.44	43.42	12.26	0.80
	Aligned	40.94	12.13		43.14	13.74		41.16	11.68		40.46	11.47		41.92	11.98		41.20	11.86	
Years Teaching	Unaligned	16.18	10.06	1.29	14.93	9.57	-0.94	16.31	10.54	0.76	16.80	10.30	1.12	14.58	10.23	-0.39	16.29	11.04	0.50
	Aligned	13.47	9.76		17.18	11.64		14.81	9.69		14.57	9.82		15.56	10.01		15.13	9.75	
Remaining Tenure	Unaligned	14.00	9.33	-0.88	14.14	8.87	-0.83	15.05	10.03	0.45	16.03	10.38	1.25	15.63	11.75	0.55	12.92	9.19	-0.93
	Aligned	15.78	10.14		16.05	12.04		14.19	9.32		13.65	9.02		14.29	9.10		14.98	9.67	

Title 12. Continued

		PS			PST			OTH		
Characteristic		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
Age	Unaligned	42.11	11.79	0.42	42.33	12.47	0.48	38.80	11.22	-0.80
	Aligned	41.15	12.20		41.22	11.59		41.98	12.01	
		15.11	9.52	-0.32	16.28	10.52	0.80	14.00	11.23	-0.46
Years	Unaligned	15.73	10.69		14.73	9.65		15.53	9.93	
Teaching	Aligned	13.54	9.62	-1.21	14.61	10.55	0.08	17.90	9.55	1.17
		15.77	9.44		14.46	8.86		14.18	9.55	
Remaining	Unaligned	42.11	11.79	0.42	42.33	12.47	0.48	38.80	11.22	-0.80
Tenure	Aligned	41.15	12.20		41.22	11.59		41.98	12.01	

Categorical teacher characteristics were compared to in-service experience alignment type throughout AFNR pathways (see Table 13). In-service alignment with Natural Resources System employment was significantly dependent with teacher locale X^2 (3, N = 109) = 11.50, p = .009, with a large effect size (V= .33). PS alignment was not proportional across certification and alignment type, granting a significant relation X^2 (1, N = 109) = 7.91, p = .005. A relationship surfaced between PST alignment and gender, resulting a significant association X^2 (1, N = 109) = 20.42, p < .001, with a large effect size (V = .43).

Table 13. Comparison of Aligned and Unaligned In-Service Experiences by Teacher Nominal Characteristics and AFNR Pathway

		AS		ABS		BIOT		ESS		FPPS		NRS		PS		PST		OTH	
		n	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$
Gender			0.00		0.18		2.52		0.22		0.11		0.63		0.41		20.42^{***+}		1.90
Male	Unaligned	31		36		13		15		7		8		23		30		2	
	Aligned	13		8		31		29		37		36		21		14		42	
Female	Unaligned	46		51		29		25		12		16		38		16		8	
	Aligned	19		14		36		40		53		49		27		49		57	
Ethnicity			0.75		0.43		2.62		1.55		2.79		0.74		3.00		1.04		2.05
White	Unaligned	66		74		35		33		17		19		50		37		8	
	Aligned	26		18		57		59		75		73		42		55		84	
Hispanic	Unaligned	4		4		4		2		0		2		5		3		0	
	Aligned	2		1		2		4		6		4		1		3		6	
Native American	Unaligned	3		3		1		1		0		1		3		2		1	
	Aligned	1		1		3		3		4		3		1		2		3	
Other	Unaligned	4		5		2		4		2		2		3		4		1	
	Aligned	3		2		5		3		5		5		4		3		6	
Childhood Home Locale			1.59		3.37		6.23		2.93		6.90		11.50^{**++}		4.06		0.97		2.15
Rural - on a farm	Unaligned	26		34		12		15		6		4		25		15		5	
	Aligned	14		6		28		25		34		36		15		25		35	
Rural - not on a farm	Unaligned	18		18		9		7		8		8		17		12		3	
	Aligned	8		8		17		19		18		18		9		14		23	
Suburban	Unaligned	24		25		18		15		2		6		14		15		2	
	Aligned	8		7		14		17		30		26		18		17		30	
Urban	Unaligned	9		10		3		3		3		6		5		4		0	
	Aligned	2		1		8		8		8		5		6		7		11	
Highest Degree			1.62		0.07		0.10		0.44		0.06		0.31		0.87		3.57		0.18
Bachelor's Degree	Unaligned	29		29		15		12		6		7		23		11		4	
	Aligned	8		8		22		25		31		30		14		26		33	
Master's Degree	Unaligned	48		58		27		28		13		17		38		35		6	
	Aligned	24		14		45		44		59		55		34		37		66	
Certification Type			2.01		3.01		0.36		0.223		0.33		2.32		7.91**		0.79		3.42
Traditional	Unaligned	70		79		36		36		16		19		49		42		7	
	Aligned	26		17		50		60		80		77		47		54		89	

83

Alternative	Unaligned	7	8	6	4	3	5	12	4	3
	Aligned	6	5	7	9	10	8	1	9	10

Note. n = 109.
*p = < .05; **p = < .01; ***p < .001
$^{+}$ Cramer's V medium effect size; $^{++}$ Cramer's V large effect size

Findings for Research Objective Six

Research objective six utilizes independent samples t tests and chi-square tests of independence to investigate between SBAE program components alignment and program characteristics. Means and standard deviations of classroom alignment t-tests are shown in Table 14. Agribusiness Systems had the most significant differences across SBAE program characteristics. SBAE classes that were aligned compared to unaligned with ABS labor markets had less teachers ($M = 1.23$, $SD = 3.57$), $t(107) = 2.31$, $p = .02$, AFNR classes ($M = 12.45$, $SD = 18.47$), $t(107) = 2.55$, $p = .01$, students ($M = 199.65$, $SD = 148.79$), $t(107) = 2.80$, $p = .006$, male students ($M = 99.50$, $SD = 77.45$), $t(107) = 2.76$, $p = .006$, female students ($M = 94.05$, $SD = 71.88$), $t(107) = 2.50$, $p = .01$, Hispanic students ($M = 83.85$, SD = 129.91), $t(107) = 2.25$, $p = .03$, black students ($M = 2.30$, $SD = 2.70$), $t(107) = 2.24$, $p = .03$, students of two or more ethnicities ($M = 27.06$, $SD = 21.57$), $t(107) = 2.24$, $p = .03$, and students who did not provide an ethnicity ($M = 12.65$, $SD = 10.27$), $t(107) = 2.53$, $p = .01$. All noted ABS significant differences had a medium effect size ($d > .05$).

SBAE classes that were aligned with local Environmental Service System labor markets had a greater number of AFNR classes ($M = 18.96$, $SD = 10.53$), $t(107) = -2.37$, $p = .02$, SBAE students ($M = 343.06$, $SD = 214.9$), $t(107) = -2.24$, $p = .03$, male students ($M = 178.23$, $SD = 119.30$), $t(107) = -2.47$, $p = .02$, female students ($M = 151.80$, $SD = 94.99$), $t(107) = -2.11$, $p = .04$, and Hispanic students ($M = 167.41$, $SD = 137.31$), $t(107) = -2.64$, $p = .009$.

In terms of class alignment with PST labor markets, aligned SBAE programs had less AFNR related classes ($M = 18.96$, $SD = 10.53$), $t(107) = 2.27$, $p = .03$, AIG funding classes (M = 10021.24, $SD = 7816.78$), $t(107) = 2.98$, $p = .004$ with a medium effect size, and white students ($M = 56.85$, $SD = 58.08$, $t(107) = 2.05$ $p = .02$.

Table 14. Comparison of Aligned and Unaligned Classes by SBAE Program Characteristics and AFNR Pathway

		AS			ABS			BIOT			ESS			FPPS		
Variable		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
# of Teachers	Unaligned	3.19	2.26	-0.98	3.57	2.19	2.31^{*+}	3.53	2.19	0.61	2.92	1.32	-1.61	3.22	1.63	-0.30
	Aligned	3.59	1.83		2.40	1.23		3.27	2.05		3.59	2.38		3.38	2.18	
# of AFNR Classes	Unaligned	16.21	10.91	-1.46	18.47	10.15	2.55^{**+}	17.66	10.06	0.23	14.39	7.45	-2.37^{*}	17.50	8.32	0.06
	Aligned	18.96	7.83		12.45	5.97		17.21	9.70		18.96	10.53		17.34	10.09	
AIG Funding	Unaligned	12165.21	7761.97	-1.29	13519.43	7229.75	1.94	14088.47	8338.25	1.28	13027.84	6129.93	0.13	13677.56	6077.04	0.51
	Aligned	13920.54	5887.13		10176.20	5594.66		12273.11	6236.85		12840.77	7545.81		12753.37	7254.33	
# of Students	Unaligned	290.16	215.77	-1.29	336.81	207.03	2.80^{**+}	320.24	226.15	0.32	252.95	169.59	-2.24^{*}	323.72	210.58	0.27
	Aligned	341.07	185.24		199.65	148.79		307.04	192.83		343.06	214.96		309.25	203.92	
Gender																
Males	Unaligned	145.83	117.52	-1.52	172.98	112.85	2.76^{**+}	161.89	124.97	0.16	124.50	83.05	-2.47^{*}	160.56	107.79	0.04
	Aligned	178.22	98.74		99.50	77.45		158.21	103.14		178.23	119.30		159.29	111.82	
Females	Unaligned	130.51	91.90	-1.10	148.64	91.55	2.50^{*+}	142.97	99.80	0.37	114.00	76.66	-2.17^{*}	148.72	101.50	0.52
	Aligned	149.74	88.31		94.05	71.88		136.30	85.75		151.80	94.99		136.63	88.63	
Non-Binary	Unaligned	3.32	3.29	-1.12	3.88	3.59	1.57	4.18	3.92	1.22	3.37	3.83	-0.58	4.94	4.50	1.78
	Aligned	4.07	3.65		2.55	2.54		3.34	3.15		3.77	3.24		3.37	3.16	
No Answer	Unaligned	10.51	20.61	0.44	11.31	18.45	1.87	11.18	15.39	0.58	11.08	22.96	0.53	9.50	11.73	-0.11
	Aligned	9.04	10.31		3.55	3.55		9.20	17.85		9.25	12.87		9.97	17.90	
Ethnicity																
White	Unaligned	73.16	66.96	-0.63	79.24	71.23	0.78	71.26	63.90	-0.60	75.50	73.76	-0.14	82.67	56.78	0.39
	Aligned	81.72	73.02		65.80	60.85		79.72	72.41		77.45	67.45		75.60	71.82	
Hispanic	Unaligned	129.56	134.62	-1.27	156.71	131.28	2.25^{*+}	147.03	142.91	0.21	98.37	114.66	-2.64^{**}	140.44	166.69	-0.10
	Aligned	162.22	131.00		83.85	129.91		141.37	129.15		167.41	137.31		143.91	127.00	
Black	Unaligned	5.76	8.32	-0.51	6.98	9.22	2.24^{*+}	7.84	11.58	1.54	5.55	9.17	-0.50	7.17	10.89	0.56
	Aligned	6.61	9.03		2.30	2.70		5.20	6.37		6.42	8.32		5.91	8.12	
Asian	Unaligned	8.78	14.65	-1.17	11.87	18.85	1.80	15.47	23.73	2.23	9.68	15.69	-0.33	14.72	24.49	1.13
	Aligned	12.74	20.74		4.15	6.62		7.76	12.41		10.86	18.49		9.60	15.81	
Native American	Unaligned	5.05	5.88	0.27	4.76	5.21	-0.66	4.79	4.99	-0.19	5.42	6.20	0.69	6.00	5.22	0.92
	Aligned	4.76	4.78		5.65	6.38		5.00	5.67		4.66	4.98		4.71	5.46	
Two or More	Unaligned	23.08	20.02	-1.16	27.06	21.57	2.24^{*+}	26.79	23.22	0.66	21.95	17.63	-1.15	27.50	21.72	0.56
	Aligned	27.67	20.81		15.95	10.07		24.07	18.81		26.66	21.66		24.53	20.21	
No Answer	Unaligned	24.56	29.50	-0.53	28.63	27.71	2.53^{*+}	27.97	27.99	0.66	21.47	27.59	-1.24	28.72	21.23	0.54

86

	Aligned	27.26	20.86		12.65	10.27		24.48	25.19		27.96	25.22		25.10	27.05	

Note. n = 109. AIG = Agriculture Incentive Grant in dollar amount.
**p* = < .05; ***p* = < .01; ****p* < .001
[+] Cohen's *d* > .5; [++] Cohen's *d* > .8.

Table 14. Continued

		NRS			PS			PST			OTH		
Variable		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
# of Teachers	Unaligned	3.12	2.55	-0.51	3.02	1.91	-1.59	3.55	1.90	1.41	3.83	1.94	0.57
	Aligned	3.40	2.01		3.66	2.21		2.94	2.45		3.33	2.11	
# of AFNR Classes	Unaligned	15.12	9.24	-1.03	16.02	8.20	-1.35	18.77	9.34	2.27*	21.17	11.51	0.98
	Aligned	17.78	9.87		18.55	10.92		14.26	10.15		17.15	9.69	
AIG Funding	Unaligned	10231.12	4948.53	-1.72	12308.20	6358.21	-0.83	14213.75	6313.17	2.98**+	15817.33	12303.27	1.04
	Aligned	13400.26	7293.69		13431.64	7633.41		10021.24	7816.78		12736.40	6690.83	
# of Students	Unaligned	274.82	197.90	-0.81	280.96	184.63	-1.48	322.03	187.12	0.79	327.17	169.77	0.19
	Aligned	318.45	205.57		338.62	217.84		288.74	238.85		310.74	206.61	
Gender													
Males	Unaligned	136.47	101.42	-0.93	142.69	102.53	-1.50	169.92	104.28	1.47	173.67	82.69	0.32
	Aligned	163.75	112.30		174.28	116.24		136.50	122.10		158.67	112.35	
Females	Unaligned	133.18	98.79	-0.27	126.10	83.85	-1.36	139.05	82.75	0.07	141.33	83.44	0.08
	Aligned	139.63	89.42		149.64	95.31		137.68	106.96		138.47	91.26	
Non-Binary	Unaligned	2.41	2.35	-1.60	3.37	3.22	-0.74	3.35	2.62	-1.29	2.50	4.23	-0.83
	Aligned	3.86	3.58		3.86	3.65		4.26	4.79		3.70	3.41	
No Answer	Unaligned	2.76	3.17	-1.90	8.80	11.34	-0.62	9.71	12.52	-0.17	9.67	14.96	-0.03
	Aligned	11.21	18.15		10.84	20.79		10.29	24.35		9.90	17.17	
Ethnicity													
White	Unaligned	73.35	77.94	-0.22	70.98	73.34	-0.82	85.80	72.50	2.05*	88.83	89.82	0.44
	Aligned	77.40	68.13		81.86	65.92		56.85	58.08		76.07	68.50	
Hispanic	Unaligned	138.00	161.78	-0.18	125.86	127.60	-1.29	145.27	125.24	0.22	156.17	160.62	0.24
	Aligned	144.33	128.59		158.71	137.70		139.09	152.01		142.59	132.62	
Black	Unaligned	5.41	11.67	-0.37	5.53	8.76	-0.67	5.85	7.38	-0.48	4.50	5.61	-0.47
	Aligned	6.25	7.97		6.64	8.48		6.71	10.92		6.21	8.75	
Asian	Unaligned	7.94	16.43	-0.64	9.10	17.22	-0.75	10.09	16.07	-0.31	10.67	17.26	0.03
	Aligned	10.91	17.74		11.64	17.81		11.24	20.56		10.44	17.60	
Native American	Unaligned	4.88	5.01	-0.04	5.33	6.20	0.73	4.75	5.09	-0.51	2.33	1.86	-1.21
	Aligned	4.93	5.52		4.57	4.66		5.32	6.16		5.08	5.53	
Two or More	Unaligned	18.47	13.26	-1.45	21.49	16.89	-1.71	25.19	19.89	0.13	24.67	19.64	-0.04
	Aligned	26.23	21.28		28.12	22.73		24.65	21.76		25.04	20.52	
No Answer	Unaligned	14.53	12.93	-1.94	24.29	20.89	-0.52	26.60	22.25	0.53	21.33	14.73	-0.42
	Aligned	27.76	27.44		26.93	30.12		23.71	33.44		25.95	26.66	

Note. n = 109. AIG = Agriculture Incentive Grant in dollar amount.

