SECONDARY AGRICULTURE EDUCATORS' PERCEPTIONS OF THE IMPORTANCE AND CAPABILITY OF TEACHING AGRICULTURAL FOOD SCIENCE

by

Krysta Kelso, B.S.

A thesis submitted to the Graduate Council of
Texas State University in partial fulfillment
of the requirements for the degree of
Master of Education
with a Major in Agricultural Education
May 2017

Committee Members:

Douglas Morrish, Chair

Dexter Wakefield

Nathan Bond

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DEDICATION

This thesis is dedicated to my guardian angel and step-mom, Mary Kelso. You were always the rock that kept our family together. Although you have been gone for four years now, I know you are my number one supporter. Thank you for watching over me day in and day out while I completed this milestone in my life. I am saddened that you cannot physically be here to see me fulfill my dream of earning my Master's degree, but I know you have the front row seat in heaven. Thank you for the guidance and perseverance throughout my college education. I love you to the moon and back, Momma!

ACKNOWLEDGEMENT

First, I would like to thank my mom and dad for all the encouragement and support over the last six years from my Bachelor's degree at Texas A&M University to my Master's degree at Texas State University. Without your mental support, financial support, love, and encouragement through the past years, I would not have been able to fulfill my accomplishments in furthering my education. Thank you, Dad, for always pushing me to be my best and setting a good example for your daughters. Mom, thank you again for always answering the phone when I needed to talk about school and my troubles; I do not know where I would be without you two, I love you very much!

Thank you to my sisters, Ashton and Kassidy. You have been a helping hand throughout my educational career. Ashton, I appreciate all of the 'pep talks' and encouraging words along the way. Thank you for always being an amazing role model as my big sister and friend. Kassidy, thank you for always believing in me and keeping the family strong during our difficult times; I love you guys!

Cody, thank you for your love and support throughout these past few years, Graduate school would have been a little more challenging without you. You have been my rock, and I appreciate that!

This whole experience would not have been possible without the support and encouragement from my committee members: Dr. Douglas Morrish, Dr. Dexter Wakefield, and Dr. Nathan Bond. You have all made this experience challenging but unforgettable. Thank you for being great mentors, for your endless patience and believing

in me throughout my time at Texas State University.

I also would like to acknowledge all the graduates and undergraduate's students and friends who have played an important role in my success here at Texas State University. I have met a lot of people and gained many friendships I will never forget. A special thank you goes out to the girls who have kept me going throughout the past two years: Bridget McIntosh, Robin Coombs, and Rosalie Kelley. Thank you for the endless hours of encouragement and support. Without you, my time at Texas State University would not have been the same. I wish you all success in your endeavors and hope to keep in touch!

Lastly, I want like to thank the Lord, our savior, Jesus Christ for the strength, opportunities, and doors that have opened over the last two years. I want to thank Him for allowing me to complete this milestone in my life. Without Him, graduate school would not be possible. I will always walk through his guidance in the next steps of life that I take.

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ABSTRACT

Throughout the last decade, numerous research reports have highlighted the importance of food science and its critical role in maintaining the nation's food supply (Marsh & Bugusu, 2007). Though this is an important trend across the nation, Food and Meat Science is not mandated as a curriculum in secondary education. It is, however, discussed as a set of skills taught through certain classes in the state of Texas agricultural science courses. In 2016, the Texas Education Agency introduced a new certification domain known as "Food Science and Processing." The problem is that a pre-service teacher is not required to complete a food science course. The courses that are offered in meat and/or food science are voluntary. Therefore, students who are studying to obtain an agricultural teaching certification are not well trained in areas of food science. In this study the researchers sought to identify the importance and ability levels perceived by agriculture educators of selected skills associated with Food Science. The following research objectives were used to fulfill the purpose of this study: (1) to describe the demographic characteristics of participating agriculture educators, (2) to describe the importance of selected agriculture food science content areas as perceived by secondary educators, (3) to describe the perceived capability of secondary agricultural educators to teach agricultural food science content areas, and (4) to determine the discrepancy between the importance of agricultural food science content areas and the capability to teach agricultural food science areas as perceived by secondary agriculture educators.

Results from the research indicated that a majority of the agricultural educators needed professional development in all six Food Science constructs. Most importantly, the research found that professional development was highly needed in the Hazard Analysis Critical Control Point (HACCP) construct.

I. INTRODUCTION

This quantitative research study examined secondary agriculture educators' perception of and the importance and capability of teaching agricultural food science. The study draws upon scholarship in four fields: the history of agricultural education in the United States, self-efficacy of educators, the professional development of educators, and the history of agricultural education in Texas. The study's conceptual framework is based on the Borich Needs Assessment Model.

Statement of the Problem

Previous scholarship has established the importance of agriculture and food science and its' role in maintaining the nation's food supply (Marsh & Bugusu, 2007). Society has changed from once rural production agriculture to a faster paced, technological entity. Accordingly, food science is a top priority when determining better ways to improve prevention and food safety (Tarrant, 1998). These issues are taught in schools in Texas, specifically, in agricultural science courses. Though this is an important trend across the nation, food and meat science is not mandated as a curriculum in secondary education. Although meat science is not a mandated course the concepts and skills associated with food science are taught in these three courses: Food Processing and Safety, Food Technology, and Advanced Animal Science.

The content of these three courses changes quickly. When students enroll in these courses, they may receive misinformation due to the educators' lack of curricular base of knowledge. Many students do not find out about the opportunities and careers related to food science until later on in their collegiate years due to agricultural educators not informing their students (Miller, 1993).

Professional development is one of many ways to improving school programs (Koundinya & Martin, 2010). Educators who are lifelong learners can engage in various forms of professional development, such as taking college courses, correspondence courses, self-learning experiences, in-service, seminars, workshops, etc. (Layfield & Dobbins, 2002). Teachers can sharpen their understanding of topics in agricultural education by attending professional development events. Barrick, Ladewig, and Hedges (1983) stated that regardless of certification method, all agriculture educators have a continuing desire and need for professional development to ensure their skills are current. Although there is a lack of professional development in the food science industry, it is still essential for agriculture science teachers to understand proper food education. Agriculture science teachers must have the necessary understanding to teach food science because food is a product of agriculture (Koundinya & Martin, 2010).

Texas Educators Certification for Agricultural, Food and Natural Resources 6-12 exam, added a new domain for newly certified teachers as of the 2017 school year. The new domain is labeled as ‘Food Science and Processing’ (Texas Education Agency, 2016). This will only accompany the knowledge and skills needed to be successful at educating students in the subject of food science. The domain explains that a beginning teacher must understand the processing, packaging, quality, and marketing of food and its by-products. Because this information was added to the required curriculum in 2017, agricultural educators who are currently in the field will need professional development for this domain. Including these topics in the courses of the teacher preparation program is a way to teach new teacher entering the field about the new domain.

Purpose of Study

The purpose of this study was to describe secondary agriculture educators' perceptions of the importance of, and their ability to teach selected agricultural food science skills in a formal secondary education setting.

Research Objectives

The following objectives were identified to fulfill the purpose of this study

1. Describe the demographic characteristics of participating agriculture educators in Texas.
2. Describe the importance of selected agricultural food science content areas as perceived by secondary educators in Texas.
3. Describe the perceived capability of secondary agriculture educators in Texas to teach agricultural food science content areas.
4. Determine the discrepancy between the importance of agricultural food science content areas and the capability to teach agricultural food science areas as perceived by secondary agriculture educators.

Keywords

For the purpose of the study, the following terms were defined:

Supervised Agriculture Experience (SAE): The Supervised Agricultural Experience Program is education. It is hands-on, real-life agricultural career preparation experiences tied to agricultural science curriculum, student aptitudes, interests, career, and educational goals and to the agricultural industry. It ties together the entire agricultural education experience. Each agricultural education should have an SAE that is documented in an approved record book (Texas FFA Organization, 2015).

National FFA Organization (FFA): FFA is an extracurricular student organization for those interested in agriculture and leadership. It is one of three components of agricultural education (National FFA Organization, 2015).

Vocational Agriculture Teachers Association of Texas (VATAT): The VATAT is a professional organization for agriculture science teachers and supporters that informs members about the latest agricultural education practices, encourages higher standards of teaching and provides a unified voice in the state legislature (VATAT, 2016).

Agriculture Education: The program is part of a three-part model of education that consists of classroom instruction, supervised agricultural experiences and the FFA. Classroom agricultural education is applied to hands-on learning opportunities called supervised agricultural experiences (SAEs). SAEs include activities such as starting a business, working for an established company or working in production agriculture (Texas FFA Organization, 2015).

Food Science: Food Science can be defined as the application of the basic sciences of engineering to study the fundamental physical, chemical, and biochemical nature of foods and the principles of food processing (Potter & Hotchkiss, 2012).

Professional Development: Any structured program of activities or interactions that can increase teachers' knowledge and skills, improve their teaching practice, and contribute to their personal, social, and emotional growth (Desimone, 2011).

What is: What is are the measured behaviors, skills, and competencies of trainees (Borich, 1980).

What should be: What should be are the goals of the training program (Borich, 1980).

Mean Weighted Discrepancy Score (MWDS): Mean Weighted Discrepancy Score is calculated to find the highest need of professional development from importance/ability rating of certain competencies (McKim & Saucier, 2011).

Fabrication: Fabrication is breaking down of a carcass from whole quarters into primal and sub primal cuts (Savell & Smith, 2009).

USDA Grading System: A quality grade is a composite evaluation of factors that affect palatability of meat (tenderness, juiciness, and flavor). These factors include carcass maturity, firmness, texture, and color of lean, and the amount and distribution of marbling within the lean. Beef carcass quality grading is based on (1) degree of marbling and (2) degree of maturity. Yield grading is the estimated amount of boneless, closely trimmed retail cuts from the high-value part of the carcass (Goodson, Hale, & Savell, 2013).

Packaging System: The meat packaging system is a system to ensure each package of meat is packaged correctly and delivered to any company so that customers get fresh products. Packing fresh products is carried out to avoid any type of contamination or spoilage to the meat (Kerry, O'grady, Hogan, 2006).

Hazard Analysis Critical Control Points (HACCP): HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product (United States Food and Drug Administration, 2014)

II. REVIEW OF LITERATURE

The focus of this study was to examine secondary agriculture educators' perception of the importance and capability of teaching agricultural food science. A detailed understanding of the history of agricultural education in the United States was deemed necessary to understand fully how important professional development and self-efficacy is when teaching agriculture food science. This chapter examined the historical perceptions of agriculture teachers, the importance of self-efficacy, and the importance of professional development when teaching food science courses. The conceptual framework that shaped this research was based on the Borich Needs Assessment Model.

Theoretical Framework

Borich Needs Assessment Model

In today's changing educational system, agriculture educators are expected to teach a more diversified student body and incorporate a more innovated technology in the curriculum. In-service training programs are one of a few ways educators can be equipped with the knowledge and skills needed to successfully meet the demands of ever changing curriculum in the classroom (David & Jayaratne, 2015). In order to plan a successful in-service training for all educators, identifying training needs is crucial (David & Jayaratne, 2015). One way of completing this is setting up a Borich Needs Assessment Model. Borich (1980) stated, "A training need can be defined as a discrepancy between an educational goal and trainee performance in relation to this goal" (p. 39). Among needs assessment models, Borich Needs Assessment Model is the most common and widely used in agricultural education today (Zarafshani & Hossein, 2008). Borich created this model with intentions to allow scholars to collect data that can be weighted and ranked in order of priority (Layfield & Dobbins, 2000). The Borich Needs Assessment Model measures the agriculture educator's perceived level of importance and perceived level of accomplishment through mean weighted discrepancy score (Lester, 2012). Two polar positions of *what is* and *what should be* are training needs that can be conceptualized as a discrepancy analysis (Borich, 1980). Borich (1980) defines what is as measured behaviors, skills, and competencies, and what should be is explained as the goals of the training program. The difference between these two positions can be used as a guide to measure the overall effectiveness of the training program (Borich, 1980). In order to implement the Borich Needs Assessment Model, five steps need to be followed.