88

*p = < .05; **p = < .01; ***p < .001
$^{+}$ Cohen's d > .5; $^{++}$ Cohen's d > .8.

To evaluate the differences among nominal data, chi-square tests were completed (see Table 15). The alignment of SBAE classes and local labor markets was dependent on California FFA Region. Agribusiness Systems χ^2 (5, N = 109) = 23.49, $p < .001$, Biotechnology Systems χ^2 (5, N = 109) = 20.59, $p < .001$, Environmental Service Systems χ^2 (5, N = 109) = 40.96, $p < .001$, and Food Products and Processing Systems χ^2 (5, N = 109) = 16.43, $p < .001$ were significantly depend on the California FFA Region the SBAE program resided in. All noted dependencies had medium effect size ($V > .05$).

Table 15. Comparison of Aligned and Unaligned Classes by SBAE Program Nominal Characteristics and AFNR Pathway

		AS		ABS		BIOT		ESS		FPPS		NRS		PS		PST		OTH	
		n	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$	*n*	$\chi2$
NCES Locale			0.76		1.97		0.61		2.58		3.13		3.59		3.83		5.98		3.823
City	Unaligned	10		14		6		3		2				6		8		1	
	Aligned	6		2		10		13		14		14		10		8		15	
Suburban	Unaligned	24		25		17		16		10		7		22		27		1	
	Aligned	17		6		24		25		31		34		19		14		40	
Town	Unaligned	18		24		8		12		4		7		16		21		1	
	Aligned	12		6		22		18		26		23		14		9		29	
Rural	Unaligned	11		16		7		7		2		1		7		19		3	
	Aligned	11		6		15		15		20		21		15		3		19	
California FFA Region			3.78		23.49^{***++}		20.50^{***++}		40.96^{***++}		16.43^{**++}		9.90		7.123		4.05		5.55
North Coast	Unaligned	6		5		2		4		5		1		5		6		0	
	Aligned	4		5		8		6		5		9		5		4		10	
Superior	Unaligned	5		6		1		10		1		4		5		10		2	
	Aligned	7		6		11		2		11		8		7		2		10	
Central	Unaligned	19		27		14		5		7		1		12		21		2	
	Aligned	9		1		14		23		21		227		16		7		26	
San Joaquin	Unaligned	15		27		4		0		1		3		9		20		2	
	Aligned	13		1		24		28		27		25		19		8		26	
South Coast	Unaligned	5		8		8		6		3		2		8		7		0	
	Aligned	6		3		3		5		8		9		3		4		11	
Southern	Unaligned	13		16		9		13		1		6		12		11		0	
	Aligned	7		4		11		7		19		14		8		9		20	

Note. n = 109. NCES = National Center for Educational Statistics

**p* = < .05; ***p* = < .01; ****p* < .001

$^{+}$ Cramer's V medium effect size; $^{++}$ Cramer's V large effect size

Student Supervised Agricultural Experiences projects were examined in Table 16. SAEs that are aligned with students' individual Animal Systems labor markets resided in programs with significantly less AFNR classes (M = 11.36, SD = 18.04), t(107) = 2.18, p = .03, with a medium effect size (d = .70). ABS aligned SAEs came from programs with significantly fewer teachers (M = 2.50, SD = 3.55), t(107) = 2.06, p = .04, AFNR classes (M = 12.70, SD = 5.05), t(107) = 2.41, p = .02, students (M = 201.05, SD = 146.58), t(107) = 2.76, p = .007, male students (M = 98.05, SD = 76.27), t(107) = 2.84, p = .005, female students (M = 201.05, SD = 146.58), t(107) = 2.51, p = .01, Hispanic students (M = 84.90, SD = 133.17), t(107) = 2.21, p = .03, students of two or more races (M = 15.00, SD = 9.06), t(107) = 2.49, p = .01, and students who provided no answer regarding their ethnicity (M = 15.15, SD = 15.69), t(107) = 2.03, p = .04. All ABS difference had a medium effect size (d > .05).

Biotechnology Systems SAE alignment stemmed from programs with significantly more teachers (M = 3.75, SD = 2.28), t(107) = -3.08, p = .003, AFNR classes (M = 19.20, SD = 10.43), t(107) = -3.08, p = .003, AIG funding (M = 13943.83, SD = 7697.08), t(107) = -2.38, p = .02, students (M = 341.76, SD = 209.89), t(107) = -2.39, p = .02, and male students (M = 180.03, SD = 115.81), t(107) = -3.05, p = .003.

SBAE programs that produced SAEs that were aligned with ESS labor markets had significantly more teachers (M = 3.91, SD = 2.47), t(107) = -3.07, p = .003, AFNR classes (M = 20.48, SD = 10.73), t(107) = -3.76, p < .001, AIG funding (M = 14492.00, SD = 7715.81), t(107) = -2.57, p = .01, students (M = 373.52, SD = 221.50), t(107) = -3.55, p = .001, male students (M = 196.07, SD = 123.12), t(107) = -3.92, p = .000, female students (M = 168.33, SD = 98.43), t(107) = -3.16, p = .001, Hispanic students (M = 183.74, SD = 143.12), t(107) = -3.55, p = .001, students of two or more races (M = 29.12, SD = 23.28), t(107) = -2.28, p = .02, and students who provided no answer regarding their ethnicity (M = 30.90, SD = 26.43), t(107) = -2.26, p = .03.

Finally, aligned NRS SAEs had a significantly greater number of teachers (*M* = 3.51, *SD* = 2.13), *t*(107) = -2.31, *p* = .02, AFNR classes (*M* = 18.13, *SD* = 9.79), *t*(107) = -2.50, *p* = .01, students (*M* = 326.74, *SD* = 111.03), *t*(107) = -2.35, *p* = .02, male students (*M* = 167.89, *SD* = 111.03), *t*(107) = -2.16, *p* = .02, female students (*M* = 144.80, *SD* = 89.87), *t*(107) = -2.16, *p* = .03.

.

Table 16. Comparison of Aligned and Unaligned SAEs by SBAE Program Characteristics and AFNR Pathways

		AS			ABS			BIOT			ESS			FPPS		
Variable		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
# of Teachers	Unaligned	3.47	2.13	1.68	3.55	2.22	2.06^{*+}	2.45	1.20	-3.08**	2.73	1.33	-3.07**	2.55	1.29	-1.36
	Aligned	2.36	1.50		2.50	1.10		3.75	2.28		3.91	2.47		3.45	2.15	
# of AFNR Classes	Unaligned	18.04	9.64	2.18^{*+}	18.42	10.29	2.41^{*+}	13.15	6.46	-3.08**	13.82	7.16	-3.76***	15.27	8.21	-0.75
	Aligned	11.36	9.39		12.70	5.05		19.20	10.43		20.48	10.73		17.60	9.95	
AIG Funding	Unaligned	12948.73	6975.92	0.19	13173.18	7465.34	0.83	10515.82	4552.35	-2.38*	11102.29	5782.20	-2.57**	12112.45	6227.89	-0.39
	Aligned	12525.18	8091.96		11717.00	4801.03		13943.83	7697.08		14492.00	7715.81		12995.06	7166.18	
# of Students	Unaligned	322.30	204.17	1.64	336.49	207.58	2.76^{**+}	242.27	173.90	-2.39*	241.27	156.74	-3.55**	260.55	198.28	-0.87
	Aligned	216.73	185.97		201.05	146.58		341.76	209.89		373.52	221.50		317.38	204.95	
Gender																
Males	Unaligned	164.42	111.49	1.39	173.30	112.81	2.84^{**+}	112.21	81.23	-3.05**	117.90	76.55	-3.92***	129.91	100.50	-0.93
	Aligned	115.64	96.72		98.05	76.27		180.03	115.81		196.07	123.12		162.82	111.74	
Females	Unaligned	143.58	89.75	1.72	148.71	91.47	2.51^{*+}	115.27	80.86	-1.79	110.53	71.63	-3.16**	118.27	95.13	-0.79
	Aligned	94.45	88.97		93.75	72.08		148.76	93.05		163.33	98.43		140.91	90.18	
Non-Binary	Unaligned	3.83	3.50	1.77	3.83	3.59	1.27	3.52	3.88	-0.23	3.25	3.49	-1.07	3.64	4.86	0.00
	Aligned	1.91	2.47		2.75	2.63		3.68	3.27		3.97	3.41		3.63	3.29	
No Answer	Unaligned	10.47	17.76	1.06	10.65	17.86	0.99	11.27	24.78	0.56	9.59	20.30	-0.17	8.73	13.59	-0.24
	Aligned	4.73	4.98		6.50	12.19		9.29	12.34		10.16	13.62		10.02	17.38	
Ethnicity																
White	Unaligned	79.47	69.33	1.21	81.02	72.35	1.35	59.76	57.20	-1.70	71.53	68.95	-0.74	91.73	72.14	0.75
	Aligned	52.73	68.17		57.85	51.52		84.16	73.16		81.38	70.03		75.09	69.24	
Hispanic	Unaligned	146.71	132.64	0.79	156.47	130.71	2.21^{*+}	111.73	121.74	-1.64	97.39	105.29	-3.55**	80.00	114.57	-1.67
	Aligned	113.27	143.72		84.90	133.17		157.07	136.75		183.74	143.12		150.45	134.08	
Black	Unaligned	6.04	7.77	-0.28	6.70	9.16	1.49	4.85	9.50	-1.02	4.98	8.14	-1.30	5.73	9.59	-0.16
	Aligned	6.82	14.52		3.55	4.74		6.67	8.17		7.12	8.92		6.16	8.53	
Asian	Unaligned	11.18	18.25	1.31	11.24	18.24	0.99	7.06	12.98	-1.34	8.43	14.36	-1.13	11.36	29.16	0.18
	Aligned	3.91	5.17		6.95	13.59		11.92	19.03		12.22	19.82		10.35	15.92	
Native American	Unaligned	5.18	5.49	1.49	4.96	5.28	0.12	4.33	4.43	-0.75	5.59	6.18	1.20	7.27	6.31	1.52
	Aligned	2.64	4.30		4.80	6.18		5.18	5.81		4.34	4.64		4.66	5.29	
Two or More	Unaligned	25.97	20.68	1.46	27.27	21.55	2.49^{*+}	19.33	16.78	-1.94	20.35	15.43	-2.28*	22.45	20.31	-0.44
	Aligned	16.55	15.88		15.00	9.06		27.49	21.40		29.12	23.28		25.31	20.48	
No Answer	Unaligned	27.22	26.80	1.84	28.07	27.45	2.03^{*+}	21.00	29.71	-1.24	19.78	24.72	-2.26*	26.73	24.98	0.14

94

	Aligned	12.09	13.42	15.15	15.69	27.74	24.34	30.90	26.43	25.58	26.37

Note. n = 109. AIG = Agriculture Incentive Grant in dollar amount
*p = < .05; **p = < .01; ***p < .001
$^{+}$ Cohen's d > .5; $^{++}$ Cohen's d > .8.

Table 16. Continued

Variable		NRS *M*	NRS *SD*	NRS *t*(107)	PS *M*	PS *SD*	PS *t*(107)	PST *M*	PST *SD*	PST *t*(107)	OTH *M*	OTH *SD*	OTH *t*(107)
# of Teachers	Unaligned	2.00	1.10	-2.31*	3.32	2.11	-0.22	3.62	2.03	0.96	2.67	1.53	-0.58
	Aligned	3.51	2.13		3.41	2.10		3.21	2.13		3.38	2.11	
# of AFNR Classes	Unaligned	10.55	6.89	-2.50*	17.38	10.47	0.02	18.77	11.14	1.12	12.00	6.24	-0.96
	Aligned	18.13	9.79		17.34	8.65		16.59	8.93		17.52	9.84	
AIG Funding	Unaligned	9811.82	5214.03	-1.54	12778.56	7201.84	-0.24	14492.03	7021.71	1.77	9404.33	3145.55	-0.87
	Aligned	13253.30	7170.91		13117.34	6890.09		12022.34	6968.45		13005.09	7117.59	
# of Students	Unaligned	177.09	162.41	-2.35*	299.38	200.85	-0.81	318.41	209.31	0.26	216.00	53.33	-0.82
	Aligned	326.74	203.43		331.98	210.33		307.87	202.59		314.35	206.23	
Gender													
Males	Unaligned	84.73	76.60	-2.42*	157.03	112.53	-0.30	172.79	116.30	0.94	123.67	41.02	-0.57
	Aligned	167.89	111.03		163.59	108.78		152.09	107.55		160.51	111.93	
Females	Unaligned	83.64	79.95	-2.16*	130.51	87.74	-1.21	133.15	90.66	-0.47	89.33	19.04	-0.96
	Aligned	144.80	89.87		152.07	94.43		141.67	90.91		140.02	91.35	
Non-Binary	Unaligned	2.45	3.80	-1.20	3.38	3.12	-0.98	3.13	2.63	-1.14	1.33	0.58	-1.17
	Aligned	3.77	3.40		4.05	3.93		3.91	3.82		3.70	3.47	
No Answer	Unaligned	6.27	11.76	-0.74	8.46	11.38	-1.14	9.33	12.08	-0.25	1.67	0.58	-0.85
	Aligned	10.30	17.48		12.27	23.52		10.20	19.27		10.12	17.17	
Ethnicity													
White	Unaligned	50.36	67.24	-1.34	79.37	75.08	0.50	91.23	79.00	1.64	77.67	60.47	0.02
	Aligned	79.73	69.32		72.46	59.37		68.71	62.55		76.75	69.87	
Hispanic	Unaligned	81.45	115.95	-1.63	132.63	123.19	-1.08	136.51	142.33	-0.40	90.67	76.00	-0.69
	Aligned	150.29	134.04		161.10	148.88		147.14	129.18		144.83	134.66	
Black	Unaligned	2.00	1.61	-1.69	4.97	7.86	-1.82	7.28	11.35	1.06	4.67	3.21	-0.30
	Aligned	6.58	8.93		8.02	9.48		5.47	6.59		6.16	8.70	
Asian	Unaligned	3.09	5.05	-1.48	11.07	19.60	0.48	10.08	14.95	-0.17	5.67	8.14	-0.48
	Aligned	11.28	18.21		9.41	13.50		10.66	18.87		10.58	17.70	
Native American	Unaligned	4.91	7.92	-0.01	4.94	5.23	0.04	5.13	6.22	0.29	2.33	1.53	-0.84
	Aligned	4.93	5.13		4.90	5.80		4.81	4.97		5.00	5.48	
Two or More	Unaligned	14.18	14.99	-1.88	23.57	20.10	-0.95	24.79	19.70	-0.09	20.67	5.69	-0.37
	Aligned	26.23	20.61		27.41	20.89		25.14	20.91		25.14	20.65	
No Answer	Unaligned	13.91	17.97	-1.59	24.50	23.15	-0.61	24.10	18.11	-0.47	7.33	2.89	-1.24
	Aligned	27.02	26.63		27.68	30.65		26.59	29.76		26.22	26.31	

Note. $n = 109$. AIG = Agriculture Incentive Grant in dollar amount

96

*p = < .05; **p = < .01; ***p < .001

+ Cohen's d > .5; ++ Cohen's d > .8.