1. List the chosen competencies.
2. Administer a survey using a questionnaire.
3. Rank the competencies based on the ratings collected from the questionnaire.
4. Compare the high priority competencies to the professional development opportunity.
5. Emphasize the focus training program content to match the highest priority competencies.

The Borich Needs Assessment Model can be applied to many studies within a variety of institutions. The model is easily adapted to teacher educators who have limited resources but need immediate feedback (Borich, 1980). A significant characteristic of this model is it's reliance on participants to judge their own performance (Zarafshani & Hossein, 2008).

History of Teacher Education in Agriculture

Agricultural education has been taught formally and informally for many years.

Agricultural education dates back to the 16th century. The book, *The Rise of the High School in Massachusetts* (1911), states that in the year 1647, towns that contained 50 households were required to hire one school master to teach all students reading and writing. Towns with 100 households were required to set up grammar schools to prepare boys for the universities. As soon as schools were formed, the need for agricultural education emerged. In 1785, Thomas Jefferson proposed adding agriculture to the school curriculum. As a result, the gender public started to adapt agriculture in their everyday life.

From 1825 to 1850, several schools introduced courses directly related to agriculture. As the public-school movement gained momentum in the 1830s, agriculture education also rose in popularity. Between 1830 and 1860, agricultural education was the most prominent rural issue of the period, especially in the North (Spielmaker, 2005). Historians hold differing views to explain the inclusion of agriculture education in teacher preparation. Most agriculture educators agree that the legislation that was passed provided a framework for agricultural education (Campbell, 1995). Before the passage of these laws, the only students who were able to attend college in America were from upper class societies. This situation changed once the first Morrill Act in 1862 passed. This act offered land grants for agricultural universities, making it easier for lower and middle class citizens to obtain a college education. The land grant university system established throughout America was one of the most significant pieces of legislation in agriculture related to higher education (Herren & Hillison, 1996). During this era, the business of the day was agriculture. Therefore, the original intent was for the Land Grant College of Agriculture "to teach such branches of learning as are related to agriculture and the mechanical arts in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life (National Research Council, 1995, p.14).

The support continued for the university land grant system with the passage of the Hatch Act of 1887, which created incentives to expand number of agricultural-based programs (Conroy, Dailey, & Shelley-Tolbert, 2000). The Hatch Act of 1887, fifteen states obtained funding to conduct original research investigations, and these experiments directly related to contributing to the establishment and maintenance of a permanent and effective agriculture industry of the United States (1887). Prior to the advancement of the experimental stations, scientists relied heavily on books and agriculture magazines for information about the advancements in agriculture science. After the experimental stations were created, scientists used record books to gather information about agriculture. The records provided two types of information: the content and category of each bulletin that was reported as well as the editorials on the pattern of domestic and foreign agricultural research (Ferleger, 1990). The success of such experimental stations was done by improving relationships with the state's farmers, tailoring research to their needs and having adequately trained scientist to solve problems for the farms (Rosenberg, 1971). Although the Hatch Act implemented experimental stations for scientist and farmers, a large gap developed between the two parties. Many farmers believed that the Hatch Act was noted to use "practical information" this meant that scientists were to examine the farms based on the farmer's specific concerns to his own farm (Knoblauch, Law, & Meyer, 1962).

During this period of much debate, legislators passed the Adams Act in 1906, which not only increased the financial resources for the stations, but due to the specification of “original experiments”, created a control of the expenditures of the funds (Rosenberg, 1964). As the experimental stations began to improve, more productive farmers were quick to make use of the stations. More productive farmers used them as a way to improve their farming techniques. Likewise, less productive farms eventually saw the value of the practices; although they were reluctant to adapt technology they had not cultivated first-hand (Kantor & Whalley, 2014).

In 1914, legislators established the Smith-Lever Act, which officially began the cooperative extension to many farmers and scientists (Huffman & Evenson, 2008). During this time, many advocates called for vocational education for the farmers. It was not until the cotton boll weevil attack on farms in the south that prompted new and improved methods to cotton culture. Due to this amount of success to improved practices, field demonstrations were implemented to farms across the country (Lloyd, 1926). By 1912, the establishment of cooperative demonstration farms had implemented success to the farms in the south. The Smith-Lever of 1914 was the start of vocational education with the help of agriculture educators as extension agents across the United States (Lloyd, 1926).

The history of teacher education in agriculture and its advancement continued with the passage of the Smith-Hughes Act of 1917. From the beginning of the Morrill Act in 1862 to the passage of the Smith-Hughes Act of 1917, there was great interest in agriculture and teaching agriculture. This soon became an issue to find adequately prepared teachers to deliver a curriculum of agriculture (Hillison, 1987). By end of 1916, only fourteen schools received state aid for agriculture teacher preparation programs. The

Smith-Hughes Act of 1917 greatly contributed to the development and advancement of agricultural education (Fravel, 2004). The act provided funding to the development of teacher education programs in agriculture (Croom, 2008). Many questions arose in the early 1900s involving agriculture and teacher education. True (1929) recommended that agriculture experts answer the following questions: What should be done at the college level to prepare teachers who have no experience of teaching? Who is responsible for preparing teachers of agriculture? What is the primary source of teaching agriculture educators? During the same time as, the Smith-Hughes Act of 1917, public interest grew in the teaching of agricultural education in elementary and secondary schools. Historians mark this time as the start of vocational education in both primary and secondary schools (True, 1929). Considering this growing concern of secondary education in agriculture, President Lincoln signed the Land Grant Act in 1862 (National Research Council, 1995), which promoted branches of learning related to agriculture. Senator Justin Morrill advocated for "the liberal and practical education of industrial classes in the several professions of life" (Herren & Hillison, 1996, p. 45). The elementary and secondary schools soon adopted agricultural education as part of the fundamental curriculum. Deans and administration set aside funds and resources to educate teachers in short courses and summer classes (True, 1929). Colleges established a teacher preparation program for teachers' education in agriculture. By 1930, four-year programs of college training became a minimum for regular employment as a teacher. Most colleges developed adequate programs to meet the demand of teachers (Lanthrop & Stimson, 1954), although there were no formal pre-service teacher education programs available in agriculture until the passage the Smith-Hughes Act of 1917 (True, 1929).

Self-Efficacy in Teacher Education

The most successful teachers in education attribute their success to high confidence, belief and positive attitudes. These three factors are the first indicators of how successful a teacher can be (Stripling, Ricketts, Roberts, & Harlin, 2008). Perceived self- efficacy is defined as…

> people's confidence about their capabilities to provide an outcome of designated levels of performance and their ability to perform a task. It is not related to the skills one has, but with the confidence of what one can do with the skills one maintains (Bandura, 1994, p. 2).

Bandura found that self-efficacy beliefs can affect an educator's choice of activity, the effort and performance used on the activity, and the obstacles for overcoming the challenge of the activity (Posnanski, 2002). The four major processes that produce diverse effects of self-efficacy include cognitive, motivational, affective and selection processes (Bandura, 1994). Bandura described social cognitive theory as how people achieve and maintain specific behavior patterns and valued goals. Personal goal setting is determined by the self-assessment of one's capability. A teacher who possesses strong perceived self-efficacy has higher goal-setting challenges and a sturdier commitment in the classroom (Bandura, 1994). In a classroom setting, a teacher with a strong sense of efficacy remains task-oriented in the existence of pressing situational demands, setbacks, and failures (Bandura, 1994). Educators who are self-regulated maintain a high sense of efficacy in their capabilities, which in turn influences the knowledge and skills they obtain for themselves and the commitment to overcome certain challenges (Zimmerman, Bandura, & Martinez-Pons, 1992). Performance accomplishments can payoff when adopting good analytical thinking in the classroom (Bandura, 1994).

Self-efficacy used in the context of teachers and teaching has been labeled as, teacher self-efficacy. Tschannen-Moran and Woolfolk Hoy (2001) described teacher self-efficacy as “a judgment about his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated” (p. 1).

Like the social cognitive theory, teacher efficacy is related to the efforts invested in teaching, goal setting, and the level of aspiration. Teachers with higher efficacy tend to exhibit greater levels of lesson planning and organizational skills. They are open to new ideas and more willing to experiment and teach new methods to better meet the academic needs of their students (Tschannen-Moran & Hoy, 2001). Teachers with greater efficacy believe that unmotivated students are still teachable. This belief is actualized by extra effort and time put in by the teacher as well as school and administrative support (Wolf, Foster, & Birkenholz, 2010). In addition to these characteristics, Tschannen-Moran and Hoy (2001) found that teachers who possess greater efficacy levels:

1. Possess greater enthusiasm for teaching.
2. React more calmly when students produce errors.
3. Obtain greater commitment to teaching and helping students in the classroom.
4. Exert more energy with students who show a sense of confusion or struggle toward a task.

In more recent studies Roberts, Harlin and Ricketts (2006) found student teachers who enter the field of agricultural education have a level of teaching efficacy that is based on their previous coursework, observations, and teaching experience. These researchers showed that teaching efficacy is correlated to a preservice teacher's student teaching experience. Therefore, teachers who have a greater level of preparation in the student teaching period will have a higher level of efficacy (Wolf, Foster, & Birkenholz, 2010). Examining the correlation between perceptions of preparation and teacher self–efficacy, Darling-Hammond, Chung, and Frelow (2002), found that the overall rating of teacher preparedness related significantly to the sense of efficacy. This was depended upon whether they were able to make a difference in student learning.

Importance of Professional Development

Teachers' professional development needs are continuously changing due to the increase in innovative technology and new developments in agriculture, food, fiber, and natural resource industry. Therefore, it is important to evaluate professional development often (Washburn, King, Garton, & Harbstreit, 2001). Saucier (2010) also stated that often times, local schools and school districts address the opportunity for professional development due to the ongoing learning opportunities, especially for agriculture educators. Research has shown with the continuing change in education, agriculture educators should continue professional development to balance the changes in environment, contractual obligations, and teaching ability (Lester, 2012). Effective professional development is essential when determining the satisfactory level for teachers as well as their schools.

An important method to address the lack of competency in teachers is professional development (Maultsby, 1997). With the changes of curriculum competencies and the demands of technology, a career as an agriculture educator cannot be based off a four-year educational preparation (Saucier, 2010). Cook and Fine (1996) agree with the statement above and further explain:

> Professional development is a key tool that keeps teachers abreast of current issues in education, helps them implement innovations, and refines their practice. It must enrich teaching, improve learning, support teacher development, be ongoing and long term, be job embedded and inquiry based, support current beliefs about teaching and learning, be clearly related to reform efforts, be modeled after learning experiences considered valuable for adults, and support systematic change. (p. 1).