Seen in Table 17 are the comparisons of categorical data between SAE alignment types. PS Systems were associated with the NCES locale of the school χ^2 (3, N = 109) = 8.15, p = .04. In addition, Agribusiness Systems χ^2 (5, N = 109) = 33.78, p < .001, Biotechnology Systems χ^2 (5, N = 109) = 60.29, p < .001, Environmental Service Systems χ^2 (5, N = 109) = 75.62, p < .001, and Natural Resources Systems χ^2 (5, N = 109) = 11.35, p < .001 were significantly dependent on the California FFA Region the SBAE program resided in. All noted dependencies had a large effect size relative to their degrees of freedom.

Table 17. Comparison of Aligned and Unaligned SAEs by SBAE Program Nominal Characteristics and AFNR Pathways

		AS		ABS		BIOT		ESS		FPPS		NRS		PS		PST		OTH	
		n	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$
NCES Locale			0.13		7.63		2.31		3.62		0.637		7.13		8.15^{*+}		1.42		2.19
City	Unaligned	14		15		5		6		1		1		5		5		1	
	Aligned	2		1		11		10		15		15		11		11		15	
Suburban	Unaligned	37		37		15		19		4		1		29		17		0	
	Aligned	4		4		26		22		37		20		12		24		41	
Town	Unaligned	27		22		6		12		4		4		19		11		1	
	Aligned	3		8		24		18		26		26		11		19		29	
Rural	Unaligned	20		15		7		14		2		5		15		6		1	
	Aligned	2		7		15		8		20		17		7		16		21	
California FFA Region			5.05		33.78^{***++}		60.29^{***++}		75.62^{***++}		10.123		11.35^{*++}		1.758		7.67		10.70
North Coast	Unaligned	9		4		7		9		3		1		6		1		0	
	Aligned	1		6		3		1		7		9		4		9		10	
Superior	Unaligned	10		5		3		12		0		4		8		6		2	
	Aligned	2		7		9		0		12		8		4		6		10	
Central	Unaligned	28		26		0		4		5		0		20		12		0	
	Aligned	0		2		28		24		23		28		8		16		28	
San Joaquin	Unaligned	25		27		0		0		1		2		16		7		1	
	Aligned	3		1		28		28		27		26		12		21		27	
South Coast	Unaligned	9		8		8		8		0		2		6		6		0	
	Aligned	2		3		3		3		11		9		5		5		11	
Southern	Unaligned	17		19		15		18		2		2		12		7		0	
	Aligned	3		1		5		2		18		18		8		13		20	

Note. n = 109. NCES = National Center for Educational Statistics

*p = < .05; **p = < .01; ***p < .001

$^{+}$ Cramer's V medium effect size; $^{++}$ Cramer's V large effect size

The alignment of FFA activities were investigated across SBAE program characteristics as illustrated in Table 18. Aligned BIOT FFA activities stemmed from programs with significantly more teachers (M = 3.71, SD = 2.32), t(107) = -2.50, p = .01, AFNR classes (M = 19.10, SD = 10.50), t(107) = -2.65, p = .009, students (M = 340.43, SD = 213.57), t(107) = -2.09, p = .04, and male students (M = 180.63, SD = 116.63), t(107) = -2.87, p = .005.

SBAE programs that had FFA opportunities that were aligned with ESS labor markets had significantly more teachers (M = 4.04, SD = 2.56), t(107) = -3.33, p = .001, AFNR classes (M = 20.61, SD = 11.21), t(107) = -3.40, p = .001, students (M = 373.90, SD = 223.55), t(107) = -3.10, p = .002, male students (M = 198.41, SD = 124.34), t(107) = -3.63, p = .000, female students (M = 161.53, SD = 98.67), t(107) = -2.54, p = .01, Hispanic students (M = 181.88, SD = 144.14), t(107) = -2.92, p = .004, students of two or more races (M = 29.65, SD = 22.92), t(107) = -2.26, p = .03, and students who provided no answer regarding their ethnicity (M = 31.65, SD = 26.57), t(107) = -2.27, p = .03.

Aligned NRS FFA activities came from program with significantly more teachers (M = 3.55 SD = 2.16), t(107) = -2.19, p = .03 and students who are of two ethnicities or more (M = 27.00, SD = 21.22), t(107) = -2.33, p = .02

Table 18. Comparison of Aligned and Unaligned FFA Activities by SBAE Program Characteristics and AFNR Pathways

		AS			ABS			BIOT			ESS			FPPS		
Variable		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
# of Teachers	Unaligned	3.35	2.04	-0.03	3.35	2.00	-0.07	2.68	1.36	-2.50*	2.76	1.33	-3.33**	3.05	1.51	-0.70
	Aligned	3.37	2.21		3.38	2.40		3.71	2.32		4.04	2.56		3.42	2.20	
# of AFNR Classes	Unaligned	16.91	8.98	-0.62	17.60	9.74	0.45	14.00	7.21	-2.65**	14.52	7.31	-3.40***	18.00	8.78	0.31
	Aligned	18.12	11.06		16.62	10.08		19.10	10.50		20.61	11.21		17.23	10.02	
AIG Funding	Unaligned	12533.49	7108.36	-0.71	13014.33	7255.21	0.29	11615.11	6294.79	-1.37	11778.33	5678.27	-1.80	12646.95	5550.18	-0.18
	Aligned	13523.80	7011.45		12560.15	6500.85		13569.36	7370.58		14188.43	8223.70		12960.68	7359.85	
# of Students	Unaligned	307.26	206.33	-0.29	316.06	197.02	0.40	255.62	173.63	-2.09*	256.90	169.07	-3.10**	321.42	197.27	0.23
	Aligned	318.90	202.72		297.54	228.90		340.43	213.57		373.90	223.55		309.58	206.55	
Gender																
Males	Unaligned	155.68	110.45	-0.46	163.69	107.85	0.70	118.38	85.49	-2.87**	125.28	84.26	-3.63**	164.32	99.54	0.21
	Aligned	165.83	112.13		146.12	120.49		180.63	116.59		198.41	124.34		158.48	113.37	
Females	Unaligned	138.10	91.77	-0.08	138.13	86.11	-0.10	122.54	78.80	-1.34	118.48	78.06	-2.54**	142.26	94.67	0.19
	Aligned	139.49	89.45		140.19	105.11		146.89	95.41		161.53	98.67		137.86	90.11	
Non-Binary	Unaligned	3.78	3.67	0.57	3.53	3.28	-0.56	3.89	3.85	0.56	3.57	3.84	-0.21	4.16	4.15	0.73
	Aligned	3.39	3.07		3.96	3.97		3.50	3.24		3.71	2.98		3.52	3.30	
No Answer	Unaligned	9.71	19.52	-0.14	10.71	18.34	0.90	10.81	23.44	0.40	9.57	19.51	-0.21	10.68	15.05	0.22
	Aligned	10.20	11.87		7.27	11.59		9.42	12.64		10.25	13.76		9.72	17.44	
Ethnicity																
White	Unaligned	73.28	63.00	-0.67	77.51	70.26	0.20	62.41	59.32	-1.56	71.17	67.55	-0.90	94.53	71.02	1.23
	Aligned	82.56	79.32		74.42	67.80		84.15	73.31		83.14	71.54		73.02	68.84	
Hispanic	Unaligned	141.74	136.24	-0.16	147.66	129.90	0.60	118.62	120.94	-1.39	109.45	114.17	-2.92**	116.26	102.10	-0.97
	Aligned	146.00	130.38		129.54	146.13		156.04	138.57		181.88	144.14		149.06	139.00	
Black	Unaligned	5.88	8.48	-0.37	6.04	8.96	-0.18	5.51	9.34	-0.53	5.24	8.59	-1.14	9.21	10.82	1.74
	Aligned	6.51	8.87		6.38	7.47		6.43	8.23		7.12	8.57		5.47	7.97	
Asian	Unaligned	10.51	17.67	0.05	9.07	15.42	-1.48	8.73	14.41	-0.73	9.52	18.10	-0.59	14.95	25.14	1.24
	Aligned	10.34	17.45		14.85	22.74		11.33	18.93		11.51	16.92		9.50	15.45	
Native American	Unaligned	5.03	5.49	0.25	4.82	5.61	-0.37	4.05	4.11	-1.21	5.41	5.96	1.00	6.53	5.64	1.42
	Aligned	4.76	5.37		5.27	4.86		5.38	5.96		4.37	4.73		4.59	5.35	
Two or More	Unaligned	24.37	19.45	-0.43	24.65	20.82	-0.34	21.30	18.97	-1.37	20.95	17.05	-2.26	30.89	24.22	1.39
	Aligned	26.10	22.07		26.19	19.29		26.93	20.95		29.65	22.92		23.78	19.41	
No Answer	Unaligned	25.35	29.62	-0.18	26.27	25.36	0.40	20.86	27.89	-1.39	20.47	24.79	-2.27	29.84	28.21	0.76

101

Aligned	26.27	19.33		23.88	28.91		28.18	25.01		31.65	26.57		24.82	25.75

Note. n = 109. AIG = Agriculture Incentive Grant in dollar amount
$^{*}p = < .05$; $^{**}p = < .01$; $^{***}p < .001$
$^{+}$ Cohen's $d > .5$; $^{++}$ Cohen's $d > .8$.

Table 18. Continued

		NRS			PS			PST			OTH		
Variable		*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)	*M*	*SD*	*t*(107)
# of Teachers	Unaligned	2.39	1.38	-2.19*	3.33	2.26	-0.18	3.38	1.64	0.10	3.52	2.58	0.44
	Aligned	3.55	2.16		3.41	1.71		3.34	2.43		3.31	1.94	
# of AFNR Classes	Unaligned	13.33	7.99	-1.94	16.96	10.38	-0.64	18.32	8.33	0.94	17.16	12.61	-0.12
	Aligned	18.16	9.94		18.26	8.38		16.56	10.86		17.43	8.86	
AIG Funding	Unaligned	10031.72	4717.85	-1.91	12624.11	6659.38	-0.62	13357.80	5877.70	0.61	12657.00	7457.15	-0.20
	Aligned	13474.53	7318.49		13527.79	7931.76		12523.10	7949.47		12980.10	6976.98	
# of Students	Unaligned	238.11	181.00	-1.69	305.43	209.41	-0.47	320.66	184.75	0.42	300.16	233.27	-0.32
	Aligned	326.19	206.19		325.35	194.25		304.00	220.49		315.06	196.03	
Gender													
Males	Unaligned	123.83	94.81	-1.50	159.95	118.21	0.06	166.80	97.53	0.63	156.56	129.62	-0.15
	Aligned	166.55	112.68		158.50	93.54		153.31	121.19		160.37	105.25	
Females	Unaligned	102.28	83.41	-1.89	132.40	90.22	-1.07	137.74	83.11	-0.09	133.12	101.79	-0.35
	Aligned	145.81	90.53		152.35	90.91		139.37	97.01		140.26	87.45	
Non-Binary	Unaligned	2.17	2.23	-2.00	3.21	3.13	-1.91	3.92	3.66	0.80	2.84	2.81	-1.31
	Aligned	3.92	3.58		4.56	3.96		3.39	3.26		3.87	3.60	
No Answer	Unaligned	9.83	12.75	-0.02	9.87	13.43	-0.02	12.20	21.62	1.31	7.64	10.54	-0.75
	Aligned	9.90	17.77		9.94	23.24		7.93	11.57		10.56	18.48	
Ethnicity													
White	Unaligned	52.17	69.01	-1.66	74.81	69.01	-0.44	79.68	68.62	0.40	79.60	69.53	0.23
	Aligned	81.64	68.79		81.09	71.04		74.31	70.50		75.93	69.73	
Hispanic	Unaligned	123.61	153.16	-0.68	138.83	129.22	-0.52	142.34	124.79	-0.07	134.20	143.34	-0.39
	Aligned	147.24	129.82		153.29	143.92		144.19	141.48		146.06	131.18	
Black	Unaligned	3.17	3.99	-1.61	5.95	8.95	-0.31	6.98	10.41	0.96	5.48	5.92	-0.42
	Aligned	6.70	9.14		6.50	7.85		5.39	6.69		6.31	9.26	
Asian	Unaligned	5.83	13.13	-1.23	10.97	19.18	0.46	10.78	14.38	0.18	12.00	22.83	0.50
	Aligned	11.36	18.16		9.29	13.26		10.17	19.89		9.99	15.71	
Native American	Unaligned	2.67	2.54	-1.96	5.29	6.07	1.05	4.68	4.77	-0.44	5.32	5.68	0.41
	Aligned	5.37	5.73		4.12	3.55		5.14	5.95		4.81	5.37	
Two or More	Unaligned	15.00	11.44	-2.33*	24.29	21.02	-0.55	25.42	19.15	0.19	24.56	23.31	-0.13
	Aligned	27.00	21.22		26.62	19.13		24.68	21.54		25.15	19.59	
No Answer	Unaligned	19.67	18.09	-1.07	26.07	23.99	0.22	29.58	30.70	1.44	22.92	19.20	-0.60
	Aligned	26.89	27.36		24.88	30.71		22.41	21.23		26.52	27.90	

Note. *n* = 109. AIG = Agriculture Incentive Grant in dollar amount

103

*p = < .05; **p = < .01; ***p < .001
$^{+}$ Cohen's d > .5; $^{++}$ Cohen's d > .8.

Seen in Table 19 are the comparisons of categorical data between FFA alignment types. Agribusiness Systems χ^2 (5, N = 109) = 15.91, p = .007, Biotechnology Systems χ^2 (5, N = 109) = 47.27, p < .001, Environmental Service Systems χ^2 (5, N = 109) = 67.88, p < .001, and Natural Resources Systems χ^2 (5, N = 109) = 12.58, p < .03 were significantly associated on the California FFA Region the SBAE program resided in. All noted dependencies had a large effect size relative to their degrees of freedom.

Table 19. Comparison of Aligned and Unaligned FFA Activities by SBAE Program Nominal Characteristics and AFNR Pathways

		AS		ABS		BIOT		ESS		FPPS		NRS		PS		PST		OTH	
		n	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$	*n*	$\chi 2$
NCES Locale			2.67		1.82		2.68		2.55		1.17		2.38		3.02		0.60		3.20
City	Unaligned	12		14		6		6		3		1		11		6		3	
	Aligned	4		2		10		10		13		15		5		10		13	
Suburban	Unaligned	22		29		17		22		9		6		29		20		7	
	Aligned	19		12		24		19		32		35		12		21		34	
Town	Unaligned	20		23		7		16		4		7		23		14		7	
	Aligned	10		7		23		14		26		23		7		16		23	
Rural	Unaligned	14		17		7		14		3		4		12		10		8	
	Aligned	8		5		15		8		19		18		10		12		14	
California FFA Region			2.50		15.91^{**++}		47.27^{***++}		67.88^{***++}		9.333		12.58^{*++}		3.083		5.27		4.63
North Coast	Unaligned	7		6		6		10		3		0		7		4		2	
	Aligned	3		4		4		0		7		10		3		6		8	
Superior	Unaligned	9		6		2		12		0		6		8		6		5	
	Aligned	3		6		10		0		12		6		4		6		7	
Central	Unaligned	19		23		4		7		9		4		18		15		5	
	Aligned	9		5		24		21		19		24		10		13		23	
San Joaquin	Unaligned	16		27		1		2		3		4		18		8		8	
	Aligned	12		1		27		26		25		24		10		20		20	
South Coast	Unaligned	6		9		8		8		1		2		10		6		1	
	Aligned	5		2		3		3		10		9		1		5		10	
Southern	Unaligned	11		12		16		19		3		2		14		11		4	
	Aligned	9		8		4		1		17		18		6		9		16	

Note. n = 109. NCES = National Center for Educational Statistics

$*p = < .05$; $**p = < .01$; $***p < .001$

$^{+}$ Cramer's V medium effect size; $^{++}$ Cramer's V large effect size

Summary

Section IV provided a detailed record of the findings derived from each research objective. Findings were displayed in Table 5 through 19. The final section will summarize the methodology and present the resulting conclusions, implications, and recommendations for future research and practice.

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The first section argued that in order for School-Based Agriculture Education to be relevant to the technical and soft skill demands of that agriculture industry, it is imperative for teacher human capital experiences and SBAE program components to reflect those needs. Additionally, such a study investigating the alignment of CTE programs and local labor markets has yet to be completed for each Agriculture, Food, and Natural Resources pathway.

The second section discussed the progression of literature relating to the structural transformation of agriculture which led to the evolution of Career Technical Education and School-Based Agriculture Education. Teacher development and needs were also discussed through the lens of how teachers can influence the focus of their programs. Identifying the factors of aligned secondary and post-secondary institutions was then reviewed. Theoretical and conceptual frameworks completed the section by outlining the basis of this study.

The third section described the methodology employed to investigate the research objectives. Research design, instrumentation, data collection, and analysis were explained and justified in their use.

The fourth sectioned reported the data and statistical results retrieved from the participants. Due to the purposive sampling technique of the study, the findings should not be generalized beyond the 109 respondents that provided usable data.

This final section will present conclusions based on the findings of the study. A discussion on how these findings can be implied to SBAE teachers and programs is then rationalized. The section concludes with recommendations for practice and research.

Purpose of Study

The purpose of this study is two-fold: 1) explore and describe the alignment of local AFNR labor markets between SBAE program components and teacher experience; and 2) compare the alignment between local AFNR labor markets and teacher experiences and SBAE program components.

Research Objectives

1. Describe teacher characteristics in the sample.
2. Describe SBAE program characteristics in the sample.
3. Determine the alignment between teacher experiences and their local AFNR labor markets.
4. Determine the alignment between SBAE program components and local AFNR labor markets.
5. Compare teacher characteristics between aligned and unaligned teacher experiences.
6. Compare SBAE program characteristics between aligned and unaligned program components.

Methods

The causal-comparative design investigated a purposive sample of 109 (n = 109) agriculture department chairs that were characterized as agriculture teachers. These subjects were selected so that they can represent themselves as an agriculture teacher and their programs in which they would presumably be the most knowledgeable.

A modified version of the Moser and McKim (2021) Curriculum Scale was utilized. The researcher-modified pathway scale requested respondents to indicate the presence of the eight Agriculture, Food, and Natural Resources pathways: Agribusiness Systems, Animal Systems, Biotechnology Systems, Environmental Service Systems, Food Products and Processing Systems, Natural Resources Systems, Plant Systems, Power, Structural, Technical Systems. A ninth "Other Agriculture" pathway was included for agriculture experiences and program opportunities that are unfit to be categorized into AFNR. To investigate the alignment of teacher experiences, both pre and in-service, AFNR pathway presence was rated on a scale of 0% (*No Experience in Pathway*) to 100% (*All Experience in Pathway*). To facilitate alignment data collection of each program component, classroom/curriculum, SAE, and FFA, AFNR pathway presence was rated on a scale of 0% (Not Present in Program Component) to 100% (*Encompasses All of Program Component*). Additionally, teacher and SBAE program characteristics were collected through a variety of methods.

Labor market information was gathered by first categorizing North American Industry Classification System industries into the nine aforementioned pathways. Employment metrics were collected for governmental databases. Commuting Zones were characterized as local labor markets due to their equitable representation of urban and rural contributions to local economies.

Alignment of teacher experiences and SBAE program components were categorized depending on resulting discrepancy scores. Independent sample t-tests and chi-square tests of independence were used to compare teacher and program characteristics between "aligned" and "unaligned" experiences and components.

Summary of Findings

The findings of this study are summarized in relation to the research objectives.

Research Objective One

Research objective one was intended to describe the characteristics of the participating agriculture teachers. The sample consisted of 109 agriculture teachers in California. The mean age of the respondents was 41.69 (*SD* = 11.93) with a nearly 15-

year long career and 14 years left (*SD* = 10.01, *SD* = 9.56 respectively). Most of the teachers were female (59.63%) and white (84.40%) that came from a rural farming locale (36.70%). In terms of education, 66.06% have received a Master's degree and 88.07% have completed a traditional teacher licensure certification process.

Research Objective Two

Research objective two sought to describe the characteristics of SBAE programs that the agriculture teachers resided. There are approximately three teachers at every SBAE program (*SD* = 2.09) where a mean of 17.37 (*SD* = 9.78) classes were taught among the respondents. A mean of $12,906 (*SD* = 7056) were awarded during the 2021 Agriculture Incentive Grant funding cycle. Central (25.69%) and San Joaquin FFA (25.69%) regions were equally represented with Southern region following at 18.35%. Most SBAE programs were located in a suburban area (37.61%) or town (27.52%). SBAE programs had a mean of 311 students (*SD* = 204.12). In addition, most students were male and Hispanic (51.18%, 49.03% respectively) with white female students following second (26.26%, 44.48% respectively).

Research Objective Three

Research objective three investigated AFNR pathway presence among pre-service and in-service experience. Local labor market percent shares of each pathway were also described. Local AFNR labor markets mostly composed of Agribusiness Systems-type industries (*M* = 28.75) with Plant Systems industries at a mean of 23.28. With only a mean of 2.54 of industry shares, Natural Resource System industries were the least popular. Animal Systems was the most present with pre-service and in-service experiences (*M* = 34.99, *M* = 27.64 respectively). Other Agriculture, had the lowest mean percentage presence for both types of experience.

<u>Research Objective Four</u>

SBAE class, SAE, and FFA components were evaluated for alignment for research objective four. PST and PS pathways had the largest mean presence in the classroom component (M = 22.97, M = 20.17 respectively). Animal Systems had the largest mean for both the SAE and FFA component ($M = 47.25$, $M = 27.83$ respectively). However, FPSS, NRS, and OTH pathways were consistently the most aligned across all three SBAE components.

<u>Research Objective Five</u>

Addressing research objective five required the researcher to compare teacher characteristics of aligned AFNR experience and unaligned AFNR experiences.

Pre-Service Experiences. There were no significant differences for most of the teacher characteristics, however; remaining teaching tenure was significantly different ($p < .05$) for aligned pre-service Biotechnology Systems experiences as well as Other Agriculture experiences.

In comparing nominal forms of data with a chi-square test of independence the following significant associations ($p < .05$) were determined: AS alignment and highest degree attained, BIOT alignment and childhood home locale, NRS alignment and teaching certification type, and PST alignment and gender.

In-Service Experiences. There were no significant differences for all teacher characteristics comparing aligned and unaligned in-service AFNR experiences. Nominal forms of data were compared and the following significant relationships ($p < .05$) surfaced: NRS alignment and childhood home locale, PS alignment and certification type, and PST alignment and gender.

Research Objective Six

The final research objective compared SBAE program characteristics against component alignment using numerical and categorical-type independence tests.

Classroom. Evaluating the differences in classroom alignment resulted in the following significant decrease ($p < .05$) in SBAE program characteristics and ABS alignment: number of teachers, AFNR classes, students, male students, female students, Hispanic students, black students, students of two or more ethnicities, and student who provided no response. The following significant increases ($p < .05$) were found among SBAE program characteristics and ESS alignment: AFNR classes, students, male students, female students, and Hispanic students. Lastly, the following significant decreases ($p < .05$) were found among SBAE program characteristics and PST alignment: AFNR classes, AIG funding, students, and white students.

Using chi-square tests, it was determined that California FFA region was significantly associated ($p < .001$) with ABS, BIOT, ESS, and FPPS alignment.

SAE. The alignment of SAEs with local labor markets was compared across SBAE program characteristics. A significant decrease ($p < .05$) in program characteristics were found for aligned AS SAES: number of AFNR classes. The following significant decreases ($p < .05$) in program characteristics and ABS alignment were found: number of teachers, number of AFNR classes, students, male students, female students, Hispanic students, students of two or more races, and students who provided no answer of their ethnicity. The following significant increases ($p < .05$) were found among SBAE program characteristics and ESS SAE alignment: number of teachers, number of AFNR classes, AIG funding, students, male students, female students, Hispanic students, students of two or more races, and students who provided no answer of their ethnicity. In addition, the following significant increases ($p < .05$) were found among SBAE program characteristics and NRS alignment: number of AFNR classes, students, male students, and female students.

Using chi-square tests, it was determined that California FFA region was significantly dependent ($p < .001$) with ABS, BIOT, ESS, and FPPS SAE alignment. PS alignment was also dependent on program locale.

FFA. FFA activity alignment with local labor market was compared across program characteristics. Evaluating the differences in FFA ABS alignment found in the following significant increases ($p < .05$) in SBAE program characteristics: number teachers, AFNR classes, students, and male students. FFA ESS alignment resulted in the following significant increases ($p < .05$) in program characteristics: number of teachers, AFNR classes, students, male students, female students, Hispanic students, students of two or more races, and students who provided no answer of their ethnicity. Aligned NRS FFA activities proceeded to have a significant increase ($p < .05$) in teachers and students who are of two ethnicities or more.

Using chi-square tests, California FFA region surfaced to be a significant dependent ($p < .001$) with ABS, BIOT, ESS, and NRS FFA alignment.

Conclusions

The following conclusions were based on the findings of this study considering the purposive sample limits its generalizations:

Research Objective One

- The average California agriculture teacher that participated in the study was a 42-year-old female who is 15 years into their career with 14 years perceivably left. Their background stems from a rural farming area where they eventually received a Master's degree and a traditional teaching certification.

Research Objective Two

- From the 109 agriculture teachers that provided a usable survey response, the average SBAE program they came from is a three-person department that taught 17 total AFNR classes. During the 2021 Agriculture Incentive Grant funding cycle they received nearly $13,00. The suburban area programs could have resided in either the Central or San Joaquin region. The 311 student population of the program mainly consisted of white females.

Research Objective Three

- California AFNR labor markets are largely composed of Agribusiness and Plant Systems type industries.
- Animal, Plant, Power, Structural, and Technical, and Agribusiness Systems are the disciplines of focus during both a teacher's pre-service and in-service training experiences. However, these pathways do not align to the labor markets that teachers are locally residing in.

Research Objective Four

- Animal, Plant, Power, Structural, and Technical, and Biotechnology Systems are the most popular pathways that SBAE programs establish in the courses, SAEs, and FFA opportunities.
- The percentage of programs that are aligned with their individual labor markets varied across pathways and program components, however, an overwhelming majority of programs were aligned with Other Agriculture, Food Products and Processing, and Natural Resources Systems type labor markets.

Research Objective Five

- Though no teacher characteristic consistently differed at a significant level across the pathways, remaining teacher tenure was statistically lower for Biotechnology Systems and Other Agriculture pre-service alignment.
- Dependencies between pre-service AFNR alignment and alignment were scattered with Animal Systems dependent on degree earned, Biotechnology Systems dependent on the childhood home locale of the teacher, Natural Resources Systems dependent on teacher certification type and Power, Structural, and Technical Systems dependent on teacher gender.
- There were no teacher characteristics that differ within teacher in-service AFNR experience.
- Dependencies between in-service AFNR alignment and alignment were scattered with Natural Resources dependent on childhood home locale, Plant Systems dependent on the certification type, and Power, Structural, and Technical Systems dependent on teacher gender.

Research Objective Six

- Across all SBAE components, prominent differences between aligned and unaligned components were consistently seen in the number of teachers, classes taught, students, male students, female students, and Hispanic students for ABS, BIOT, ESS, and NRS pathways.
- The alignment of SBAE program components with ABS, BIOT, ESS, FPSS, and NRS labor markets were regularly dependent on the California FFA region the program resided.

Discussion and Implications

Alignment is constituted as educational institutions that meet the needs of local labor markets, and therefore create value for educational attainment and student success (Van Noy & Cleary, 2017). There are a variety of factors that are inputted into aligned programs including program structure, curricula selection, and co-curricular activities that should be tailored to address labor needs (Van Noy & Cleary, 2017). Opportunities for governmental funding of Career Technical Education programs over the past decade has substantially increased with the hope of producing more students that exit secondary education with practical industry skills that reflect the skills and knowledge the local community needs (Imperatore & Hyslop, 2017). However, just as this study has shown, trade reports have mentioned that program alignment varies just as much as individual local market, resulting in extensive discrepancies (Carreira, 2008).

Both Human Capital Theory (Becker, 1994) and the content-based model for teaching agriculture (Roberts & Ball, 2009) reflect the process in which students build knowledge and skills through industry-based curriculum and activities and result in being a skilled worker. School-Based Agriculture Education components and teacher experiences are in an opportune position to build personal competencies, courses, SAEs, and FFA activities that lead to successful students who thrive economically in their labor market.

California AFNR labor markets are driven by Agribusiness and Plant Systems industries, cumulatively encompassing over 50% of agricultural employment. Though this study's report on agriculture employment differs from the USDA Economic Research Service (2020) as what constitutes an "agricultural job" is narrowly defined compared what AFNR standards and SBAE programs identify as agriculture. This was accounted and adjusted for in this study.

Teacher experience presence, both pre and in-service, were saturated with animal, plant, agribusiness, and technical pathways which differs from Moser and McKim's (2021) study where presence was more balanced across AFNR pathways. This resulted in wide-ranging alignment across all AFNR pathways in which the four pathways mentioned earlier were not the front runners in terms of the proportion of teachers that had aligned experiences. California agriculture education has historically developed SBAE programs on the traditional agriculture disciplines of plants, animals, and mechanics. Formal and in-formal teacher education programs have reflected this by mandating certain credit hours dedicated to animal, plant, agribusiness, and mechanics courses. Again, teacher education programs may have reflected what is occurring in schools throughout the state, which could make a case for higher-education alignment, however alignment stems from a grassroots perspective (i.e. local labor market). These discrepancies in teacher experience can influence what SBAE programs concentrate in, and eventually impact student career readiness positively or negatively.

The three components of SBAE programs concentrated mostly on the traditional norms of agricultural disciplines with some disparities. Classroom presence of the AFNR pathways mimicked three of the four pathways that teacher experience focused on. A higher presence in Biotechnology Systems was determined possibly due to the growing popularity of creating agriscience courses that meet high school graduation and college entrance science requirements. As expected, animal, plant, and technical (mechanics) related SAEs were the most prevalent, and have been historically (Parker, 2019). The AFNR pathways that were most popular in FFA activities was mirrored the classroom and SAE components. In addition, Other Agriculture did become a front runner in this component suggesting that many of the leadership and service activities that SBAE programs complete do not align within AFNR pathway standards.

Although not a direct purpose of the study, the data indicates that Animal, Plant, and Power, Structural, and Technical Systems pathways were the most popular across all teacher experiences and SBAE program components. No discrepancy scores were calculated to unveil any form of alignment between teachers and their programs; however, teacher experiences and program components do seem to be consistent. Alignment with local labor markets is a different story. Among all measures of alignment, the popular AFNR disciplines in teacher experiences and program components were not the most aligned with local employment needs. A number of studies alluded to this scenario. Sublett (2019) found that AFNR course taking surpasses agriculture employment shares, while others determined that there is no relationship between projected job demands and course offerings (Hargis, 2011; Harris et al., 2020). SBAE programs need to be weary of how government CTE funding is being allocated so that resources are not revoked due to a mismatch in program focus and job demands (Carreira, 2008).

Comparing aligned and unaligned AFNR teacher experiences across teacher characteristics resulted in limited evidence on what characteristics lead to labor market alignment. Remaining teacher tenure was significantly lower for aligned Biotechnology and Other Agriculture despite this difference not be reflected in the years teaching variable. Gender expressed a difference in both pre-service and in-service experience aligning to Power, Structural, and Technical Systems. In general, mechanics experiences are male-dominated, however the data shows that there was a greater proportion of females that were aligned with PST labor markets than males. This may be due to the nature of what mathematically constitutes being “aligned” in this study. The absence or low presence of a pathway in both the teacher experience and the labor market still results in that experience being “aligned.” PST labor markets comprised an approximate average of 6% of all employment shares, so female PST experience could have ranged from 0% to 16% and still be declared “aligned” according to Moser’s and McKim’s (2021) calculations.