Most professional development programs have a common quality that provides teachers with many learning opportunities (Cook & Fine, 1996; Maultsby, 1997; Saucier, 2010). These include:

1. A willingness to explore new roles.
2. A demonstration communication, teamwork, and cooperation to be a successful educator.
3. An interest in using new instructional techniques.
4. An understanding of the technology used for career development.
5. The creation of activities and exercises to broaden the knowledge of their students about career development theories.
6. An increased understanding of themselves both as an educator and an individual.

Layfield and Dobbins (2002) determined that a critical factor of addressing professional development and developing successful teachers is correctly identifying the needs that are in the greatest demands. To correctly identify the need for professional development, a gathering of data from a possible trainee can be conducted. After analyzing the data, a potential educational program can be implemented (Layfield & Dobbins, 2002). Educators can accomplish this process by adhering to the process of the Borich Needs Assessment Model (Briers & Edwards, 1998). Touchstone (2015), in her study on professional development needs of beginning educators, found that skills and knowledge were the highest concern of beginning teachers. By identifying the challenges facing beginning agriculture educators, a program can be developed appropriately for professional development to assist in preparing new teachers for a successful transition into the classroom (Touchstone, 2015). To accomplish this goal, educational programs should respond to educator's current need in and out of the classroom over time (Saucier, 2010). Saucier (2010) found that teachers who have received ample amounts of professional development (continued education) have a higher self-efficacy level and do the best job possible at teaching their curriculum. Teachers who gain the most from their professional development programs feel committed to positively changing their teaching practices for the better of their classroom. Furthermore, when teachers set their own learning experiences and develop a more student-centered learning environment in the classroom, a more positive learning environment occurs (Park, Moore, & Rivera, 2007).

In a more recent study, Roberts, Rodriguez, Gouldthorpe, Stedman, Harder, and Hartmann (2016) found that teachers who experienced some type of professional development over time in their teaching career expressed a positive change in attitude, aspiration, knowledge, and behavior. This experience enhanced teachers' desire to work in multidisciplinary teams. Engaging in teams is beneficial when working together to address the issue of professional development needs. These findings are aligned with the Theory of Adult Learning (Knowles, Holton III, & Swanson, 2014), which addresses the reason why adults need to know why they need to learn something, specifically, to become more motivated when they see a need to learn something. Additionally, the theory stated that adults should be involved in the planning process of their own learning experience. Therefore, adults should formulate learning goals, experience new information, engage in problem-solving situations relevant to their needs, and identify topics of value (Saucier, 2010).

In previous years, school and district administrators have arranged and provided content for in-service training with little input directly from the teachers (Ingersoll, 1976). Teachers must be consulted when deciding on which topic to study during professional development opportunities (Wilson, 1974). In order for all professional development to be beneficial, surveys or questionnaires should be sent out to encourage attendance and provide adequate material needed for the program (Maultsby, 1997). Eventually changes in teachers' attitude, professionalism, and instruction will positively change early in their teaching career due to the knowledge and availability of professional development programs within the district (Saucier, 2010).

Agricultural Education in Texas

Agricultural education has a long history in Texas schools. Many changes have occurred in agricultural education since the passage of the Smith-Hughes Act in 1917. Historically, agricultural education first began as four different courses: Vocational Agriculture (VA) I, II, III, IV (Norris & Briers, 1988). The four classes were elective courses in which student enrolled for the entire year. These courses focused mainly on production usage in agriculture. The courses curriculum was also taught in sequential order. Therefore, what was taught in Vocational Agricultural I is progressively advanced toward VA II, III, and IV (Pate, 1981). While students were enrolled in one of the four classes, they were provided additional training through the supervised occupational experience program (SOEP), which required students to own or manage a plant or animal project or work on a ranch. Through these SOE programs, students applied the knowledge they had learned to 'real-world applications' (Pate, 1981). During the mid-1980's, agricultural educators in Texas began to restructure the Vocational Education courses. During the restructuring process, Vocational Agricultural I, II, III, and IV allowed for semester courses, which made it possible for students to specialize in one area of agriculture (Norris & Briers, 1988). The new semester-long courses, gave students a chance to specialize in one subject or gain experience in many different subjects in agricultural education. The change in classes soon went from strictly production agriculture to an increase in agribusiness and emerging technology in agriculture (Norris & Briers, 1988).

Today, agricultural education continues to provide students with classes that are categorized by semester. However, the classroom model has significantly changed from the original categories. Agriculture educators today provide students with an opportunity to participate in an organization called the FFA, which is a student-led leadership development organization strives to change lives and prepare students for premier leadership, career success, and personal growth. FFA was originally knows for Future Farmers of America, a term which was used from 1944 to 1988 (Official FFA Manual, p.18). The organization is now known as the National FFA organization. The name was changed to direct attention away from a perception of farming and ranching to one that captures the essence of agriculture in today's modern world. Members of FFA are prepared for more than 300 careers, including agricultural science, technology development, marketing, engineering, production agriculture, horticulture, forestry, accounting, wildlife management, and mechanics.

The Texas FFA consists of a three-part model: the FFA, agricultural instruction, and supervised agricultural experience. FFA is not viewed as an extracurricular; it is defined as intracurricular. Classroom instruction is applied through hands-on learning opportunities called supervised agricultural experiences (SAE). Starting a business, internship opportunities, or working in production agriculture are all activities of an SAE. The FFA is the third part in the three-part model. FFA activities in the chapter are based upon well-integrated curriculum. FFA activities and programs focus on the areas of the FFA mission; premier leadership, personal growth, and career success (The Official FFA Manual). More specifically, Texas education now provides students with the opportunities to incorporate science, technology, engineering, and mathematics (STEM) in education. In order to meet the needs of the diverse student body in the 21st century, school districts in Texas are looking for ways to implement a new "meta-discipline" that will transform traditional classrooms into problem solving and discovery zones. Implementation of STEM education involves project-based knowledge and inquiry learning in the lesson plan, as

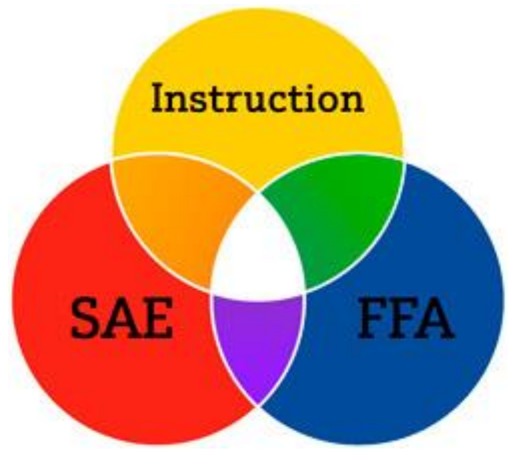

Figure 1. Three-Part Model

opposed to the lecture style teaching (Wooten, Rayfield, & Moore, 2013). Knob stated that a plethora of experiential learning opportunities are available in agricultural education. He claimed, “More education should be occurring outside of the classroom because classrooms are some of the most sterile environments imaginable” [(as cited in Baker & Robinson, 2011, p. 186]. In response to this belief, agriculture educators are encouraging students to participate in Supervised Agriculture Experiments (SAE), much like SOEP, to succeed in STEM areas. In a study, Wooten, Rayfield, and Moore, (2013) found that students who participate in SAE projects learn the highest number of concepts in science.

In recent years, most agriculture educators have focused on scientific problem solving in their teaching, due to the trends of the agriculture industry today. Curriculum materials emphasize more of science-based learning than production agriculture. Johnson, Wardlow, and Franklin (1997) agreed with this approach by stating the most recent change in agricultural education is the increase significance of ‘agriscience’. Hands-on or application-oriented science education is a primary reason why teachers incorporate agricultural education science in their curriculum (Lee, 1994). With the emerging technology in agricultural education, laboratories are an effective way to give students practice in applying of theories taught in the classroom (Shoulders & Myers, 2012). It is advisable to incorporate laboratories throughout the agriculture curriculum due to their important role in the learning process (Warner, Arnold, Jones, & Myers, 2006). Myers (2005) viewed agricultural laboratories as, “learning experiences in which students interact with materials and/or models to observe and understand the nature of agriculture and its underlying biological, physical, and social science components”(p.

14). By providing hands-on laboratory instructions, students are prepared more effectively for scientifically-based careers in agriculture (Shoulders & Myers, 2012).In a research study, Shoulders and Myers (2012) found that teachers who utilize food science laboratories often report positive perception of student learning. Furthermore Johnson, Wardlow, and Franklin (1997) suggested teachers should broaden their hands-on instructional activities in the classroom to enhance student learning outcome and cultivate a positive attitude toward learning.

III. METHODOLOGY

The purpose of this study was to determine how secondary agriculture educators perceive the importance of and their ability to teach selected agricultural food science skills in a formal secondary education setting. This quantitative study utilized a survey research design, which is useful for collecting numerical data to research the importance and ability for food science skills perceived by agriculture educators. An advantage of this design was that it enabled the research to be conducted on a large scale of 1,967 agricultural educators in Texas. The research objectives addressed included:

1. Describe the demographic characteristics of participating agriculture educators in Texas.
2. Describe the importance of selected agricultural food science content areas as perceived by secondary educators in Texas
3. Describe the perceived capability of secondary agriculture educators to teach agricultural food science content areas.
4. Determine the discrepancy between the importance of agricultural food science content areas and the capability to teach agricultural food science areas as perceived by secondary agriculture educators.

Population and Sample

The target population of the study consisted of all 2016-2017 secondary agriculture educators in Texas (N=1967). The researcher obtained the list of teachers from the Vocational Agriculture Teachers Association of Texas (VATAT), which maintains a directory and updates the list each academic year. The researcher followed a census survey approach to collect information about the secondary agriculture educators focusing specifically on teachers who teach one of the three food science courses. To avoid omitting any teachers, the researcher initially sent the survey to every agriculture teacher in the population. The Dillman's *Tailored Design Method for Mail and Internet Surveys* states that the population should to contacted five times during the survey period (Dillman, 2007). The researcher sent an initial contact email which included a cover letter asking for participation in the study and an attached link to Qualtrics software with the questionnaire. The group received up to four reminder emails to all unfinished responses to complete the questionnaire.

Instrumentation

A website (qualtrics.com) distributed the survey five times to agriculture educators in Texas. According to the VATAT directory, 2,064 agriculture educators in Texas were included in the original questionnaire. Due to duplicate emails and bounced emails during the distribution of the survey, the final number of participants who received the email was 1,967. The survey assessed the food science competencies and the related skills from both the Texas Education Agency (TEA) and the Texas Essential Knowledge and Skills (TEKS). On the TEA and the TEKS websites, the researcher selected 38 competencies from the three different classes: Advanced Animal Science, Food Processing, and Food Technology and Safety. Through the selected skills, each agriculture educator selected his/her level of the ability to teach the skill as well as the importance of teaching each skill. If the agriculture educators stated that they did not teach one or more of the three courses, then the surveys were not used. However, the demographic data was used for further research in the study.

To ensure validity of the survey instrument, a panel of experts reviewed it at the beginning of the creation of the survey and the collection of the skills needed for the food science competencies. The experts consisted of two professors in the Department of Agriculture and one professor in the Department of Curriculum and Instruction. Additionally, twenty-one graduate students examined the survey for face validity. Their feedback narrowed the selected skills and the different competencies. The panelists' recommendations included: the survey was visually appealing, it does not look hard to complete, and the layout of the survey was good.

Pilot Test

Prior to distributing the online questionnaire to the population for this study, the researcher conducted a pilot study using a group of (n=30) agriculture educators in Texas. The researcher employed a random stratified sampling method when conducting the pilot test. On October 10, 2016 the researcher selected samples from the VATAT directory of agriculture educators. Three agriculture educators were selected from each of the ten areas, totaling 30 agriculture educators to be surveyed. All 30 participants completed the survey, which took on average 10-15 minutes, and wrote comments or gave suggestions for improving the instrument. Fourteen of the 30 participants completed the pilot survey with a response rate of 46.6%. Using the information and data collected from the experts and pilot test, modifications were made to the online questionnaire. Cronbach's coefficient alphas were calculated to measure internal consistency of the questionnaire. The reliabilities for scales relating to the importance and capability of the skills provided by the agriculture educator ranged from (.75) to (.98). Table 1 lists the Cronbach's α levels for each construct.

Table 1

Cronbach's α for Pilot Questionnaire

Construct Area	Cronbach's α	
	Importance	Ability
General Food Science	.918	.885
Slaughter Process	.958	.952
Fabrication	.890	.951
USDA Beef Grading System	.952	.896
Meat Science	.754	.941
Packaging System	.966	.988
Hazard Analysis and Critical Control Points (HACCP)	.960	.988
Sanitation	.848	.979

Collection of Data

On November 11, 2016, the researcher sent the initial survey through Qualtrics software. The survey included a cover letter to the entire agricultural education population totaling 2,064. Of the 2,064 agriculture educators, the distribution process experienced 85 bounced and twelve duplicate emails, resulting in the population totaling 1,967 teachers. The deadline for the initial survey was set for November 18, 2016. By the deadline, 282 participants had returned their surveys (14.3%). On November 18, the researcher sent follow-up emails along with a survey to those who had not responded. The purpose of the follow-up email was to inform those agriculture educators that the survey was sent out and to request their assistance in completing the survey. The second deadline for the second round of surveys was November 25, 2016. By this deadline, 498 recorded responses from the survey (25.3%) had responded to the survey. On November 25, the researcher sent a third reminder email along with the survey to those who had not responded. The deadline for the third distribution was December 2, 2016. By this deadline, 711 educators (36.1%) had responded. On December 9, the researcher sent a fourth email reminder was sent out to those who had not responded to the survey.

The final deadline for the response rate was set for December 16, 2016. In the end 769 of 1,967 agriculture educators submitted their surveys for a final response rate of 39%.

Data Analysis Overview

The researcher used SPSS 24.0 for Windows software to analyze the data. Descriptive statistics were used to familiarize the reader with the demographics of the agriculture educator. Frequencies, percentages, means, and Mean Weighted Discrepancy Scores (MWDS) were calculated to fully describe the data that was collected by the researcher for both ability and importance.

After inputting all of the information into the SPSS software, the demographic of each agriculture educator was taken into account and put into different tables. The frequencies and percentages were calculated for:

1. Gender
2. Race/ethnicity
3. Number of years of teaching experiences
4. Highest level of degree earned
5. Texas FFA area the where agriculture educator taught

6. Size of the school
7. Geographical location of the school
8. Number of teachers in the agriculture department

These demographic questions were asked to every agriculture educator, no matter their response rate for question number one of the survey. After the demographics were analyzed, the researcher then examined the frequencies, percentages, means, and standard deviation for each importance level and ability to teach level of each of the constructs. After the constructs for each importance level and ability to teach level were analyzed, the Mean Weighted Discrepancy Scores were calculated for each of the 38 competencies, using and Excel MWDS calculator (McKim & Saucier, 2011). An Excel-based Mean Weighted Discrepancy Score calculator was used to calculate the MWDS. The Discrepancy Score (DS) was calculated as the importance score subtracted from the ability score for each competency for each participant. Weighted Discrepancy Score (WDS) was calculated for each respondent on each competency as multiplying the discrepancy score (DS) by the mean importance score for each competency (WDS). Finally, the MWDS was calculated for each competency as taking the sum of the Weight Discrepancy Score (WDS) and dividing it by each competency (MWDS). After calculating the MWDS for each competency, the competencies were ranked. The competency with the highest score was the one with the highest needs and the highest priority of professional development.

IV. FINDINGS AND DISCUSSION

This study investigated how secondary agriculture educators' perceive the importance of, and their ability to teach selected agricultural food science skills in a formal secondary education setting.

The following research objectives were proposed for the study:

1. Describe the demographic characteristics of participating agriculture educators in Texas.
2. Describe the importance of selected agriculture food science content areas as perceived by secondary educators in Texas.
3. Describe the perceived capability of secondary agriculture educators to teach agricultural food science content areas.
4. Determine the discrepancy between the importance of agricultural food science content areas and the capability to teach agricultural food science areas as perceived by secondary agriculture educators.

The research objectives serve as a guide for presenting the findings of this study. Information regarding each question is displayed and presented in separately in the following sections.

Findings Related to Research Question One

During the initial survey, the researcher asked the participants to identify the courses that they teach.

1. Advanced Animal Science
2. Food Technology and Safety
3. Food Processing

4. None of the above

Agriculture educators answered the initial question by selecting one or all three of the courses. However, if the agriculture educators selected none of the above, this meant that they did not teach any of these courses and they were directed to the bottom of the survey to fill out the demographics portion. If the agriculture educator did not teach any of the three courses, it could possibly mean that the educator was not adequately informed to teach the courses. Therefore, the researcher could not use his/her information for the ability to teach or the importance of the topic.

Table 2

Initial Survey Question

Initial Survey Question	
Class Description	*n*
Advanced Animal Science	248
Food Technology and Safety	73
Food Processing	16
None of the Courses	471

Table 2 illustrates the initial research question that was asked to the research population. There were 248 agriculture educators who responded to teaching Advanced Animal Science with 73 teaching Food Technology and Safety and 16 agriculture educators taught Food Processing. However, 471 did not teach any of the three listed classes.

After the initial survey question was asked, agriculture educators responded to the type of food science facilities they had access to, if any at all. Table 3 shows the results of certain laboratory facilities. Fifteen agriculture educators had access to a meat science laboratory and 25 had access to a food technology laboratory. However, over half of the responded population of agriculture educators (*n* = 174) did not have access to any food science laboratory facility.

Table 3

Type of Laboratory Facilities that Agriculture Educators Have Access To

	Laboratory Facilities
Type of Laboratory	*n*
Meat Science Laboratory	15
Food Technology Laboratory	25
No Laboratory Facilities	174

An explanation of the demographics of participants was considered necessary to get a snapshot of the responding population. The methodology consisted of a survey designed to determine the perception of secondary agriculture educators in Texas. As shown in Table 4, two thirds of the participants were males. The sample consisted of 61.9% males and 38.1% females.

Table 4

Gender of Agriculture Educators in Texas (n= 664)

Gender			
Male		Female	
n	(%)	*n*	(%)
411	61.9	253	38.1

The sample consisted of a mixture of Whites, Hispanics, African-Americans, Native Americans, and other. As shown in Table 5, large portions (90.4%) of the agriculture educators were White. Thirty-six agriculture educators (5.3%) were Hispanic. Nine (1.4%) were African-American and 9 were Native American (1.4%). Additionally, 10 agriculture educators (1.5%) marked their ethnicity as other.

Table 5

Ethnicity of Agriculture Educators in Texas

Race/Ethnicity									
White		Hispanic		African-American		Native American/Alaskan		Other	
n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)
600	90.4	36	5.3	9	1.4	9	1.4	10	15

Table 6 displays the number of years each educator has taught in secondary education. Of the 1,967 participants in the study, 249 (37.5%) have taught secondary agriculture for at least 5 years; 106 (16.0%) between 6 to 10 years; 83 (12.5%) for 11 to 15 years; 69 (10.4%) between the years of 16 to 20; 54 (8.1%), between 21 and 25 years; and 46 (6.9%), for 26-30 years. Finally, 57 (7.4%) agriculture educators have taught for more than thirty years.

Table 6

Number of Years Agriculture Educators Have Been Employed in Secondary Education

	Total Number of Years	
Number of Years	*n*	(%)
0-5	249	37.5
6-10	106	16.0
11-15	83	12.5
16-20	69	10.4
21-25	54	8.1
26-30	46	6.9
>30	57	8.6

Table 7 indicates the level of degree earned by the participants in the study. A majority of them (63.0%) have obtained a bachelor's degree, whereas (35.8%) hold a master's degree. Additionally, 8 agriculture educators (1.2%) have earned a doctorate.

Table 7

Highest Level of Degree Earned by Agriculture Educators

Highest Level of Degree					
Bachelor's Degree		Master's Degree		Doctorate	
n	(%)	*n*	(%)	*n*	(%)
418	63.0	238	35.8	8	1.2

The data in Table 8 illustrates the FFA areas where the participants teach. A total of 42 (6.3%) of agriculture educators teach in Area 1; Area 2 had 30 educators (4.5%). However, area 3 had the most participants 130 in the study (19.6%). Area 4 had 35 participants (5.3%); Area 5 (12.8%) consisted of 85 participants; and Area 6 (8.6%) had 57 participants. There were 98 educators, which was the second largest area in the study with a percentage of (14.8%); Area 8 (10.4%) contained 69 participants; area 9 (11.0%) included 73 participants; Area 10 had 45 (6.8%) who participated. Figure two shows the specific FFA areas in the State of Texas, illustrated below.

Table 8

FFA Area of Agriculture Educators in Texas (n= 664)

	FFA Areas	
FFA Area	*n*	(%)
Area 1	42	6.3
Area 2	30	4.5
Area 3	130	19.6
Area 4	35	5.3
Area 5	85	12.8
Area 6	57	8.6
Area 7	98	14.8
Area 8	69	10.4
Area 9	73	11.0
Area 10	45	6.8

Figure 2. Texas FFA Areas

The size of school where the participants taught is illustrated in Table 9. Seventy of them teach at a 1A school district (10.5%). Eighty-five participants (12.8%) teach for a 2A school district; 131 (19.7%) from a 3A school; 119 (17.9%) from a 4A district; 124 (18.7%) from a 5A district; 135 (20.3%) at a 6A district.

Table 9

Size of School of Agriculture Educators in Texas

	School Size	
School Size	*n*	(%)
1A	70	10.5
2A	85	12.8
3A	131	19.7
4A	119	17.9
5A	124	18.7
6A	135	20.3

Along with district size, the researcher assessed the geographic location of each agriculture educator which is shown in Table 10. The highest percentages teach in a rural location area (45.0%) with 299 participants. The suburban location was second in percentage rank (38.1%) with 253 participants. Finally, the lowest of the sample size came from an urban location with 112 agriculture educators (16.9%). According to the United States Census Bureau, by definition, rural area is an area with fewer than 2,500. Suburban is a metropolitan area but outside a central city. A school is considered suburban if a person lives inside a town or outside of the city's outer rim or just outside its official city limits. Urban is an area defined as the population can be greater than 50,000 or more people.

Table 10

Geographic Location of Agriculture Educators in Texas

	Geographic Location	
Location	*n*	(%)
Rural	299	45.0
Suburban	253	38.1
Urban	112	16.9

The last demographic question addressed the number of agriculture educators that at the school. Table 11 shows the number of agriculture educators in each department who participated in the study. There were 116 (17.5%) of participants who taught at a single teacher department. Most of them came from a two-teacher department with 221 participants (33.3%). One hundred ninety-one came from a three-teacher department (28.8%). However, 75 (11.3%) taught at a four-teacher department, and 61 (9.2%) taught at a department who had five or more teachers.