SBAE characteristics were compared between aligned and unaligned program components. All pathways revealed individualistic differences among SBAE characteristics. Notably, Agribusiness Systems, Environmental Service Systems, and Natural Resources Systems alignment differed significantly across most of the SBAE characteristics and all three agriculture education components. Whereas ABS alignment centered around program with less teachers, AFNR classes, and students. ESS and NRS alignment called for more teachers, classes, and students. Compared to ABS, where course offerings and pathways have can potentially subscribed to meeting high school and college requirements (e.g. Personal Finance, Agriculture Government, Agriculture Economics), ESS and NRS pathways may be considered as bonus offerings and therefore require more teachers to head these classes. Altonji et al. (2012) and Sweetland (1996) provided analogous inferences in which human capital investments are difficult to measure as institutions and student course-taking are led to meet education requirements, not labor requirements, and imposing heterogenic outcomes on both the student and the educational program.

Pathway alignment of all the SBAE component was highly dependent on the California FFA Region the SBAE program resided in. ABS, BIOT, ESS, and FPPS pathway alignment was associated with the geographic region in California, however; these geographic dependencies were not determined by the NCES locale of the program. FFA regions are more geographically representative of the Commuting Zones (i.e. local labor market) used in this study and could have induced the relationship between alignment and region.

Recommendations

The following recommendations for practitioners and researchers are outlined below.

Practice

1. SBAE program course offerings, SAE projects, and FFA activities (when applicable) and teachers training experiences should reflect the industrial needs of their individual local labor market. Similar to how the agriculture industry has gone through a structural transformation into an agri-food industry, agriculture education should do the same across all components. Using government employment data is advised, but, again, what is considered to be an "agricultural job" may differ between agriculture education and government designations.
2. Career Technical Education grants that are publicly funded should either add or strengthen requirements in order to be awarded. Grants such as the Agriculture Incentive Grant, Perkins, and K12 Workforce should review what pathways and CTE programs should have priority in relation to their local economies.
3. There are five universities in California that offer agriculture teacher education programs. The universities dispersed across the state with highly diverse agricultural focuses and labor markets. It is recommended that these university programs align their degrees credit hour requirements to the labor markets that surround them, allowing agriculture teacher candidates to become more specialized.
4. California agriculture education and the California Department of Education CTE Model Curriculum Standards should adopt the Agriculture, Food, and Natural Resources standards in alignment with most of the United States and

replace the current California ANR standards. California Agriculture and Natural Resources standards do not encompass all that SBAE programs do or should do compared to the national AFNR standards set forth by The Council of Agriculture Education.

Research

1. The agri-food system has proven to be its own microcosm of industries. With such a constricted definition of what represents an "agricultural job" or "agricultural industry," a system of categorizing industries and occupations into AFNR categories would ascertain more reliable and valid studies that focus on agriculture economics, education, and business.
2. Most of the literature on CTE alignment with labor market is produced by private organizations and trades with limited peer-reviewed work being completed. This study took a surface level look at the parameters that relate to pathway alignment. Should agriculture education researchers tackle a topic such as this, studying individual AFNR pathways to uncover the nuances that each pathway possesses would be valuable.
3. Researchers should investigate the composition of SBAE program advisory committees and major stakeholders. CTE alignment literature clearly advocates that advisory committees are the back bone of SBAE programs in terms of gaining community support, building programs, and aligning courses and opportunities to industry needs. Again, advisory committees should reflect the needs of agriculture employment, not what the program has already established. Investigating the industries that the committee members represent is imperative.

4. Stemming from the third recommendation for practitioners above, researchers should investigate where agriculture education students come from and what areas they teach in after the student teaching experience. Do these candidates remain relatively close to the university they graduated from? In a multi-program state like California, students have more options for educational attainment and job placement compared to other states.
5. To build upon the Moser and McKim (2021) study, AFNR pathway alignment should be investigated within the confines of teacher experiences and SBAE program components. Significant discrepancies between one's training and actual occupational demands could encroach on the performance and qualities of all aspects of the job and program.
6. It is recommended that regression analysis be completed to uncover the factors that ultimately determine alignment within an individual pathway. This study identified teacher and program characteristics that differed between aligned and unaligned programs, however not all characteristics were consistent across all AFNR pathways.
7. In the case that future researchers do investigate how the FFA component aligns with industry employment demands, either a replacement of the Other Agriculture pathway or an addition of an AFNR Cluster Skills or a Career Readiness Practices category should occur. FFA activities encompass a broad spectrum of activities that may not always tie to AFNR standards. However, FFA activities do constantly address Cluster Skills or Career Readiness Practices due to the nature of such activities. Such categories can be just as ambiguous as these skills can be tied to each AFNR pathway as well.
8. Researchers should be cautious on what is declared as "aligned" if the same discrepancy score calculations are used from Moser and McKim (2021).

Despite meeting the threshold be being within 10% of one another, should a pathway presence of 0% and a labor market share of 10% be considered "aligned?" Researchers should be making their own informed decisions and modify such definitions and calculations to meet their needs.

Summary

This final chapter reviewed the purpose and objectives of the study that led to the methodological decisions of such research goals. The study's findings were summarized to provide a glimpse into what the methods outputted and how each research objective was met. A number of conclusions were drawn based on these findings with further justified in the discussion and implications section. Finally, a number of recommendations were posed for practitioners and researchers alike to investigate deeper and better understand this type of research within agriculture education.

REFERENCES

REFERENCES

A Roadmap to Advancing CTE without Limits. (2021). Advancing CTE.

Adams, E. (2010). A Framework for the Preparation of Accomplished Career and Technical Education Teachers. *Journal of Career and Technical Education*, *25*(1), 21–34.

Advance CTE. (n.d.). *Career Clusters*. Retrieved September 15, 2022, from https://careertech.org/career-clusters

Agresti, A., & Finlay, B. (2009). *Statistical methods for the social sciences* (Issue 300.72 A3).

Agriculture, Food & Natural Resources | Advance CTE. (n.d.). Retrieved September 15, 2022, from https://careertech.org/agriculture

Albritton, M. C., & Roberts, T. G. (2020). Agricultural Technical Skills Needed by Entry Level Agriculture Teachers: A Modified Delphi Study. *Journal of Agricultural Education*, *61*(1), 140–151.

Aliaga, O. A., Kotamraju, P., & Stone III, J. R. (2014). Understanding participation in secondary career and technical education in the 21st century: Implications for policy and practice. *The High School Journal*, *97*(3), 128–158.

Altonji, J. G., Blom, E., & Meghir, C. (2012). *Heterogeneity in human capital investments: High school curriculum, college major, and careers*.

Alvarez-Cuadrado, F., & Poschke, M. (2011). Structural change out of agriculture: Labor push versus labor pull. *American Economic Journal: Macroeconomics*, *3*(3), 127–158.

Ary, D., Jacobs, L. C., Irvine, C. K. S., & Walker, D. (2018). *Introduction to research in education*. Cengage Learning.

Atwell, A., Ecton, W., Klein, S., D'Amico, M. M., & Sublett, C. (2022). Community college responses to align career and technical education programs with changing labor markets. *New Directions for Community Colleges*, *2022*(197), 45–58.

Baker, M., Robinson, S., & Kolb, D. (2012). Aligning Kolb's Experiential Learning Theory with a Comprehensive Agricultural Education Model. *Journal of Agricultural Education*, *53*(4), 1–16. https://doi.org/10.5032/jae.2012.04001

Barrett, C. B., Reardon, T., Swinnen, J., & Zilberman, D. (2020). Agri-food value chain revolutions in low-and middle-income countries. *Journal of Economic Literature*, *58*, 1–67.

Becker, G. S. (1994). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition)*. The University of Chicago Press Chicago. http://www.nber.org/books/beck94-1

Benson, P. W. (1982). The Relationship of FFA, Vo Ag, and Work Experience With Work Attitudes. *Journal of the American Association of Teacher Educators in Agriculture*, *23*(3), 51–57.

Bernard, H. (2002). Research Methods in Anthropology: Qualitative and Quantitative Methods. AltaMira Press. *Walnut Creek, California*.

Bozick, R., & Dalton, B. (2013). *Career and Technical Education and Academic Progress at the End of High School: Evidence from the Education Longitudinal Study of 2002.* ERIC.

Brand, B., Valent, A., & Browning, A. (2013). How Career and Technical Education Can Help Students Be College and Career Ready: A Primer. *College and Career Readiness and Success Center*.

Brunner, E. J., Dougherty, S. M., & Ross, S. L. (2021). The Effects of Career and Technical Education: Evidence from the Connecticut Technical High School

System. *The Review of Economics and Statistics*, 1–46. https://doi.org/10.1162/rest_a_01098

Bundy, J., Zeamer, K., Evans, H., Sterle, J. A., & Thomson, D. U. (2021). Animal industry survey: The importance of technical and soft skills, coursework, and extracurricular activities on the success of undergraduates entering animal industries. *Iowa State University Animal Industry Report*, *18*(1).

California Department of Education. (n.d.). *California Career Technical Education Model Curriculum Standards: Agriculture and Natural Resources*.

Canhoto, A., & Murphy J. (2016). Learning from simulation design to develop better experiential learning initiatives: An integrative approach. *Journal of Marketing Education, 38*(2), 98-106.

Cannon, J. G., Kitchel, A., & Duncan, D. W. (2012). Perceived teaching and learning professional development needs of Idaho secondary career and technical education teachers. *The Researcher*, *24*(1), 43–54.

Career Technical Education—Teaching & Learning [CA Dept of Education]. (n.d.). Retrieved January 22, 2023, from https://www.cde.ca.gov/ci/ct/

Carl D. Perkins Career and Technical Education Improvement Act of 2006, (2006).

Carl D. Perkins Vocational and Applied Technology Education Act Amendments of 1990, 101–392 (1990).

Carl D. Perkins Vocational and Applied Technology Education Amendments of 1998, Pub. L. No. 105–332 (1998).

Carl D. Perkins Vocational Education Act 1984, Pub. L. No. 98–524 (1984).

Carreira, R. (2008). *Aligning tech prep programs with current and future labor market needs*.

Carter, R., & Neason, A. B. (1984). Participation in FFA and Self-Perceptions of Personal Development. *Journal of the American Association of Teacher Educators in Agriculture*, *25*(3), 39–44.

Charlton, D. (2019). Development of agricultural supply through structural changes in labor inputs. *New York: UC Davis*.

Charlton, D., Rutledge, Z., & Taylor, J. (2021). *Evolving Agricultural Labor Markets*.

Charlton, D., Taylor, J. E., Vougioukas, S., & Rutledge, Z. (2019). Innovations for a shrinking agricultural workforce. *Choices*, *34*(2), 1–8.

Chetty, R., Hendren, N., Kline, P., & Saez, E. (2014). Where is the land of opportunity? The geography of intergenerational mobility in the United States. *The Quarterly Journal of Economics*, *129*(4), 1553–1623.

Christensen, J., Warnick, B. K., Spielmaker, D., Tarpley, R. S., & Straquadine, G. S. (2009). Agricultural In-Service Needs of Introductory Level Career and Technical Education Teachers. *Journal of Agricultural Education*, *50*(4), 1–13.

Christiaensen, L., Rutledge, Z., & Taylor, J. E. (2020). The future of work in agriculture: Some reflections. *World Bank Policy Research Working Paper*, *9193*.

Christiaensen, L., Rutledge, Z., & Taylor, J. E. (2021). Viewpoint: The future of work in agri-food. *Food Policy*, *99*, 101963. https://doi.org/10.1016/j.foodpol.2020.101963

Clearly, J., & Van Noy, M. (2014). *A Framework for Higher Education Labor Market Alignment: Lessons and Future Directions in the Development of Jobs---Driven Strategies. Working Paper*. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://files.eric.ed.gov/fulltext/ED565469.pdf

Colclasure, B. (2020). Entry-Level Workplace Competencies Needed by Graduates of a Community College Agriculture Program: A Midwest Case Study Using the Delphi Technique. *Journal of Research in Technical Careers*, *4*(2), 3.

Coleman, B. M., Bunch, J., & Thoron, A. C. (2020). Identifying Agriscience Teachers' Instructional Practice Professional Development Needs by Certification Type. *Journal of Agricultural Education*, *61*(3), 86–100.

Connell, J., Gough, R., McDonnell, A., & Burgess, J. (2014). Technology, work organisation and job quality in the service sector: An introduction. *Labour & Industry: A Journal of the Social and Economic Relations of Work*, *24*(1), 1–8.

Cranmer, S. (2006). Enhancing graduate employability: best intentions and mixed outcomes. *Studies in Higher Education*, *31*(2), 169-184.

Crawford, P., & Dalton, R. (2011). Making our graduates competitive in the workforce: What soft skills do students, faculty, alum and employers value. *Association of Public and Land-Grant Universities, the University-Industry Consortium, Michigan State University and MSU AgBio*.

Croom, D. B. (2008). The Development of the Integrated Three-Component Model of Agricultural Education. *Journal of Agricultural Education*, *49*(1), 110–120.

Dalton, B., Glennie, E., Studley, R., Warkentien, S., & Lauff, E. (2021). Do High School Industry Certifications Reflect Local Labor Market Demand? An Examination of Florida. *Career and Technical Education Research*, *46*(2), 3–22.

Dalton, R., Crawford, P., Weiss, L., & Fink, W. (2018). Exploring How Women and Men Prioritize Employability Skills for Communication, Decision Making and Self-Management. *NACTA Journal*, *62*(4), 298–307.

Davis, R. J., & Jayaratne, K. (2015). In-Service Training Needs of Agriculture Teachers for Preparing Them to Be Effective in the 21st Century. *Journal of Agricultural Education*, *56*(4), 47–58.

Deming, D. J. (2017). The growing importance of social skills in the labor market. *The Quarterly Journal of Economics*, *132*(4), 1593–1640.

DiBenedetto, C. A., Willis, V. C., & Barrick, R. K. (2018). Needs Assessments for School-Based Agricultural Education Teachers: A Review of Literature. *Journal of Agricultural Education*, *59*(4), 52–71.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. John Wiley & Sons.

Dougherty, S. M., & Lombardi, A. R. (2016). From vocational education to career readiness: The ongoing work of linking education and the labor market. *Review of Research in Education*, *40*(1), 326–355.

Duncan, D. W., Ricketts, J. C., Peake, J. B., & Uesseler, J. (2006). Teacher Preparation and In-Service Needs of Georgia Agriculture Teachers. *Journal of Agricultural Education*, *47*(2), 24.

Dyer. (1996). Developing a model for supervised agricultural experience program quality: A synthesis of research. *Journal of Agricultural Education*, *37*(2), 24–33. https://doi.org/10.5032/jae.1996.02024

English, C. W., Simpson, C., & Alston, A. J. (2019). The Perceived Impact of Life Experiences and Selected Growth Areas Upon the Employability Preparation of Land-Grant College Graduates. *Journal of Southern Agricultural Education Research*, *69*(1), 125–137.

Erickson, B., Fausti, S., Clay, D., & Clay, S. (2018). Knowledge, skills, and abilities in the precision agriculture workforce: An industry survey. *Natural Sciences Education*, *47*(1), 1–11.

Findlay, H. J. (1992). Where do secondary vocational agriculture teachers acquire professional agricultural education competencies. *Journal of Agricultural Education*, *33*(2), 28–33.

Fisher, D. U., & Knutson, R. D. (2013). Uniqueness of agricultural labor markets. *American Journal of Agricultural Economics*, *95*(2), 463–469.

Fowler, C. S., Jensen, L., & Rhubart, D. (2018). Assessing US labor market delineations for containment, economic core, and wage correlation. *Accessed at Osf. Io/T4hpu on April*, *20*, 2018.

Fowler, C. S., & Kleit, R. G. (2014). The effects of industrial clusters on the poverty rate. *Economic Geography*, *90*(2), 129–154.