Table 11

Number of Agriculture Educators in a Department

	Number of Teachers in a Department	
Number of Teachers	*n*	(%)
One Teacher	116	17.5
Two Teachers	221	33.3
Three Teachers	191	28.8
Four Teachers	75	11.3
Five or More Teachers	61	9.2

Findings Related to Research Question Two

Research question two focused on the importance of selected agriculture food science content areas as perceived by secondary agriculture educators. The survey assessed the food science competencies and the related skills from both the Texas Education Agency (TEA) and the Texas Essential Knowledge and Skills (TEKS). On the TEA and the TEKS websites, 38 competencies were selected from the three different classes: Advanced Animal Science, Food Processing, and Food Technology and Safety. For the selected skills, each agriculture educator rated his/her level of importance of teaching each skill.

The respondents indicated their perceptions concerning the importance of selected food science content area skills. The items were scored on a five-point Likert-type scale where 1= “no importance,” 2 = “slightly important,” 3 = “moderately important,” 4 = “important,” and 5 = “very important.” The researcher explained the frequencies and means of each of the competencies.

Table 12

Agriculture Educators’ Perceived Importance of General Food Science Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Research environmental issues in food production.	1	.5	8	3.9	39	18.9	111	53.9	47	22.8	3.95	.78
Analyze financial trends in food production.	4	1.9	8	3.9	65	31.6	94	45.6	35	17.0	3.72	.86
Identify major industries and organizations in food production.	3	1.5	5	2.4	41	19.9	106	51.5	51	24.8	3.96	.82
Identify new technology innovations in the food industry.	0	0	2	1.0	33	16.0	109	52.9	62	30.1	4.12	.70

Table 12

Continued
Agriculture Educators' Perceived Importance of General Food Science Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Research regulations for food products in the processing industry.	1	.5	3	1.5	33	16.0	105	51.0	64	31.1	4.11	.75

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 12 shows the five competencies composed in General Food Science. The two competencies that were rated the highest were, i*dentifying new technology and innovation in the food industry* (*M* = 4.12; *SD* =.70) *and research regulations for food products in the processing industry* (*M* = 4.11; *SD* = .75). The lowest rated competency was, *analyze financial trends in food production* (*M* = 3.72; *SD* = .86).

Table 13 illustrates a list of competencies for the slaughter process construct which consisted of six competencies. Of those competencies, *describe the slaughter process* (*M* = 4.33; *SD* = .75), *describe federal and state inspection laws* (*M* = 4.33; *SD* = .72), and *physical components affecting meat quality* (*M* = 4.33; *SD* = .70) were rated among the highest. The lowest competency rated was, *describe the splitting, washing, and cooling process* (*M* = 4.11; *SD* =.76).

Table 13

Agriculture Educators' Perceived Importance of Slaughter Process Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Describe the slaughter process.	1	.5	3	1.5	20	9.7	86	41.7	96	46.6	4.33	.75
Describe the splitting, washing, and cooling process.	0	0	6	2.9	31	15.0	103	50.0	66	32.0	4.11	.76
Describe federal and state inspection laws.	0	0	4	1.9	18	8.7	89	43.2	95	46.1	4.33	.72
Physical components affecting meat quality.	0	0	3	1.5	18	8.7	92	44.7	93	45.1	4.33	.70
Postmortem factors affecting meat quality.	0	0	2	1.0	23	11.2	98	47.6	83	40.3	4.27	.70
Antemortem factors affecting meat quality.	0	0	3	1.5	27	13.1	93	45.1	83	40.3	4.24	.73

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 14

Agriculture Educators' Perceived Importance of Fabrication Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Definition of Fabrication.	1	.5	3	1.5	34	16.5	100	48.5	68	33.0	4.12	.76
Identify wholesale cuts.	1	.5	5	2.4	31	15.0	81	39.3	88	42.7	4.21	.82
Identify all retail cuts.	1	.5	3	1.5	24	11.7	87	42.2	91	44.2	4.28	.76
Determine cuts by species.	1	.5	6	2.9	22	10.7	85	41.3	92	44.7	4.27	.80
Identify SPECS on merchandising products.	3	1.5	8	3.9	38	18.4	104	50.5	53	25.7	3.95	.85

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 14 shows the four different competencies for the fabrication construct. The highest rated competencies were, *identify all retail cuts* (*M* = 4.28; *SD* = .76) and *determine cuts by species* (*M* = 4.27; *SD* = .80). The lowest rated competency was, *identify specifications on merchandising products* (*M* = 3.95; *SD* = .85).

Table 15 lists all four competencies for USDA grading system construct. The three highest rated competencies were, *identify factors associated with quality and yield grades* (*M* = 4.27; *SD* = .74), *definition of USDA quality grading system* (*M* = 4.24; *SD* =

.74), and *define USDA yield grading system* (*M* = 4.24; *SD* = .74). The lowest rated competency was, *assign USDA quality and yield grades* (*M* = 4.11; *SD* = .80).

Table 15

Agriculture Educators' Perceived Importance of USDA Grading System Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Definition of USDA quality grading system.	1	.5	3	1.5	23	11.2	97	47.1	82	10.7	4.24	.74
Define USDA yield grading system.	1	.5	4	1.9	20	9.7	100	48.5	81	39.3	4.24	.74
Identify factors associated with quality and yield grades.	1	.5	2	1.0	24	11.7	92	44.7	87	42.2	4.27	.74
Assign USDA quality and yield grades.	1	.5	6	2.9	32	15.5	97	47.1	70	34.0	4.11	.80

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 16 shows the four competencies for the packaging system construct. In the construct, one competency was rated the highest, *identify labeling on food products* (*M*= 4.23; *SD*= .77). The lowest rated competency was i*dentifying correct transportation for food products* (*M*= 3.99; *SD*= .80).

Table 16

Agriculture Educators' Perceived Importance of Packaging System Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Identifying food product storage.	1	.5	7	3.4	34	16.5	102	13.3	62	8.1	4.05	.80
Identify correct transportation for food products.	1	.5	6	2.9	42	20.4	103	50.0	54	26.2	3.99	.80
Identify labeling on food products.	1	.5	3	1.5	28	13.6	90	43.7	84	40.8	4.23	.77
Demonstrate correct labeling for food products.	2	1.0	6	2.9	32	15.5	95	46.1	71	34.5	4.10	.83

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 17 illustrates the five competencies for Hazard Analysis Critical Control Points (HACCP) construct. The highest rated competencies were, *identify and describe the sanitation procedures for food products* (*M* = 4.38; *SD* = .70) and *explain temperature for certain foods* (*M* = 4.32; *SD* = .71). The lowest rated competency was *identifying the seven principles of HACCP* (*M* = 4.06; *SD* = .82).

Table 17

Agriculture Educators' Perceived Importance of Hazard Analysis Critical Control Points (HACCP) Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Definition of HACCP	2	1.0	3	1.5	34	16.5	96	46.6	71	34.5	4.12	.80
Identifying 7 principles of HACCP	2	1.0	5	2.4	37	18.0	97	47.1	65	31.6	4.06	.82
Explain temperatures for certain food storage.	1	.5	1	.5	21	10.2	92	44.7	91	44.2	4.32	.71
Identify and describe the sanitation procedures for food products.	1	.5	1	.5	18	8.7	85	41.3	101	49.0	4.38	.70
Research food safety laws.	1	.5	4	1.9	34	16.5	95	46.1	72	35.0	4.13	.79

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Findings Related to Research Question Three

The third research question described the perceived ability of secondary agriculture educators in Texas to teach 29 agricultural food science related competencies.

The participants indicated their perceptions concerning their ability to teach the 29 selected food science content area skills. The items were scored on a five-point Likert-type scale where 1= “no ability ,” 2 = “below average ability,” 3 = “average ability,” 4 = “above average ability,” and 5 = “exceptional ability.” Frequencies and the number of participants were reported for each competency.

Table 18 illustrates the perceived ability to teach the five competencies under the General Food Science construct for agriculture educators. The three competencies rated the highest were, *identify major industries and organization in food production* (*M* = 3.36; *SD* = .72), *research regulations for food products in the processing industry* (*M* = 3.33; *SD* = .81), and *research environmental issues in food production explain temperature for certain foods* (*M* = 3.30; *SD* = .71). The lowest rated competency was *analyzing financial trends in the food product* (*M* = 3.15; *SD* = .76).

Table 18

Agriculture Educators’ Perceived Ability to Teach General Food Science Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Research environmental issues in food production.	1	.5	18	8.7	116	56.3	61	29.6	10	4.9	3.30	.71
Analyze financial trends in food production.	3	1.5	29	14.1	116	56.3	50	24.3	8	3.9	3.15	.76
Identify major industries and organizations in food production.	4	1.9	9	4.4	110	53.4	74	35.9	9	1.2	3.36	.72

Table 18

Continued
Agriculture Educators' Perceived Ability to Teach General Food Science Competencies

Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Identify new technology innovations in the food industry.	2	1.0	26	12.6	104	50.5	65	8.5	9	4.4	3.26	.77
Research regulations for food products in the processing industry.	3	1.5	21	10.2	103	50.0	64	31.1	15	7.3	3.33	.81

*Scale: 1= no ability, 2= below average ability, 3= average ability, 4= above average ability, 5= exceptional ability

Table 19 illustrates the ratings in the six different competencies under the Slaughter Process construct. The highest rated competency in this construct was, *describe the slaughter process* (*M* = 3.94; *SD* = .80). The three lowest rated competencies were, *postmortem factors affecting meat quality* (*M* = 3.69; *SD* = .86), *describe federal and state inspection laws* (*M* = 3.68; *SD* = .89), and *antemortem factors affecting meat quality* (*M* = 3.66; *SD* = .86).

Table 19

Agriculture Educators' Perceived Ability to Teach Slaughter Process Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Describe the slaughter process.	0	0	4	1.9	59	28.6	88	42.7	55	26.7	3.94	.80
Describe the splitting, washing, and cooling process.	1	.5	11	5.3	70	34.0	76	36.9	48	23.3	3.77	.89
Describe federal and state inspection laws.	0	0	14	6.8	82	39.8	66	32	44	21.4	3.68	.89
Physical components affecting meat quality.	1	.5	7	3.4	83	40.3	73	35.4	42	20.4	3.72	.84
Postmortem factors affecting meat quality.	1	.5	9	4.4	85	41.3	69	33.5	42	20.4	3.69	.86
Antemortem factors affecting meat quality.	0	0	11	5.3	91	44.2	62	30.1	42	21.4	3.66	.86

*Scale: 1= no ability, 2= below average ability, 3= average ability, 4= above average ability, 5= exceptional ability

Table 20 shows the fabrication construct was composed of five competencies. In this construct, one competency rated the highest, *definition of fabrication* (*M* = 3.71; *SD* = .81). Also a single competency rated the lowest, *identify SPEC on merchandising products* (*M* = 3.38; *SD* = .84)

Table 20

Agriculture Educators' Perceived Ability to Teach Fabrication Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Definition of Fabrication.	0	0	9	4.4	78	37.9	82	39.8	37	18.0	3.71	.81
Identify wholesale cuts.	1	.5	13	6.3	77	37.4	74	35.9	41	19.9	3.68	.88
Identify all retail cuts.	1	.5	11	5.3	83	40.3	69	33.5	42	20.4	3.68	.87
Determine cuts by species.	1	.5	10	4.9	80	38.8	75	9.8	40	19.4	3.69	.85
Identify SPECS on merchandisin g products.	1	.5	24	11.7	99	48.1	60	29.1	22	10.7	3.38	.84

*Scale: 1= no ability, 2= below average ability, 3= average ability, 4= above average ability, 5= exceptional ability

Table 21 illustrates the perceived ability to teach USDA Grading System competencies. The two competencies that rated the highest of them all were *define USDA yield grading system* (*M* = 3.71; *SD* = .81) and *identify factors associated with quality* *and yield grades* (*M* = 3.71; *SD* =. 83). The lowest rated competency was, *assign USDA quality and yield grades* (*M* = 3.61; *SD* = .85).