Fowler, C. S., Rhubart, D. C., & Jensen, L. (2016). Reassessing and revising commuting zones for 2010: History, assessment, and updates for US 'labor-sheds' 1990–2010. *Population Research and Policy Review*, *35*(2), 263–286.

Funding Results—Finance & Grants (CA Dept of Education). (n.d.). Retrieved December 27, 2022, from https://www.cde.ca.gov/fg/fo/fr/

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction*. Longman Publishing.

Geverdt, D. (2019). *Education Demographic and Geographic Estimates Program (EDGE): Locale Boundaries File Documentation, 2017*.

Gibbs, R. M., & Bernat Jr, G. A. (1997). Rural industry clusters raise local earnings. *Rural America/Rural Development Perspectives*, *12*(3).

Gillard, S. (2009). Soft skills and technical expertise of effective project managers. *Issues in Informing Science & Information Technology*, *6*.

Goodman, J. F. (1970). The definition and analysis of local labour markets: Some empirical problems. *British Journal of Industrial Relations*, *8*(2), 179–196.

Gordon, H. R., & Schultz, D. (2020). *The history and growth of career and technical education in America*. Waveland press.

Granovskiy, B. (2016). *Carl D. Perkins Career and Technical Education Act of 2006: An Overview. CRS Report R44542, Version 3. Updated.* (No. R44542). Congressional Research Service.

Granovskiy, B. (2018). *Reauthorization of the Perkins Act in the 115th Congress.* (No. R45446). Congressional Research Service.

Hanson, E., & Wachenheim, C. J. (2020). Industry expectations for beginning agricultural lenders. *Agricultural Finance Review*, *80*(4), 549–562.

Hargis, K. B. (2011). *Career and Technical Education Program Alignment with Local Workforce Needs*. Eastern Kentucky University.

Harris, J. C., Warner, M. T., Yee, K., & Wilkerson, S. B. (2020). *Assessing the Alignment between West Virginia's High School Career and Technical Education Programs and the Labor Market.* Institute of Education Sciences. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://files.eric.ed.gov/fulltext/ED605044.pdf

Hayward, G. C., & Benson, C. S. (1993). *Vocational-technical education: Major reforms and debates 1917-present*. US Department of Education, Office of Vocational and Adult Education.

Hendrix, R., & Morrison, C. (2018). Student perceptions of workforce readiness in agriculture. *Journal of Agricultural Education,* 59(3), 213-228.

Herren, R. (1986). Controversy and Unification: The Passage of the Smith-Hughes Act. *Journal of the American Association of Teacher Educators in Agriculture*, *27*(1), 39–44.

Hillage, J., & Pollard, E. (1998). *Employability: Developing a framework for policy analysis*.

Hillison, J. (1995). The Coalition that Supported the Smith-Hughes Act or a Case for Strange Bedfellows. *Journal of Vocational and Technical Education*, *11*(2), 4–11.

Human capital Definition & Meaning—Merriam-Webster. (n.d.). Retrieved December 25, 2022, from https://www.merriam-webster.com/dictionary/human%20capital

Imperatore, C., & Hyslop, A. (2017). CTE policy past, present, and future: Driving forces behind the evolution of federal priorities. *Peabody Journal of Education*, *92*(2), 275–289.

Johnson, R. B., & Christensen, L. (2019). *Educational research: Quantitative, qualitative, and mixed approaches*. Sage publications.

Juergeson, E. M. (1996). *The Contribution of Student Teaching on Teacher Development*. *7*(2). https://doi.org/10.5032/jaatea.1966.02021

Kechagias, K. (2011). *Teaching and assessing soft skills*.

Killian, M. S., & Parker, T. S. (1991). Higher education no panacea for weak rural economies. *Rural America/Rural Development Perspectives*, *7*(2221-2021–984), 2–7.

Kolb, D. A. (1984). *By David A. Kolb - Experiential Learning: Experience as the Source of Learning and Development: 1st (first) Edition*. White Lotus.

Kolb, D. A. (2014). *Experiential Learning: Experience as the Source of Learning and Development*. FT Press.

LaFollette, A. M. (2011). *An historical policy analysis of the Carl D. Perkins legislation: Examining the history, creation, implementation and reauthorization of the law*. University of Illinois at Urbana-Champaign.

Lewis, W. A. (1954). *Economic development with unlimited supplies of labour*.

Lindner, J. R., Murphy, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, *42*(4), 43–53.

Lytle, J. (2000). Teacher education at the millennium: A view from the cafeteria. *Journal of Teacher Education, 51*(3), 174-179.

Manley, R. A. (2011). The decentralization of Perkins: History, impact, and recommendations for future CTE legislation. *Career and Technical Education Research*, *36*(2), 119–152.

Martin, M. J., & Kitchel, T. J. (2020). The Development of Vocational Agriculture before the Vocational Education Act 1963. *Journal of Research in Technical Careers*, *4*(1), 24–37.

Matteson, M. L., Anderson, L., & Boyden, C. (2016). " Soft skills": A phrase in search of meaning. *Portal: Libraries and the Academy*, *16*(1), 71–88.

Mayor, L., Flynn, K., Dermesonluoglu, E., Pittia, P., Baderstedt, E., Ruiz-Bejarano, B., Geicu, M., Quintas, M. A., Lakner, Z., & Costa, R. (2015). Skill development in food professionals: A European study. *European Food Research and Technology*, *240*(5), 871–884.

Moore, G. E. (1994). *Back to the future: Research in Agricultural Education*. A paper presented to the National Agricultural Education Research Meeting.

Moser, E. M., & McKim, A. J. (2021). Exploring Curriculum Congruence and Connectivity within School-Based Agricultural Education. *Journal of Agricultural Education*, *62*(1).

Nakao, R. D. (2006). *Local Labor Market Opportunities and the Educational Outcomes of High School Students in the United States*. ProQuest.

National Center for O*NET Development. (n.d.). *O*NET OnLine*. Retrieved December 28, 2022, from https://www.onetonline.org/find/career?c=1

National Council for Agricultural Education. (n.d.). *Agricultural Education*. The National Council for Agricultural Education. Retrieved September 16, 2022, from https://thecouncil.ffa.org/ageducation/

National Council for Agricultural Education. (2015). *AFNR Career Cluster Content Standard*. https://ffa.app.box.com/s/n6jfkamfof0spttqjvhddzolyevpo3qn/file/294160068843

National Council for Agricultural Education. (2017). *SAE for All Teacher's Guide*. https://ffa.app.box.com/s/exollg1x7q2lntun3su2mdufw07wiklf

National FFA Organization. (2022). *Official FFA Manual*. www.ffa.org

National Research Council. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. National Academies Press.

Newcomb, L. H., McCracken, J. D., Warmbrod, J. R., & Whittington, M. S. (2003). *Methods of Teaching Agriculture* (3rd edition). Pearson.

Null, J. W. (2011). *American Educational History Journal: Volume 38 #1 & 2*. IAP.

Office of Education. (1965). *THE VOCATIONAL EDUCATION ACT OF 1963*. https://eric.ed.gov/?id=ED019402

Osamwonyi, E. F. (2016). In-Service Education of Teachers: Overview, Problems and the Way Forward. *Journal of Education and Practice*, *7*(26), 83–87.

Paige, R. (2006). No Child Left Behind: The ongoing movement for public education reform. *Harvard Educational Review*, *76*(4), 461–473.

Parker, C. (2019). *California Agricultural Education Outlook*. California Department of Education.

Peake, J. B., Duncan, D. W., & Ricketts, J. C. (2007). Identifying Technical Content Training Needs of Georgia Agriculture Teachers. *Journal of Career and Technical Education*, *23*(1), 44–54.

Pessoa, F. (2002). *The book of disquiet.* Penguin Books.

Phelps, K., Henry, A., & Bird, W. (2012). Factors Influencing or Discouraging Secondary School Students' FFA Participation. *Journal of Agricultural Education*, *53*(2), 70–86. https://doi.org/10.5032/jae.2012.02070

Phipps, L. J., Osborne, E. W., Dyer, J. E., & Ball, A. L. (2007). *Handbook on Agricultural Education in Public Schools* (6th edition). Cengage Learning.

Polopolus, L. (1982). Agricultural economics beyond the farm gate. *American Journal of Agricultural Economics*, *64*(5), 803–810.

Privitera, G. J. (2022). *Research methods for the behavioral sciences*. Sage Publications.

Ramsey, J. W. (2009). *Identifying Entry-level Skills Expected by Agricultural Industry Experts and Determining Teachers' Perceptions on Whether They Are Being Learned Through Students' Participation in the Supervised Agricultural Experience Component of the Secondary Agricultural Education Program: A Two-panel Delphi Study*. Oklahoma State University.

Rank, B., & Retallick, M. (2016). Synthesis of Contemporary SAE Research 1994–2014. *Journal of Agricultural Education*, *57*(4), 131–145. https://doi.org/10.5032/jae.2016.04131

Reardon, T., Timmer, C. P., & Minten, B. (2012). Supermarket revolution in Asia and emerging development strategies to include small farmers. *Proceedings of the National Academy of Sciences*, *109*(31), 12332–12337. https://doi.org/10.1073/pnas.1003160108

RFA: 2022-23 Agricultural Career Technical Education Incentive Grant [CA Dept of Education]. (n.d.). Retrieved December 27, 2022, from https://www.cde.ca.gov/fg/fo/r17/agin22rfa.asp

Rice, A. H., & Kitchel, T. (2015). Preservice Agricultural Education Teachers' Experiences in and Anticipation of Content Knowledge Preparation. *Journal of Agricultural Education*, *56*(3), 90–104. https://doi.org/10.5032/jae.2015.03090

Rice, A. H., & Kitchel, T. (2017). Teachers' Beliefs about the Purpose of Agricultural Education and Its Influence on Their Pedagogical Content Knowledge. *Journal of Agricultural Education*, *58*(2), 198–213.

Rinker, S., Smalley, S., & Hainline, M. (2020). Identifying the Professional and Technical Skills Agricultural Industry Employers Agricultural Graduates to Possess. *NACTA Journal*, *65*.

Roberts, & Ball. (2009). Secondary Agricultural Science as Content and Context for Teaching. *Journal of Agricultural Education*, *50*(1), 81–91.

Roberts, R., Wittie, B. M., Stair, K. S., Blackburn, J. J., & Smith, H. E. (2020). The Dimensions of Professional Development Needs for Secondary Agricultural Education Teachers Across Career Stages: A Multiple Case Study Comparison. *Journal of Agricultural Education*, *61*(3), 128–143.

Roberts, T. G., Dooley, K. E., Harlin, J. F., & Murphrey, T. P. (2006). Competencies and Traits of Successful Agricultural Science Teachers. *Journal of Career and Technical Education*, *22*(2), n2.

Roberts, T. G., & Dyer, J. E. (2004). Characteristics of effective agriculture teachers. *Journal of Agricultural Education*, *45*, 82–95.

Robinson, J. S. (2009). Assessing the employability skills of University of Kentucky College of Agriculture graduates: A comparison of hard and soft science disciplines. *NACTA Journal*, 56–62.

Rose, C., Stephens, C., Stripling, C., Cross, T., Sanok, D., & Brawner, S. (2016). The Benefits of FFA Membership as Part of Agricultural Education. *Journal of Agricultural Education*, *57*(2), 33–45. https://doi.org/10.5032/jae.2016.02033

Rosen, R., Visher, M., & Beal, K. (2018). Career and Technical Education: Current Policy, Prominent Programs, and Evidence. *MDRC*.

Rubenstein, E., Thoron, A., Colclasure, B., & Gordon, J. (2016). Supervised Agricultural Experience Programs: An Examination of the Development and Implementation of Urban Programs. *Journal of Agricultural Education*, *57*(4), 217–233. https://doi.org/10.5032/jae.2016.04217

Ryan, T. G., Young, D. C., & Kraglund-Gauthier, W. L. (2017). Action research within pre-service teacher education. *Transformative Dialogues: Teaching and Learning Journal*, *10*(3).

Sanok, D. E., Stripling, C. T., Stephens, C. A., & Griffith, A. P. (2015). Factors Impacting Members Decision to Continue FFA Beyond High School. *Journal of Agricultural Education*, *56*(4), 138–152. https://doi.org/10.5032/jae.2015.04138

Sanok, D. E., Stripling, C. T., Stephens, C. A., Ricketts, J. C., Estepp, C. M., & Conner, N. W. (2015). Professional development needs of Tennessee school-based agricultural education teachers. *Journal of Southern Agricultural Education Research*, *65*(1), 69–82.

Sapp, S., Thoron, A., & Rubenstein, E. (2019). Knowledge, skills, and competencies needed by students with training in agricultural and environmental practices as perceived by local leaders: A Delphi study. *Journal of Southern Agricultural Education Research*, *69*(1), 65–83.

Scasta, J. A. (2018). *Employer expectations of 21st century entry-level agricultural leadership, education, and communications graduates: A qualitative study*.

Schneider, M., Colglazier, A., Beutler, R., Pollard, C., & Francis, C. (2005). Student, advisor, and employer opinions on interdisciplinary education in agriculture. *Journal of Natural Resources and Life Sciences Education*, *34*(1), 101–106.

Schultz, T. W. (1961). Investment in human capital. *The American Economic Review*, *51*(1), 1–17.

Seidler, J. (1974). On using informants: A technique for collecting quantitative data and controlling measurement error in organization analysis. *American Sociological Review*, 816–831.

Shoulders, C. (2013). Teachers' use of experiential learning stages in agricultural laboratories. *Journal of Agricultural Education*, 54(3), 100-115.

Smalley, S., Hainline, M., & Sands, K. (2019). School-based Agricultural Education Teachers' Perceived Professional Development Needs Associated with Teaching, Classroom Management, and Technical Agriculture. *Journal of Agricultural Education*, *60*(2). https://doi.org/10.5032/jae.2019.02085

Smalley, S. W., & Hainline, M. S. (2021). *Pre-Service Teachers Self-Perceived Training Needs Associated with Program Design and Management and Leadership and SAE Development*. *62*(1).

Smith, E. (2010). Sector-specific human capital and the distribution of earnings. *Journal of Human Capital*, *4*(1), 35–61.

Smith-Hughes Act, 39 (1917).

Smylie, M. A. (1997). From bureaucratic control to building human capital: The importance of teacher learning in education reform. *Arts Education Policy Review*, *99*(2), 35–38.

Snider, C. S., Robinson, J. S., Edwards, M. C., & Terry Jr, R. (2021). Student Teachers' Views on their Competence to Teach the National AFNR Career Pathways: Implications for the Preparation of Preservice Teachers in Agricultural Education. *Journal of Agricultural Education*, *62*(3).

Sorensen, T. J., Lawver, R. G., Hopkins, N., Jensen, B., Dutton, C., & Warnick, B. K. (2018). Preservice Agriculture Teachers' Development during the Early Phase of Student Teaching. *Journal of Agricultural Education*, *59*(4), 105–119.

Stevens, A. H., Kurlaender, M., & Grosz, M. (2019). Career technical education and labor market outcomes evidence from California community colleges. *Journal of Human Resources*, *54*(4), 986–1036.

Stimson, R. W. (1919). *Vocational Agricultural Education by Home Projects*. Macmillan.

Strengthening Career and Technical Education for the 21st Century Act, Pub. L. No. 115–224 (2018).

Sublett, C. (2019). *Time and Place: An Examination of Career and Technical Education Course Taking and Labor Markets across Two High School Cohorts.* ERIC.

Sublett, C., & Griffith, D. (2019). *How Aligned is Career and Technical Education to Local Labor Markets?* Thomas B. Fordham Institute.

Suffren, Q., & Mezera, D. (2018). Aligning State Career and Technical Education Programs with Industry Needs and Priorities. A Playbook for State Policymakers. *Foundation for Excellence in Education (ExcelinEd)*.

Supporting Full Implementation of the Agricultural Education Model. (2021). *The Agricultural Education Magazine*, *94*(2).

Sutton, A. (2017). Preparing for local labor: Curricular stratification across local economies in the United States. *Sociology of Education*, *90*(2), 172–196.

Sweetland, S. R. (1996). Human capital theory: Foundations of a field of inquiry. *Review of Educational Research*, *66*(3), 341–359.

Talbert, B. A., & Balschweid, M. A. (2006). Career Aspiratioins Of Selected FFA Members. *Journal of Agricultural Education*, 67–80. https://doi.org/10.5032/jae.2006.02067

Talbert, B. A., Vaughn, R., Croom, D. B., & Lee, J. S. (2007). *Foundations of agricultural education. Danville, IL*. Professional Educators Publications, Inc.

Thiel, B., & Marx, A. (2019). The Influence of Agriscience Research SAEs on Perceived Self-efficacy of 21st Century Skill Attainment. *Journal of Agricultural Education*, *60*(01). https://doi.org/10.5032/jae.2019.01080

Tocco, B., Davidova, S., & Bailey, A. (2012). *Key issues in agricultural labour markets: A review of major studies and project reports on agriculture and rural labour markets*.

Tolbert, C. M., & Killian, M. S. (1987). *Labor market areas for the United States*. US Department of Agriculture, Economic Research Service, Agriculture and ….

Tongco, M. D. C. (2007). *Purposive sampling as a tool for informant selection*.

Townsend, C., & Carter, R. (1983). The Relationship of Participation in FFA Activities and Leadership, Citizenship, and Cooperation. *Journal of the American Association of Teacher Educators in Agriculture*, *24*(1), 20–25.

Tuttle-Huff, L. L. (2015). *Career Technical Education and Business Collaborating to Meet the Needs of the Economy in Southwest Ohio: Truth or Fallacy?*

United States. Department of Labor. Secretary's Commission on Achieving Necessary Skills. (1991). *What work requires of schools: A SCANS report for America 2000*. Secretary's Commission on Achieving Necessary Skills, US Department of Labor.

U.S. Census Bureau. (2022). *2022 North American Industry Classification System Manual*.

USDA ERS - Ag and Food Sectors and the Economy. (2020). https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/

Van Noy, M., & Cleary, J. (2017). Aligning Higher Education and the Labor Market: Guiding Principles and Open Questions. *New Brunswick, NJ: Rutgers University, School of Management and Labor Relations, Education and Employment Research Center*.

Weeks, K. J., Lawver, R. G., Sorensen, T. J., & Warnick, B. K. (2020). Do Teachers Have the Skills: 21st Century Skills in the Agricultural Education Classroom? *Journal of Agricultural Education*, *61*(4).

Wells, T., Hainline, M. S., Rank, B. D., Sanders, K. W., & Chumbley, S. B. (2021). A Regional Study of the Agricultural Mechanics Knowledge and Skills Needed by School-based Agricultural Education Teachers. *Journal of Agricultural Education*, *62*(2), 148+. Gale Academic OneFile.

Williams, C. C. (2019). *Characteristics of High-Quality Career and Technical Education Teachers* [Ph.D., University of Idaho]. https://www.proquest.com/docview/2271928061/abstract/F2456E5FED8E4CAEPQ/1

Wilson, K., Niewoehner-Green, J., & Rodriguez, M. (2019). What are Employers Looking For? A Content Analysis of Job Postings Targeting Recent Graduates in Agriculture and Natural Resources. *NACTA Journal*, *63*(2).

Wolf, K., Foster, D., & Birkenholz, R. (2010). The Relationship Between Teacher Self-Efficacy and the Professional Development Experiences of Agricultural Education Teachers Candidates. *Journal of Agricultural Education*, *51*(4), 38–48. https://doi.org/10.5032/jae.2010.04038

Wonacott, M. E. (2003). *History and Evolution of Vocational and Career-Technical Education. A Compilation.*

Xu, D., & Trimble, M. (2016). What about certificates? Evidence on the labor market returns to nondegree community college awards in two states. *Educational Evaluation and Policy Analysis*, *38*(2), 272–292.

APPENDICES

APPENDIX A: IRB APPROVAL

PROTOCOLS

FRESNO STATE.

#1347 - Alignment of Agricultural Teacher Experiences, Program Components and Labor Markets

Protocol Information

Review Type	Status	Approval Date	Continuing Review Date
Expedited	**Approved**	**May 26, 2022**	--

Expiration Date	Initial Approval Date	Initial Review Type
May 26, 2032	**May 26, 2022**	**Expedited**

Approval Comment

None

Feedback

General Information

APPENDIX B: SURVEY CONSENT STATEMENT

FRESNO STATE

Jordan College of Agricultural Sciences and Technology

You are being asked to participate in a research study exploring the alignment of teacher experience, program components, and local agriculture industries. Completing the following survey will be the extent of your participation. Participants must be at least 18 years old to engage in this research. Participation in this research is completely voluntary. You have the right to say no. You may change your mind at any time and withdraw. If you have concerns or questions about this study, such as scientific issues, or how to do any part of it, please contact Dr. Steve Rocca through srocca@csufresno.edu or (559) 278-5088 or contact Jonathan Moules through jmoules@mail.fresnostate.edu or (209) 648-6838.

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Fresno State Committee for the Protection of Human Subjects at 559-278-4468 or email cphs@mail.fresnostate.edu. By clicking on the button below, you voluntarily agree to participate in this online survey.

APPENDIX C: QUALTRICS SURVEY

Enter the zip code of your school.

Indicate the FFA Region your school is in.

- Superior
- North Coast
- Central
- San Joaquin
- South Coast
- Southern

How many years have you taught high school agriculture?

How many more years do you intend to teach agriculture?

Age

Indicate what best describes the geographic location of your childhood/adolescent home?

Rural - on a farm

Rural - but not a farm

Suburban

Urban

What is the highest level of education you have obtained?

Associate's Degree

Bachelor's Degree

Master's Degree

Ph.D.

Other

Gender

Male

Female

Decline to answer

Other

Select your ethnicity below.

White or Caucasian

Black or African American

American Indian/Native American or Alaskan Native

Asian

Native Hawaiian or Other Pacific Islander

Other

Decline to Answer

Use the sliders to identify the presence of each pathway during **your individual pre-service training experience**. Examples include but are not are limited to university coursework, work/volunteer experiences, extracurriculars, etc.

Notes: Cumulative total across pathways must total 100%. If the pathway was not present in your pre-service experience, please drag the slider to the left until it says zero.

	No Experience in Pathway	All Experience in Pathway	
	0 10 20 30 40 50	60 70 80 90 100	
Agribusiness Systems			0
Animal Systems			0
Biotechnology Systems			0
Environmental Service Systems			0
Food Products and Processing Systems			0
Natural Resources Systems			0
Plant Systems			0
Power, Structural, Technical Systems			0
Other			0
Total:			**0**

Use the sliders to identify the presence of each pathway during **your individual in-service training experiences**. Examples include but are not limited to professional development, post-bac university coursework, work/volunteer experiences, etc.

Note: **Cumulative total across pathways must total 100%.** If the area was not present in your in-service experience, please drag the slider to the left until it says zero.

No Experience — Much Experience

0 10 20 30 40 50 60 70 80 90 100

Agribusiness Systems	0
Animal Systems	0
Biotechnology Systems	0
Environmental Service Systems	0
Food Products and Processing Systems	0
Natural Resources Systems	0
Plant Systems	0
Power, Structural, Technical Systems	0
Other	0
Total:	**0**

For the question below, please answer as a representative of your entire program. Use the sliders to identify the presence of each pathway within the **curriculum taught by all teachers in your program.**

Notes: **Cumulative total across pathways must total 100%.** If the pathway is not present in the curriculum your program teaches, please drag the slider to the left until it says zero.

	Not Present 0	10	20	30	40	50	60	70	80	90	Highly Present 100	
Agribusiness Systems												0
Animal Systems												0
Biotechnology Systems												0
Environmental Service Systems												0
Food Products and Processing Systems												0
Natural Resources Systems												0
Plant Systems												0
Power, Structural, Technical Systems												0
Other												0
Total:												**0**

For the question below, please answer as a representative of your entire program. Use the sliders to identify the presence of each pathway within the **SAEs supervised by all teachers in your program.**

Note: **Cumulative total across pathways must total 100%.** If the pathway is not present in the SAEs your program supervises, please drag the slider to the left until it says zero.

	Not Present 0 10 20 30 40 50 60 70 80 90 100 Highly Present	
Agribusiness Systems		0
Animal Systems		0
Biotechnology Systems		0
Environmental Service Systems		0
Food Products and Processing Systems		0
Natural Resources Systems		0
Plant Systems		0
Power, Structural, Technical Systems		0
Other		0
Total:		**0**

For the question below, please answer as a representative of your entire program.
Use the sliders to identify the presence of each pathway that are strictly related to the **FFA activities your students participate within entire program.** Examples include but are not limited to Career Development Events, Leadership Development Events, FFA leadership conferences, state and national conventions, community service events, etc.

Note: **Cumulative total across pathways must total 100%.** If the pathway is not present in the FFA activities your students participate in, please drag the slider to the left until it says zero.

	Not Present 0 10 20 30 40 50 60 70 80 90 100 Highly Present	
Agribusiness Systems		0
Animal Systems		0
Biotechnology Systems		0
Environmental Service Systems		0
Food Products and Processing Systems		0
Natural Resources Systems		0
Plant Systems		0
Power, Structural, Technical Systems		0
Other		0
Total:	**0**	

We thank you for your time spent taking this survey.
Your response has been recorded.

APPENDIX D: SURVEY RECRUITMENT EMAILS

1st Survey Recruitment Email

Dear California Agriculture Teacher,

Last week, you received an email inviting you to participate in a project to determine the alignment of the AFNR pathways among teachers' experiences, program components, and agriculture labor markets.

With just 5 to 10 minutes of your time to complete the survey, California Agricultural Education staff will better understand and address the needs of programs and teachers.

All participating teachers will be entered into a drawing to win one of four, twenty-five dollar ($25) gift cards. If you have any questions, please contact us using the information found further down the email. Begin the survey by ${l://SurveyLink?d=CLICKING HERE}. Thank you for your participation!

To participate in the survey click the link below.

Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Sincerely,

Jonathan Moules
(209) 648-6838
jmoules@mail.fresnostate.edu

Dr. Steven Rocca
(559) 999-3170
srocca@csufresno.edu

Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

2nd Survey Recruitment Email

Dear California Ag Teacher,

Over the past month, you have been invited to participate in a survey to investigate how teachers' agriculture experiences align with their program's components. Partaking in this research is valuable to California Agriculture Education.

Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}
Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Please email Jonathan Moules at jmoules@mail.fresnostate.edu with any questions or concerns you may have about this research of the survey. Participating teachers will be entered into a drawing to win one of four $25 gift cards. Thank you for taking time out of your busy schedule to make a difference in the profession.

Regards,

Jonathan Moules
(209) 648-6838
jmoules@mail.fresnostate.edu

Steven Rocca
Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

3rd Survey Recruitment Email

Greetings,

Over the past month, my graduate student, Jonathan Moules, has been leading some impactful research here at Fresno State regarding how teacher experiences, program pathways, and agricultural labor markets align. We are still in need of survey participants. Teachers will be entered into a drawing to win one of four $25 gift cards.

Please email Jonathan Moules at jmoules@mail.fresnostate.edu with any questions or concerns you may have about this research or the survey. Thank you for taking time out of your busy schedule to make a difference in the profession.

Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}
Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Regards,

Jonathan Moules
(209) 648-6838
jmoules@mail.fresnostate.edu

Steve Rocca
Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

4th Survey Recruitment Email

Dear California Agriculture Teacher,

Over the past two months, my graduate advisor and I have been collecting data on teacher backgrounds and their program's agricultural ties. My thesis research focuses on California agriculture teachers, programs, and industry labor markets and their alignment with one another. Gathering your personal and program background may assist California Agricultural Education staff and teachers in better understanding and addressing program needs.

This is your last chance to be entered into a drawing to win one of four, twenty-five dollar ($25) gift cards. If you have any questions, please contact Jonathan Moules using the information found further down the email.

Begin the survey by ${l://SurveyLink?d=CLICKING HERE}. Thank you for your consideration!

Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}
Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Sincerely,

Jonathan Moules
(209) 648-6838
jmoules@mail.fresnostate.edu

Dr. Steven Rocca
(559) 999-3170
srocca@csufresno.edu
Follow the link to opt-out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

5th Survey Recruitment Email

Dear CA Agriculture Teachers,

Thank you all so much for participating in my thesis research. Your responses are of high value in shaping how teachers, programs, and communities align with one another.

As I mentioned four $25 gift cards will be given through a random drawing to those who participated. After assigning all participating teachers a number, a random number generator was used to pick our four names.

Those awardees are:
[Name]
[Name]
[Name]
[Name]

You will be contacted with your gift.

If you are interested in learning more about my thesis research I would be happy to entertain any questions through email (jmoules@mail.fresnostate.edu) or phone (2096486838).

Again, thank you all again!

-Jonathan Moules
Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

APPENDIX E: ANR TO AFNR PATHWAY ALIGNMENT

California Agriculture & Natural Resources CTE Model Standards Descriptions	Agriculture, Food, and Natural Resources Content Standards Descriptions
Agricultural Business In the Agricultural Business pathway, students learn about agricultural business operation and management. Topics include accounting, finance, economics, business organization, marketing, and sales.	**Agribusiness Systems** Encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application, and management of agribusiness systems in AFNR settings.
Agricultural Mechanics The Agricultural Mechanics pathway prepares students for careers related to the construction, operation, and maintenance of equipment used by the agriculture industry. Basic agricultural mechanics topics include skills, safety, woodworking, electrical systems, plumbing, cold metalwork, concrete, and welding technology. Advanced topics, deal with metal fabrication, small engines, agriculture power and technology, and agriculture construction.	**Power Structural, and Technical Systems** Encompasses the study of agricultural equipment, power systems, alternative fuel sources, and precision technology, as well as woodworking, metalworking, welding, and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of power, structural and technical systems in AFNR settings.
Agriscience* The Agriscience pathway helps students acquire a broad understanding of a variety of agricultural areas, develop an awareness of the many career opportunities in agriculture, participate in occupationally relevant experiences, and work cooperatively with a group to develop and expand leadership abilities. Students study California agriculture, agricultural business, agricultural technologies, natural resources, and animal, plant, and soil sciences. *UCCI Courses Included	**Biotechnology Systems** Encompasses the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food, and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of biotechnology systems in AFNR settings. **Food Products and Processing Systems** Encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry, and human

	behavior in local and global food systems; food selection and processing for storage, distribution, and consumption; and the historical and current development of the food industry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of food products and processing systems in AFNR settings.
Animal Science In the Animal Science pathway, students study large, small, and specialty animals. Students explore the necessary elements, such as diet, genetics, habitat, and behavior, to create humane, ecologically, and economically sustainable animal production systems. The pathway includes the study of animal anatomy and physiology, nutrition, reproduction, genetics, health and welfare, animal production, technology, and the management and processing of animal products and by-products.	**Animal Systems** Encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, management, and processing, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses, and/or poultry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of animal systems in AFNR settings.
Forestry and Natural Resources The Forestry and Natural Resources pathway helps students understand the relationships between California's natural resources and the environment. Topics include energy and nutrient cycles, water resources and management, soil conservation, wildlife preservation and management, forest, and fire management, and lumber production. In addition, students study the outdoor recreation industry and multiple-use management.	**Environmental Service Systems** Encompasses the study of systems, instruments, and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of environmental service systems in AFNR settings. **Natural Resource Systems** Encompasses the study of the management, protection, enhancement, and improvement of soil, water, wildlife, forests, and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and

	techniques for the development, application, and management of natural resource systems in AFNR settings.
Ornamental Horticulture The Ornamental Horticulture pathway prepares students for careers in the nursery, landscaping, and floral industries. Topics include plant identification, plant physiology, soil science, plant reproduction, nursery production, and floriculture, as well as landscaping design, installation, and maintenance. **Plant and Soil Science** The Plant and Soil Science pathway covers topics such as plant classification, physiology, reproduction, plant breeding, biotechnology, and pathology. In addition, students learn about soil management, water, pests, and equipment, as well as cultural and harvest practices.	**Plant Systems** Encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media, and nutrients, as well as growth and cultural practices through the study of crops, turfgrass, trees, shrubs, and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of plant systems in AFNR settings.