Table 21

Agriculture Educators' Perceived Ability to Teach USDA Grading System Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Definition of USDA quality grading system.	1	.5	4	1.9	89	43.2	75	36.4	37	18.0	3.69	.80
Define USDA yield grading system.	1	.5	5	2.4	85	41.3	76	36.9	39	18.9	3.71	.81
Identify factors associated with quality and yield grades.	1	.5	6	2.9	86	41.7	72	35.0	41	19.9	3.71	.83
Assign USDA quality and yield grades.	1	.5	11	5.3	90	43.7	69	33.5	35	17.0	3.61	.85

*Scale: 1= no ability, 2= below average ability, 3= average ability, 4= above average ability, 5= exceptional ability

Table 22 displays the Packaging System Construct, which included four competencies. The highest rated competency was *identify labeling on food products* (*M* = 3.51; *SD* = .80) the two lowest rated competencies were *identify correct transportation* *for food products* (*M* = 3.42; *SD* = .80) and *demonstrate correct labeling for food products* (*M* = 3.41; *SD* = .83).

Table 22

Agriculture Educators' Perceived Ability to Teach Packaging System Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Identifying food product storage.	2	1.0	10	4.9	104	50.5	66	32.0	24	11.7	3.49	.80
Identify correct transportation for food products.	2	1.0	13	6.3	108	14.0	62	8.1	21	10.2	3.42	.80
Identify labeling on food products.	2	1.0	11	5.3	98	47.6	72	35.0	23	11.2	3.51	.80
Demonstrate correct labeling for food products.	3	1.5	15	7.3	105	51.0	61	29.6	22	2.9	3.41	.83

*Scale: 1= no ability, 2= below average ability, 3= average ability, 4= above average ability, 5= exceptional ability

The Hazard Analysis Critical Control Point (HACCP) construct is displayed in Table 23 and includes five competencies. The two highest rated competencies were *explain temperatures for certain food storage* (M= 3.43; SD= .80), *identify and describe the sanitation procedures for food products* (M= 3.43; SD= .80). However, the lowest rated competency was *identifying 7 principles of HACCP* (M= 3.32; SD= .90).

Table 23

Agriculture Educators' Perceived Ability to Teach Hazard Analysis Critical Control Point (HACCP) Competencies

	Rating											
Scale	1		2		3		4		5			
Competencies	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*M*	*SD*
Definition of HACCP	2	1.0	22	2.9	100	48.5	60	29.1	22	10.7	3.38	.85
Identifying 7 principles of HACCP.	3	1.5	29	14.1	97	47.1	54	26.2	23	11.2	3.32	.90
Explain temperatures for certain food storage.	1	.5	16	7.8	104	50.5	64	31.1	21	10.2	3.43	.80
Identify and describe the sanitation procedures for food products.	1	.5	16	7.8	104	50.5	63	30.6	22	10.7	3.43	.80
Research food safety laws.	1	.5	16	7.8	113	54.9	54	26.2	22	10.7	3.39	.80

*Scale: 1= no ability, 2= below average ability, 3= average ability, 4= above average ability, 5= exceptional ability

Findings Related to Research Question Four

Research question four ranked the agricultural food science competencies determined by the secondary agriculture educators by the most needed procession development using mean weight discrepancy scores.

Table 24 displays the mean and standard deviation for the importance and ability rankings and mean weighted discrepancy for the construct's competencies. *Identify new technology innovations in the food industry* had the highest MWDS of 3.56 for the

General Food construct. The lowest was *analyzing financial trends in food production* with a 2.11 MWDS.

Table 24

Importance, Ability, and Mean Weighted Discrepancy Scores for General Food Science Competencies

	Importance		Ability		
General Food Science Competencies	*M*	*SD*	*M*	*SD*	MWDS
Identify new technology innovations in the food industry.	4.12	.70	3.26	.77	3.56
Research regulations for food products in the processing industry.	4.11	.75	3.33	.81	3.21
Research environmental issues in food production.	3.95	.78	3.30	.71	2.57
Identify major industries and organizations in food production.	3.96	.82	3.36	.72	2.34
Analyze financial trends in food production.	3.72	.86	3.15	.76	2.11

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 25 shows the mean and standard deviation for importance and ability rankings and mean weighted discrepancy scores. The highest MWDS of 2.84 was *describing federal and state inspection laws*. For the construct, *describing the splitting, washing, and cooling process* was ranked as having the lowest MWDS of 1.40.

Table 25

Importance, Ability, and Mean Weighted Discrepancy for Slaughter Process Competencies

	Importance		Ability		
Slaughter Process Competencies	*M*	*SD*	*M*	*SD*	MWDS
Describe federal and state inspection laws.	4.33	.72	3.68	.89	2.84
Physical components affecting meat quality.	4.33	.70	3.72	.84	2.67
Postmortem factors affecting meat quality.	4.27	.70	3.69	.86	2.49
Antemortem factors affecting meat quality.	4.24	.73	3.66	.86	2.49
Describe the slaughter process.	4.33	.75	3.94	.80	1.66
Describe the splitting, washing, and cooling process.	4.11	.76	3.77	.89	1.40

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 26 shows the mean and standard deviation for importance and ability rankings and mean weighted discrepancy score for the Fabrication competencies. *Identify all retail cuts* was ranked the highest MWDS of 2.58. The lowest ranked MWDS for the construct was *definition of fabrication* with a 1.68.

Table 26

Importance, Ability, and Mean Weighted Discrepancy for Fabrication Competencies

	Importance		Ability		
Fabrication Competencies	*M*	*SD*	*M*	*SD*	MWDS
Identify all retail cuts.	4.28	.76	3.68	.87	2.58
Determine cuts by species.	4.27	.80	3.69	.85	2.44
Identify SPECS on merchandising products.	3.95	.85	3.38	.84	2.26
Identify wholesale cuts.	4.21	.82	3.68	.88	2.23
Definition of Fabrication.	4.12	.76	3.71	.81	1.68

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 27 explains the mean and standard deviation for importance and ability rankings and the mean weighted discrepancy scores for USDA Grading System construct's competencies. *Identify factors associated with quality and yield grades* possess a MWDS of 2.41, which is the highest of the USDA Grading System construct. The lowest ranked competency for USDA Grading System construct, with a MWDS of 2.06 was *assign USDA quality and yield grades.*

Table 27

Importance, Ability, and Mean Weighted Discrepancy for USDA Grading System Competencies

	Importance		Ability		
USDA Grading System Competencies	*M*	*SD*	*M*	*SD*	MWDS
Identify factors associated with quality and yield grades.	4.27	.74	3.71	.83	2.41
Definition of USDA quality grading system.	4.24	.74	3.69	.80	2.33
Define USDA yield grading system.	4.24	.74	3.71	.81	2.24
Assign USDA quality and yield grades.	4.11	.80	3.61	.85	2.06

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 28 lists the means and standard deviation for the importance and ability rankings and the mean weighted discrepancy scores for the Packaging System construct's competencies. The highest ranked competency was, *identify labeling on food products* with a MWDS of 3.08. *Identify correct transportation for food products* was ranked the lowest with a MWDS of 2.30.

Table 28

Importance, Ability, and Mean Weighted Discrepancy for Packaging System Competencies

	Importance		Ability		
Packaging System Competencies	*M*	*SD*	*M*	*SD*	MWDS
Identify labeling on food products.	4.23	.77	3.51	.80	3.08
Demonstrate correct labeling for food products.	4.10	.83	3.41	.83	2.85
Identifying food product storage.	4.05	.80	3.49	.80	2.30
Identify correct transportation for food products.	3.99	.80	3.42	.80	2.24

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

Table 29 indicates the mean and standard deviation for importance and ability rankings and the mean weighted discrepancy score for Hazard Analysis Critical Control Points (HACCP) competencies. The highest ranked competency was *identify and describe the sanitation procedures for food production* with a MWDS of 4.14. *Identify 7 principles of HACCP* was the lowest ranked competency with a MWDS of 3.01.

Table 29

Importance, Ability, and Mean Weighted Discrepancy for Hazard Analysis Critical Control Points (HACCP) Competencies

	Importance		Ability		
HACCP Competencies	*M*	*SD*	*M*	*SD*	MWDS
Identify and describe the sanitation procedures for food products.	4.38	.70	3.43	.80	4.14
Explain temperatures for certain food storage.	4.32	.71	3.43	.80	3.83
Research food safety laws.	4.13	.79	3.39	.80	3.07
Definition of HACCP	4.12	.80	3.38	.85	3.06
Identifying 7 principles of HACCP.	4.06	.82	3.32	.90	3.01

*Scale:1= no importance, 2= slightly important, 3= moderately important, 4= important, 5= very important

V. SUMMARY, CONCLUSION, IMPLICATION, AND RECOMMENDATIONS

Summary

The purpose of this study was to describe secondary agriculture educators' perceptions of the importance of, and their ability to teach selected agricultural food science skills in a formal secondary education setting.

The following objectives were identified to fulfill the purpose of this study:

1. Describe the demographic characteristics of participating agriculture educators in Texas.
2. Describe the importance of selected agricultural food science content areas as perceived by secondary educators in Texas.
3. Describe the perceived capability of secondary agriculture educators to teach agricultural food science content areas.
4. Determine the discrepancy between the importance of agricultural food science content areas and the capability to teach agricultural food science areas as perceived by secondary agriculture educators.

The study was conducted quantitatively using a census survey research design. , The census survey method was useful for collecting numerical data to research the importance and ability for food science skills perceived by agriculture educators. The research design made it useful to conduct the research on a large scale of 1,967 agriculture educators in Texas.

Beginning August 31, 2016, 2,129 agriculture teachers were registered with the VATAT. Among those 2,129, the study examined 1,967 due to complications when sending out the survey to the target population. Of the 1,967 agriculture educators, 769 responded for a response rate of 39%.

Conclusion

Research objective one sought to determine the personal and professional characteristics of Texas agriculture educators. The participants were asked whether they taught a class that included food science competencies. These courses included: Advanced Animal Science, Food Processing, and Food Technology and Safety. In addition to what classes agriculture educators taught, they were also asked whether they had access to a meat science or food technology laboratory facility. Most of the agriculture educators (174) did not have a laboratory facility to teach the classes. On the other hand, 15 teachers had access to a meat science laboratory and 25 teachers had a food technology laboratory. The data indicated that most agriculture educators lack laboratory facilities due to lack of funding or student interest in the discipline are to access these types of facilities. Much of the population surveyed did not teach any of the three courses offered. The researcher concluded this was due to lack of funding, low administrative support, and lack of student interest on the topic. Additionally, teachers indicated not teaching the courses due to a low self-efficacy or ability to do so. According to the Texas Examinations of Educators Standards, a new domain was added to the Agriculture, Food and Natural Resource Examination in 2017. The new domain is Food Science and Processing which accounts for 12% of the total test. Teachers attaining certification prior to this new domain being added were not tested on the material. Therefore, the lack of knowledge could be a determining factor in teachers not teaching these courses. However, 248 agriculture educators taught Advanced Animal Science, 16 taught Food Processing, and 73 taught Food Technology and Safety. The researcher suggests there were agriculture educators that did teach it due having access to a laboratory facility. This would make it easier to teach some skills such as; fabrication or slaughter if an educator had access to a laboratory. Another suggestion of why they are teaching it students' interest in food science. Teachers could have also had previous experience in the disciple such as FFA participation of growing up around agriculture.

Research objective two was to determine the rating of importance for the six different constructs. In research objective two, it was found that there was a relatively high importance rating for all of the competencies. The highest rated importance competency was *identify and describe the sanitation procedures for food products* (M = 4.38) and the lowest rated importance competency was *identify SPECS on merchandising products* (M = 3.95). The researcher suggests that there are many factors that could determine why agriculture educators have a high importance on the competencies. First, the major impact food science has on feeding the world. According to Rastall (2014) health and food safety of the nation depends upon the availability of good quality food. Food safety is a topic that is often in the news and can be a major concern the nation. It is important to have exceptional quality and safe food for consumers to eat. Food science will always be a revolving issue to the nation due to foodborne illnesses. Food security does not end at the farm gate. There is more to the security of food than just growing it at home. A second fact is technology and innovation which is constantly changing in food science. There are many types of technology that helps researcher determine how food is bought and sold on a daily basis. For example, milk trucks have samples of milk that are tested at the farm for any type of bacteria before it can be hauled to the processing plant. In research by Siegrist and Sütterlin (2016), stated that in recent years, the public has shown less interest when adapting technology about food science due to the undesired knowledge about the topic. In this study, it was shown that people were unaware of the outcomes related to technology in food science. In addition to technology, there are food safety laws that are set in place to provide consumers with wholesome and safe foods. These laws fall under the United States Drug Administration and can be located in the Food Safety and Modernization Act. The title of these laws include: Title I-Improving Capacity to Prevent Food Safety Problems, Title II-Improving Capacity to Detect and Respond to Food Safety Problems, Title III-Improving the Safety of Imported Food, and Title IV-Miscellaneous Provisions. Lastly, the researcher suggests that all of the competencies were rated moderately high in importance due to the number of jobs available in food science. According to Pay Scale, food science salaries range from $43,000 to $81,000 per year. The hourly rate for a food science career ranges from $14.91/hour to $26.06/hour. Recorded by the School of Food Science, there are over forty careers available in food science.

Research objective three was to determine the rating of ability to teach the six different constructs. In research objective three, it was found that agriculture educator's ability to teach was relatively low when compared to the importance rating.

In the construct of general food science agriculture educators indicated that they had the highest ability to teach *identifying major industries and organizations in food production* (M = 3.36) and the lowest ability to teach competency was *analyzing trends in food production* (M= 3.15). Identifying major industries and organizations can be found on reliable internet sources along with the information about each company. On the other hand, analyzing trends in food production might be difficult if the educator was unaware of food science terms or research related to those trends. For the slaughter process construct, it was determined that their highest ability to teach was *describing the slaughter process* (*M* = 3.94) and the lowest ability to teach was *antemortem factors affecting meat quality* (*M* = 3.66). The research suggests that while teaching the process of slaughter might be easy, factors affecting meat quality can be hard. If the educator did not receive classes related to meat science during their bachelor or post-bachelor degree, the results would show their ability teach would be low. However, in the fabrication construct, educators rated their ability to teach all of the competencies on average of a (*M* = 3.69). Additionally they rated one competency lower compared to the rest; *identification of SPECS on merchandising products* (*M* = 3.38). Identification of specification for meat products are a serious of Institutional Meat Purchase Specifications (IMPS) that are used to correcting fabricate and package meat products (Hilton & Wulf, 2001). In construct number four, educators rated their ability to teach *USDA yield grading system* (*M* = 3.71) and *factors associated with quality and yield grades* (*M* = 3.71) as their highest ability to teach and assigning quality and yield grades (*M*= 3.61). Assigning yield and quality grades can be difficult due to the elements that goes into calculating or assigning them. *Identifying labeling on food products* (*M* = 3.51) was the highest rated ability to teach and demonstrate correct labeling for food products (*M* = 3.41) was the lowest rated ability to teach for the packaging system construct. The researcher proposes that this could be due to not knowing how to identify specifications along with knowing the components that are incorporated in the labeling system. In the last construct Hazard Analysis Critical Control Points (HACCP), agriculture educators indicated the teaching the *definition of HACCP* (*M* = 3.38) and *researching food safety* *laws* (*M* = 3.39) was among their highest ability to teach for this construct. The lowest competency in this construct was identifying the seven principles of HACCP (M = 3.32). The researcher implies that there is a significant importance of knowing the seven principles especially in food science due to the principles enhancing the safety and food quality of consumer's food.

Agriculture educators rated that their ability to teach all six constructs as average or below average on all of the constructs. This is due to agriculture educators that are in the field now not obtaining the extra classes to teach food science competencies. The researcher suggests that professional development would help the majority of the agriculture educators. The areas of need are identified and the next step would be hosting a professional development event based upon the results of this study. The researcher also proposes that students would benefit in knowing these competencies of food science. For example, if a student tries to buy meat products at a local grocery store, that student if educated on the following topics would be able to identify the packaging label and what the components mean, the fat to lean ratio, what he/she is getting for the dollar, and by the color of the meat if it is the best quality or not.

Research objective four sought to determine the various food science competencies in need of professional development by the secondary agriculture educators using a mean weighted discrepancy score. The perceived importance and perceived ability for each of the competencies, from the six constructs, were used to calculate the mean weight discrepancy scores (MWDS). The MWDS was then used to rank each competency and determine which ones had the highest need for professional development in food science.

After the Mean Weighted Discrepancy Scores were calculated, the research ranked the top five highest need for professional development. When calculating the scores, the higher the MWDS the higher the need for professional development.

The five highest need for professional development, found in this research was: *identify and describe the sanitation procedures for food products (*MWDS= 4.14), *explain food temperatures for certain food storage* (MWDS= 3.83), *identify new technology innovations in the food industry* (MWDS= 3.56), *identify labels on food products* (MWDS= 3.08), and *research food safety laws* (MWDS= 3.07).

After the research was conducted and the Mean Weighed Discrepancy Scores were calculated, the researcher determined that there was a need for professional development in all six constructs. Unlike Lester (2012), in a study for professional development in agricultural mechanics, which found many negative MWDS indicating there was not an ongoing need in certain constructs. However, in this research, it was determined that the lowest score (MWDS=1.40) was above a 1.0 shows the need for professional development in all competencies.

According to Lester (2012) and Saucier (2010), continuing professional development for agriculture educators will improve their self-efficacy levels and will help them to become more balanced in the classroom due to changes of the environment and their teaching abilities. Since the data indicated a need for professional development in all six constructs, it is suggested that this issue be addressed at the local level by school district. Schools could offer a two-day event for agriculture educators to learn what the ongoing trends and innovations are in agricultural food science. specifically, a district might hire a butcher to demonstrate how the slaughter processes can be completed as well as the fabrication processes is conducted. During the next day of training, agriculture educators could learn how to determine the USDA yield and quality grade difference species. This professional development could count for the required number hours for each year.

Implications

The results from the Borich Needs Assessment indicate that agriculture educators have a need for professional development in food science. Prior to this study, research related to professional development in food science has not been evaluated before. Therefore, the results in this study indicate the need from professional development is high but the highest overall for every competency is in the construct of Hazard Analysis Critical Control Points (HACCP). Hazard Analysis and Critical Control Points is defined as a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product (Hulebak & Schlosser, 2002).

According to the Centers for Disease Control and Prevention (2010) there were an estimated 76 million foodborne illnesses annually in the United States. The number of foodborne illnesses resulting in deaths, illness, and hospitalizations continue to increase each year. In 2007 alone, there were 21,244 foodborne illnesses reported and 18 deaths due to unsafe food preparation standards.

Many professional organizations offer professional development to educator in the area of regulatory processes. Continuing the education of classroom teachers with all levels of experience plays key roles in academics today. University students who aspire to become teachers have the opportunity to take specialized design courses which educate them about health hazards associated with food, inspection procedures to identify foodborne illnesses, and methods to eliminate these hazards. According to the British Nutrition Foundation (2001) teachers must have the proper knowledge and education about food safety in order for students to receive accurate food safety education.

Due to there being a much higher need in Hazard Analysis Critical Control Points professional development needs is more of a concern. With the need for HACCP (MWDS= 4.14) there could be an opportunity to put on a professional development event at the local and district level. HACCP is a management system that regulates food safety through the analysis and control of biological, chemical, and physical hazards from raw material production to distribution and consumption of the finish product (United States Food and Drug Administration, 2015). The findings of this study suggest that educators could benefit from professional development at the Vocational Agriculture Teachers Association of Texas conference. Teachers could attend workshops to become certified in specific areas, such as Hazard Analysis Critical Control Points or HACCP trained and a butcher's certification. An agriculture educator could learn about the research and development that is ongoing within food science, the slaughter process, fabricating process, how to USDA yield and quality grade different species, learn how to package items the correct way and why, and the seven principles of HACCP and how to use them. During the training, agriculture educators would participate in groups to complete projects throughout those four days to check for understanding of the concepts. At the end of the four days, the agriculture educators would present a project that includes the seven principles of HACCP and how they are used. Once this is completed successfully, the agriculture educators would be presented with their certification and have the opportunity to teach their students. Additionally, the research suggests that this would be an ongoing training throughout the academic school year with check-ups from a local HACCP regulator that will visit the classrooms often.

Agriculture educators would have the opportunity to learn what HACCP is and the regulations and qualification that go along with becoming HACCP trained. This can be a chance to bring back the certification to the classroom for students to become HACCP trained as well. Agriculture educators can be participating in activities that will allow them to learn how to monitor critical control points and food safety hazards (Koundinya & Martin, 2010).

Recommendations

Based on the results and conclusions of this study, future research is needed in the following areas:

1. This study indicates additional professional development is needed in every construct for food science. The domain of Food Science and Processing is new to the Agriculture, Food and Natural Resource test and novice student teachers should become more familiar with the competencies within the food science. Teacher education programs should provide a required class of food science to student teachers obtaining their teaching certification. This recommendation relates to research by Newman and Johnson (1994) stating that when it comes to the topic relating to the food industry, agriculture educators have a strong need for professional development.
2. The researcher suggests to send out an initial survey asking one question; if the agriculture educator taught one of the three courses: Advanced Animal Science,

Food Technology, and Food Processing and Safety or none of the above. By doing this, the researcher can obtain information to what agriculture educators teach those classes and those who do not. This will help the researcher to focus on the agriculture educators who do teach one of the three courses.