APPENDIX F: NAICS INDUSTRY ALIGNMENT TO AFNR PATHWAYS

AFNR Pathway Assignment of NAICS Industries	
6-Digit Code	NAICS Industry Title
AFNR Pathway – Animal Systems	
112111	Beef Cattle Ranching and Farming
112112	Cattle Feedlots
112120	Dairy Cattle and Milk Production
112130	Dual-Purpose Cattle Ranching and Farming
112210	Hog and Pig Farming
112310	Chicken Egg Production
112320	Broilers and Other Meat Type Chicken Production
112330	Turkey Production
112340	Poultry Hatcheries
112390	Other Poultry Production
112410	Sheep Farming
112420	Goat Farming
112511	Finfish Farming and Fish Hatcheries
112512	Shellfish Farming
112519	Other Aquaculture
112910	Apiculture
112920	Horses and Other Equine Production
112930	Fur-Bearing Animal and Rabbit Production
112990	All Other Animal Production
115210	Support Activities for Animal Production
311111	Dog and Cat Food Manufacturing
311119	Other Animal Food Manufacturing
453910	Pet and Pet Supplies Stores
541940	Veterinary Services
712130	Zoos and Botanical Gardens
812910	Pet Care (except Veterinary) Services
AFNR Pathway – Agribusiness Systems	
115115	Farm Labor Contractors and Crew Leaders
323111	Commercial Printing (except Screen and Books)
323113	Commercial Screen Printing
423110	Automobile and Other Motor Vehicle Merchant Wholesalers
423310	Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers
423490	Other Professional Equipment and Supplies Merchant Wholesalers
423820	Farm and Garden Machinery and Equipment Merchant Wholesalers
423830	Industrial Machinery and Equipment Merchant Wholesalers
423840	Industrial Supplies Merchant Wholesalers
423990	Other Miscellaneous Durable Goods Merchant Wholesalers
424420	Packaged Frozen Food Merchant Wholesalers
424430	Dairy Product (except Dried or Canned) Merchant Wholesalers
424440	Poultry and Poultry Product Merchant Wholesalers
424450	Confectionery Merchant Wholesalers

424460	Fish and Seafood Merchant Wholesalers
424470	Meat and Meat Product Merchant Wholesalers
424480	Fresh Fruit and Vegetable Merchant Wholesalers
424490	Other Grocery and Related Products Merchant Wholesalers
424510	Grain and Field Bean Merchant Wholesalers
424520	Livestock Merchant Wholesalers
424590	Other Farm Product Raw Material Merchant Wholesalers
424810	Beer and Ale Merchant Wholesalers
424820	Wine and Distilled Alcoholic Beverage Merchant Wholesalers
424910	Farm Supplies Merchant Wholesalers
424930	Flower, Nursery Stock, and Florists' Supplies Merchant Wholesalers
424990	Other Miscellaneous Nondurable Goods Merchant Wholesalers
444190	Other Building Material Dealers
444210	Outdoor Power Equipment Stores
444220	Nursery, Garden Center, and Farm Supply Stores
445210	Meat Markets
445220	Fish and Seafood Markets
445230	Fruit and Vegetable Markets
493130	Farm Product Warehousing and Storage
493190	Other Warehousing and Storage
511120	Periodical Publishers
522292	Real Estate Credit
522293	International Trade Financing
522294	Secondary Market Financing
524126	Direct Property and Casualty Insurance Carriers
524128	Other Direct Insurance (except Life, Health, and Medical) Carriers
531190	Lessors of Other Real Estate Property
532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing
532490	Other Commercial and Industrial Machinery and Equipment Rental and Leasing
541990	All Other Professional, Scientific, and Technical Services
926140	Regulation of Agricultural Marketing and Commodities
AFNR Pathway – Agribusiness Systems	
325180	Other Basic Inorganic Chemical Manufacturing
325193	Ethyl Alcohol Manufacturing
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing
325199	All Other Basic Organic Chemical Manufacturing
325311	Nitrogenous Fertilizer Manufacturing
325312	Phosphatic Fertilizer Manufacturing
325314	Fertilizer (Mixing Only) Manufacturing
325320	Pesticide and Other Agricultural Chemical Manufacturing
325411	Medicinal and Botanical Manufacturing

325412	Pharmaceutical Preparation Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing
541380	Testing Laboratories
541690	Other Scientific and Technical Consulting Services
541713	Research and Development in Nanotechnology
541714	Research and Development in Biotechnology (except Nanobiotechnology)
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)
621511	Medical Laboratories
AFNR Pathway – Environmental Service Systems	
221111	Hydroelectric Power Generation
221112	Fossil Fuel Electric Power Generation
221113	Nuclear Electric Power Generation
221114	Solar Electric Power Generation
221115	Wind Electric Power Generation
221116	Geothermal Electric Power Generation
221117	Biomass Electric Power Generation
221118	Other Electric Power Generation
221121	Electric Bulk Power Transmission and Control
221122	Electric Power Distribution
221210	Natural Gas Distribution
221310	Water Supply and Irrigation Systems
221320	Sewage Treatment Facilities
541330	Engineering Services
541620	Environmental Consulting Services
562211	Hazardous Waste Treatment and Disposal
562212	Solid Waste Landfill
562213	Solid Waste Combustors and Incinerators
562219	Other Nonhazardous Waste Treatment and Disposal
562910	Remediation Services
562998	All Other Miscellaneous Waste Management Services
813312	Environment, Conservation and Wildlife Organizations
924110	Administration of Air and Water Resource and Solid Waste Management Programs
924120	Administration of Conservation Programs
AFNR Pathway – Food Products and Processing Systems	
311211	Flour Milling
311212	Rice Milling
311213	Malt Manufacturing
311221	Wet Corn Milling
311224	Soybean and Other Oilseed Processing

311225	Fats and Oils Refining and Blending
311230	Breakfast Cereal Manufacturing
311313	Beet Sugar Manufacturing
311314	Cane Sugar Manufacturing
311340	Nonchocolate Confectionery Manufacturing
311351	Chocolate and Confectionery Manufacturing from Cacao Beans
311352	Confectionery Manufacturing from Purchased Chocolate
311411	Frozen Fruit, Juice, and Vegetable Manufacturing
311412	Frozen Specialty Food Manufacturing
311421	Fruit and Vegetable Canning
311422	Specialty Canning
311423	Dried and Dehydrated Food Manufacturing
311511	Fluid Milk Manufacturing
311512	Creamery Butter Manufacturing
311513	Cheese Manufacturing
311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing
311520	Ice Cream and Frozen Dessert Manufacturing
311611	Animal (except Poultry) Slaughtering
311612	Meat Processed from Carcasses
311613	Rendering and Meat Byproduct Processing
311615	Poultry Processing
311710	Seafood Product Preparation and Packaging
311812	Commercial Bakeries
311813	Frozen Cakes, Pies, and Other Pastries Manufacturing
311821	Cookie and Cracker Manufacturing
311824	Dry Pasta, Dough, and Flour Mixes Manufacturing from Purchased Flour
311830	Tortilla Manufacturing
311911	Roasted Nuts and Peanut Butter Manufacturing
311919	Other Snack Food Manufacturing
311920	Coffee and Tea Manufacturing
311930	Flavoring Syrup and Concentrate Manufacturing
311941	Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing
311942	Spice and Extract Manufacturing
311991	Perishable Prepared Food Manufacturing
311999	All Other Miscellaneous Food Manufacturing
312111	Soft Drink Manufacturing
312112	Bottled Water Manufacturing
312113	Ice Manufacturing
312120	Breweries
312130	Wineries
312140	Distilleries

AFNR Pathway – Natural Resources Systems

113110	Timber Tract Operations

113210	Forest Nurseries and Gathering of Forest Products
113310	Logging
114111	Finfish Fishing
114112	Shellfish Fishing
114119	Other Marine Fishing
114210	Hunting and Trapping
115310	Support Activities for Forestry
211120	Crude Petroleum Extraction
211130	Natural Gas Extraction
212111	Bituminous Coal and Lignite Surface Mining
212112	Bituminous Coal Underground Mining
212113	Anthracite Mining
212210	Iron Ore Mining
212221	Gold Ore Mining
212222	Silver Ore Mining
212230	Copper, Nickel, Lead, and Zinc Mining
212291	Uranium-Radium-Vanadium Ore Mining
212299	All Other Metal Ore Mining
212311	Dimension Stone Mining and Quarrying
212312	Crushed and Broken Limestone Mining and Quarrying
212313	Crushed and Broken Granite Mining and Quarrying
212319	Other Crushed and Broken Stone Mining and Quarrying
212321	Construction Sand and Gravel Mining
212322	Industrial Sand Mining
212324	Kaolin and Ball Clay Mining
212325	Clay and Ceramic and Refractory Minerals Mining
212391	Potash, Soda, and Borate Mineral Mining
212392	Phosphate Rock Mining
212393	Other Chemical and Fertilizer Mineral Mining
212399	All Other Nonmetallic Mineral Mining
213112	Support Activities for Oil and Gas Operations
213113	Support Activities for Coal Mining
213114	Support Activities for Metal Mining
213115	Support Activities for Nonmetallic Minerals (except Fuels) Mining
321113	Sawmills
712190	Nature Parks and Other Similar Institutions
813312	Environment, Conservation and Wildlife Organizations
924120	Administration of Conservation Programs
AFNR Pathway – Plant Systems	
111110	Soybean Farming
111120	Oilseed (except Soybean) Farming
111130	Dry Pea and Bean Farming
111140	Wheat Farming
111150	Corn Farming

111160	Rice Farming
111191	Oilseed and Grain Combination Farming
111199	All Other Grain Farming
111211	Potato Farming
111219	Other Vegetable (except Potato) and Melon Farming
111310	Orange Groves
111320	Citrus (except Orange) Groves
111331	Apple Orchards
111332	Grape Vineyards
111333	Strawberry Farming
111334	Berry (except Strawberry) Farming
111335	Tree Nut Farming
111336	Fruit and Tree Nut Combination Farming
111339	Other Noncitrus Fruit Farming
111411	Mushroom Production
111419	Other Food Crops Grown Under Cover
111421	Nursery and Tree Production
111422	Floriculture Production
111910	Tobacco Farming
111920	Cotton Farming
111930	Sugarcane Farming
111940	Hay Farming
111991	Sugar Beet Farming
111992	Peanut Farming
111998	All Other Miscellaneous Crop Farming
115111	Cotton Ginning
115112	Soil Preparation, Planting, and Cultivating
115113	Crop Harvesting, Primarily by Machine
115114	Postharvest Crop Activities (except Cotton Ginning)
115116	Farm Management Services
453110	Florists
541320	Landscape Architectural Services
561730	Landscaping Services
712130	Zoos and Botanical Gardens
AFNR Pathway – Power, Structural, and Technical Systems	
236210	Industrial Building Construction
236220	Commercial and Institutional Building Construction
237110	Water and Sewer Line and Related Structures Construction
237120	Oil and Gas Pipeline and Related Structures Construction
321912	Cut Stock, Resawing Lumber, and Planing
321999	All Other Miscellaneous Wood Product Manufacturing
327410	Lime Manufacturing
327420	Gypsum Product Manufacturing
327999	All Other Miscellaneous Nonmetallic Mineral Product Manufacturing

331110	Iron and Steel Mills and Ferroalloy Manufacturing
332215	Metal Kitchen Cookware, Utensil, Cutlery, and Flatware (except Precious) Manufacturing
332216	Saw Blade and Handtool Manufacturing
332311	Prefabricated Metal Building and Component Manufacturing
332323	Ornamental and Architectural Metal Work Manufacturing
333111	Farm Machinery and Equipment Manufacturing
333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing
333120	Construction Machinery Manufacturing
333241	Food Product Machinery Manufacturing
333243	Sawmill, Woodworking, and Paper Machinery Manufacturing
333249	Other Industrial Machinery Manufacturing
333318	Other Commercial and Service Industry Machinery Manufacturing
333515	Cutting Tool and Machine Tool Accessory Manufacturing
333922	Conveyor and Conveying Equipment Manufacturing
339999	All Other Miscellaneous Manufacturing
541330	Engineering Services
541360	Geophysical Surveying and Mapping Services
541370	Surveying and Mapping (except Geophysical) Services
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
811411	Home and Garden Equipment Repair and Maintenance
AFNR Pathway – Other Agriculture	
484220	Specialized Freight (except Used Goods) Trucking, Local
484230	Specialized Freight (except Used Goods) Trucking, Long-Distance
487110	Scenic and Sightseeing Transportation, Land
493120	Refrigerated Warehousing and Storage
561920	Convention and Trade Show Organizers
561990	All Other Support Services
711310	Promoters of Performing Arts, Sports, and Similar Events with Facilities
711320	Promoters of Performing Arts, Sports, and Similar Events without Facilities
713990	All Other Amusement and Recreation Industries
721214	Recreational and Vacation Camps (except Campgrounds)
813319	Other Social Advocacy Organizations
813410	Civic and Social Organizations
813910	Business Associations
813920	Professional Organizations

APPENDIX G: COMMUTING ZONES BY COUNTY

Commuting Zones by County

FIPS	Commuting Zone	County	State
6001	58	Alameda County	CA
6013	58	Contra Costa County	CA
6041	58	Marin County	CA
6055	58	Napa County	CA
6075	58	San Francisco City County	CA
6081	58	San Mateo County	CA
6095	58	Solano County	CA
6097	58	Sonoma County	CA
6003	59	Alpine County	CA
6005	59	Amador County	CA
6009	59	Calaveras County	CA
6017	59	El Dorado County	CA
6077	59	San Joaquin County	CA
6007	60	Butte County	CA
6011	60	Colusa County	CA
6021	60	Glenn County	CA
6089	60	Shasta County	CA
6103	60	Tehama County	CA
6015	61	Del Norte County	CA
6019	62	Fresno County	CA
6039	62	Madera County	CA
6043	62	Mariposa County	CA
6047	62	Merced County	CA
6099	62	Stanislaus County	CA
6109	62	Tuolumne County	CA
6023	63	Humboldt County	CA
6105	63	Trinity County	CA
6025	64	Imperial County	CA
6073	64	San Diego County	CA
6027	65	Inyo County	CA
6051	65	Mono County	CA
6029	66	Kern County	CA
6031	66	Kings County	CA
6107	66	Tulare County	CA
6033	67	Lake County	CA
6045	67	Mendocino County	CA
6035	68	Lassen County	CA

6049	68	Modoc County	CA
6093	68	Siskiyou County	CA
6037	69	Los Angeles County	CA
6059	69	Orange County	CA
6065	69	Riverside County	CA
6071	69	San Bernardino County	CA
6111	69	Ventura County	CA
6053	70	Monterey County	CA
6069	70	San Benito County	CA
6085	70	Santa Clara County	CA
6087	70	Santa Cruz County	CA
6057	71	Nevada County	CA
6063	71	Plumas County	CA
6091	71	Sierra County	CA
6061	72	Placer County	CA
6067	72	Sacramento County	CA
6101	72	Sutter County	CA
6113	72	Yolo County	CA
6115	72	Yuba County	CA
6079	73	San Luis Obispo County	CA
6083	73	Santa Barbara County	CA
32510	59	Carson City County	NV
32005	59	Douglas County	NV
32019	59	Lyon County	NV
32029	59	Storey County	NV
32031	59	Washoe County	NV
41015	61	Curry County	OR
41035	68	Klamath County	OR