3. The research suggest to improve the food science competencies by conducting further research related to food science competencies. The researcher should conduct additional research related to the exact competency with the highest professional development need and why the agriculture educators are not familiar or competent at teaching them.
4. The researcher recommends that a further study of comparing males to females to see if a statistical difference is present in professional development needs. If the research results were to show considerably different data and MWDS, gender specific professional development needs should be considered.
5. FFA areas need to be compared to see if a statistical difference exists in the professional development of food science.
6. Number of years of experience should be examined more closely to determine if novice teachers lack the knowledge of importance and ability compared to experienced teachers.
7. In the current research, a question was asked in the survey if the agriculture educator taught one of the three courses. Further research should be conducted as to why the agriculture educator did not teach the course.
8. In order for Texas agriculture educators to stay competent in their knowledge and abilities, professional development should reflect the needs for each of the

educators. A continuing need for professional development research should be conducted to provide accurate continued education. Layfield and Dobbins (2002) determined that a critical factor of addressing professional development and developing successful teachers is correctly identifying the needs that are in the greatest demands.

9. A mixed methods approach should be used to examine why agriculture educators lack the understanding or ability to teach any of the competencies. The QUAN-QUAL model should be used to fully understand what areas the agriculture educator lacks knowledge or ability to teach the competencies.
10. The researcher recommends professional development should be used during the Vocational Agriculture Teachers Associate of Texas to enhance their understanding of the skills. Training certifications should be introduced during these training periods for the food science domain.

APPENDIX SECTION

APPENDIX A: INSTRUMENTATION

Food Science- Krysta Kelso

Question 1

Do you teach one of these three courses? If yes, select all that apply. If no, select no.

- ☐ Advanced Animal Science
- ☐ Food Processing
- ☐ Food Technology and Safety
- ☐ No

Question 2

General Food Science

	Importance					Ability to Teach				
	No Importance	Slightly Important	Moderately Important	Important	Very Important	No Ability	Below Average Ability	Average Ability	Above Average Ability	Exceptional Ability
Research environmental issues in food production.	○	○	○	○	○	○	○	○	○	○
Analyze Financial Trends in food production.	○	○	○	○	○	○	○	○	○	○
Identify major industries and organizations in food production.	○	○	○	○	○	○	○	○	○	○
Identify new technology innovations in the food industry.	○	○	○	○	○	○	○	○	○	○
Research regulations for food products in the processing industry.	○	○	○	○	○	○	○	○	○	○

Question 3

Slaughter Process

	Importance					Ability to Teach				
	No Importance	Slightly Important	Moderately Important	Important	Very Important	No Ability	Below Average Ability	Average Ability	Above Average Ability	Exceptional Ability
Describe the slaughter process.	○	○	○	○	○	○	○	○	○	○
Describe the splitting, washing, and cooling process.	○	○	○	○	○	○	○	○	○	○
Describe federal and state inspection laws during the slaughter process.	○	○	○	○	○	○	○	○	○	○
Physical components affecting meat quality.	○	○	○	○	○	○	○	○	○	○
Postmortem factors affecting meat quality.	○	○	○	○	○	○	○	○	○	○
Antemortem factors affecting meat quality.	○	○	○	○	○	○	○	○	○	○

Question 4

Fabrication

	Importance					Ability to Teach				
	No Importance	Slightly Important	Moderately Important	Important	Very Important	No Ability	Below Average Ability	Average Ability	Above Average Ability	Exceptional Ability
Definition of Fabrication										
Identify all wholesale cuts.										
Identify all retail cuts.										
Determine cuts by species.										
Identify SPECS on merchandising products.										

Question 5

USDA Grading System

	Importance					Ability to Teach				
	No Importance	Slightly Important	Moderately Important	Important	Very Important	No Ability	Below Average Ability	Average Ability	Above Average Ability	Exceptional Ability
Definition of USDA quality grading system.										
Define USDA yield grading system.										
Identify factors associated with quality and yield grades.										
Assign USDA quality and yield grades.										

Question 6

Packaging Systems

	Importance					Ability to Teach				
	No Importance	Slightly Important	Moderately Important	Important	Very Important	No Ability	Below Average Ability	Average Ability	Above Average Ability	Exceptional Ability
Identifying food products for storage.										
Identify correct transportation for food products.										
Identify labeling on food products.										
Identify labeling on food products.										
Demonstrate correct labeling for food products.										

Question 7

Hazard Analysis Critical Control Points (HACCP)

	Importance					Ability to Teach				
	No Importance	Slightly Important	Moderately Important	Important	Very Important	No Ability	Below Average Ability	Average Ability	Above Average Ability	Exceptional Ability
Definition of HACCP	○	○	○	○	○	○	○	○	○	○
Identifying 7 Principles of HACCP	○	○	○	○	○	○	○	○	○	○
Explain temperature for certain food storage.	○	○	○	○	○	○	○	○	○	○
Identify and describe sanitation procedures for food products.	○	○	○	○	○	○	○	○	○	○
Research food safety laws.	○	○	○	○	○	○	○	○	○	○

Question 8

If selected no to the previous question, why? Select all that apply.

- ☐ Lack of Knowledge
- ☐ Lack of Ability to Teach
- ☐ No Administrative Support
- ☐ Lack of Student Interest
- ☐ Lack of Student Numbers
- ☐ Other

Question 9

Do you have access to a laboratory facility? If yes, select all that apply. If no, select no.

- ☐ Meat Science Laboratory
- ☐ Food Technology Laboratory
- ☐ No Laboratory Facilities

Question 10

If selected no to previous question, why? Select all that apply.

- ☐ Lack of Funding
- ☐ Lack of Facility
- ☐ No Administrative Support
- ☐ Other

Question 11

What is your gender?

- ○ Male
- ○ Female

Question 12

What is your ethnicity ?

- ○ White/Caucasian
- ○ Hispanic or Latino
- ○ African American
- ○ Asian American
- ○ Native American/Alaskin
- ○ Other

Question 13

How many years have you taught agriculture education?

- ○ 0-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ 21-25
- ○ 26-30
- ○ More than 30

Question 14

What is your highest level of degree earned?

- Bachelors Degree
- Masters Degree
- Doctorate

Question 15

In which FFA area is your school located?

- Area I
- Area II
- Area III
- Area IV
- Area V
- Area VI
- Area VII
- Area VIII
- Area IX
- Area X

Question 16

At what size school do you teach?

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

Question 17

What is your campus location designation?

- Rural (population less than 2,500)
- Suburban (population between 2,500 to 50,000)
- Urban (population greater than 50,000)

Question 18

How many agricultural science teachers are in your department?

- One Teacher
- Two Teachers
- Three Teachers
- Four Teachers
- Five or More Teachers

APPENDIX B: COVER LETTER

Hello my name is Krysta Kelso, a graduate student at Texas State University. I am conducting a research study describing secondary agriculture educators' perceptions of the importance of, and their capability to teach selected agriculture food science skills in a formal secondary education setting. You are being asked to complete this survey because of your experiences in teaching secondary agricultural science and technology in a public school in Texas

Your participation is voluntary, but highly encouraged. The information received will be used to enhance the quality of teaching within the profession. The survey will take no more than 15 minutes to complete.

This study involves no foreseeable serious risks. We ask that you try to answer all questions; however, if there are any items that make you uncomfortable or that you would prefer to skip, please leave the answer blank. Your responses are anonymous.

If you have any questions or concerns, please contact Krysta Kelso or her faculty advisor:

Krysta Kelso, Graduate Student
Agricultural Education
(361) 235-0474
kek111@txstate.edu

Douglas Morrish, Associate Professor
Agriculture Education
(512) 245-3321
dm43@txstate.edu

This project 2016O9351 was approved by the Texas State IRB on June 06, 2016. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Dr. Jon Lasser 512-245-3413 – (lasser@txstate.edu) or to Monica Gonzales, IRB Regulatory Manager 512-245-2334 - (meg201@txstate.edu).

Respectfully,

Krysta Kelso
Graduate Student
Department of Agriculture
Texas State University

APPENDIX C: FIRST REMINDER EMAIL

Hello my name is Krysta Kelso, a graduate student at Texas State University. I am conducting a research study describing secondary agriculture educators' perceptions of the importance of, and their capability to teach selected agriculture food science skills in a formal secondary education setting. You are being asked to complete this survey because of your experiences in teaching secondary agricultural science and technology in a public school in Texas

Your participation is voluntary, but highly encouraged. The information received will be used to enhance the quality of teaching within the profession. The survey will take no more than 15 minutes to complete.

This study involves no foreseeable serious risks. We ask that you try to answer all questions; however, if there are any items that make you uncomfortable or that you would prefer to skip, please leave the answer blank. Your responses are anonymous.

If you have any questions or concerns, please contact Krysta Kelso or her faculty advisor:

Krysta Kelso, Graduate Student	Douglas Morrish, Associate Professor
Agriculture Education	Agriculture Education
(361) 235-0474	(512) 245-3321
kek111@txstate.edu	dm43@txstate.edu

This project 2016O9351 was approved by the Texas State IRB on June 06, 2016. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Dr. Jon Lasser 512-245-3413 – (lasser@txstate.edu) or to Monica Gonzales, IRB Regulatory Manager 512-245-2334 - (meg201@txstate.edu).

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

If you agree to participate, please complete the survey by November 25, 2016

Respectfully,

Krysta Kelso
Graduate Student
Department of Agriculture
Texas State University

APPENDIX D: SECOND REMINDER EMAIL

Greetings!

On November 11th you received an email containing a link to a survey regarding a research project asking how secondary agricultural educators perceive the importance of and their capability in teaching food science. Information provided by you will be used to better understand how agricultural education teachers perceive the importance and their abilities to teach selected agriculture food science skills.

If you have already completed the online questionnaire, please accept my sincere appreciation. If you have not completed the online questionnaire, please do so **by Friday, December 2nd.** As you know, it is important that your response be included in the study.

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

Thank You!
Krysta Kelso
Master's Student
Department of Agricultural
Texas State University

APPENDIX E: THIRD REMINDER EMAIL

Greetings!

On November 11th you received an email containing a link to a survey regarding a research project asking how secondary agricultural educators perceive the importance of and their capability in teaching food science. Information provided by you will be used to better understand how agricultural education teachers perceive the importance and their abilities to teach selected agriculture food science skills.

If you have already completed the online questionnaire, please accept my sincere appreciation. If you have not completed the online questionnaire, please do so **by Friday, December 9th.** As you know, it is important that your response be included in the study.

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

Thank You!
Krysta Kelso
Master's Student
Department of Agricultural
Texas State University

APPENDIX F: FOURTH REMINDER EMAIL

Greetings!

On November 11th you received an email containing a link to a survey regarding a research project asking how secondary agricultural educators perceive the importance of and their capability in teaching food science. Information provided by you will be used to better understand how agricultural education teachers perceive the importance and their abilities to teach selected agriculture food science skills.

If you have already completed the online questionnaire, please accept my sincere appreciation. If you have not completed the online questionnaire, please do so **by Friday, December 9th.** As you know, it is important that your response be included in the study.

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

Thank You!
Krysta Kelso
Master's Student
Department of Agricultural
Texas State University

APPENDIX G: FINAL REMINDER EMAIL

Greetings!

On November 11th you received an email containing a link to a survey regarding a research project asking how secondary agricultural educators perceive the importance of and their capability in teaching food science. Information provided by you will be used to better understand how agricultural education teachers perceive the importance and their abilities to teach selected agriculture food science skills.

If you have already completed the online questionnaire, please accept my sincere appreciation. If you have not completed the online questionnaire, please do so **by Friday, December 16th.** As you know, it is important that your response be included in the study.

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

Thank You!
Krysta Kelso
Master's Student
Department of Agricultural
Texas State University

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