

The Food Safety Knowledge Level of Certified Food Managers Who Attended Two Self-
Selected Training Courses

by

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ABSTRACT

The foodservice industry is dependent on millions of employees daily to ensure proper and safe food handling of food products consumed by the general public. The State of Texas requires food establishments' management or person in charge be trained in food protection. For this inquiry, the researcher studied the knowledge level gained by food managers from two food companies and two certification courses. There were 90 food service operations that participated in the study. The data was collected through the use of a food safety knowledge test instrument.

The scope of the study was to explore the level of food safety knowledge of two self-selected certified food managers in Texas. Sixty-five percent (65.6%) of the certified food managers were certified by course A and 34.4% were certified by course B. The researcher explored two educational theories that are often utilized in the agricultural education discipline. Adult education and training programs in agriculture should use appropriate and effective instructional methods. Creswell and Martin (1993) inferred a linkage between adult education and instructional design as it related to agriculture. This study explored the phenomenon regarding certified food manager training courses and knowledge level through certification. In agricultural education, lives are affected through education and training. Trede and Wade (1993) suggested that agricultural education helps people improve their lives through an educational process using scientific knowledge.

The participants' knowledge test scores were as follows: course A (n=59) 72.9% and course B (n=31) 69.0%. The resulting t-test was determined to the knowledge test score of course A and course B, and proved not to be statistically significant at an alpha

level .05. Thus, the researcher concluded instructional design and adult learning theory did not have an impact on the knowledge level of participants as a result of the two self-selected courses for certified food manager training in this study.

Food safety knowledge of participants who spoke English or Korean as their native languages were analyzed closely as they represented the largest population of the participants. Korean as a native language represented the largest group at 45.6% of the population. English as a native language represented the second largest group at 43.3% of the population. Certified Food Manager Training is offered in these languages throughout Texas. Differences were found within the participants' native or first languages. The certified food managers who identified as English and Korean native or first language resulted a statistically significant comparison when analyzed via independent t-test. The researcher recommends further research on affects of native language on certified food manager training.

This research study discusses potential improvements that may be implemented in future research for certified food management training. The scope of this study utilized two self selected courses that were available to the participating certified food managers. For example, the Food Safety Knowledge Test instrument which was developed specifically for the scope of this research. Although this instrument was only used once it served as a suitable tool for this research project and could serve as a guide for the development of future research instruments. The researcher suggests that future researchers consider utilizing a tested and established research instrument. A study with a broader scope including courses supported by other National and State level accreditation

organization as well as increasing the number of participant; may yield additional findings.

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LIST OF ABBREVIATIONS

- (ADDIE) Analysis, Design, Development, Implementation, Evaluation
- (AFDO) Association of Food and Drug Officials
- (ANSI) American National Standards Institute
- (CCP) Critical Control Point
- (CDC) Center for Disease Control
- (CFM) Certified Food Manager
- (DSHS) Texas Department of State Health Services
- (FDA) United States Food and Drug Administration
- (FSMA) Food Safety Modernization Act
- (GM) Genetically Modified foods
- (HACCP) Hazard Analysis and Critical Control Points
- (IBM) Business Machines Corporation
- (ID) Instructional Design
- (MSDS) Materials Safety Data Sheet
- (NRA) National Restaurant Association
- (NACMCF) National Advisory Committee on Microbiological Criteria for Foods
- (PCA) Peanut Corporation of America
- (UK) United Kingdom
- (UNI) University of Northern Illinois
- (USDA) United States Department of Agriculture
- (WHO) World Health Organization

CHAPTER I

Introduction

The Center for Disease Control (CDC; 2011) suggests that each year roughly 1 in 6 Americans (or 48 million people) gets sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. Food-oriented diseases in Europe and Asia affect 130 million people each year (De Waal, 2003). The risk for foodborne illness depends both on the presence of a specific source of contamination and food handling practices that allow for transmission (Hedberg et al., 2006). Foodborne illnesses constitute an important health problem in both developed and developing countries; additionally, the number of notified incidences of foodborne illnesses in these countries has increased significantly (Mossel, 1989; Notermans et al., 1994; Todd 1989).

In the 1880s, women started organizing groups to protest the conditions at slaughterhouses in New York City and adulterated foods in other parts of the country. In 1883, Harvey W. Wiley, chief chemist of the U.S Agricultural Department's Bureau of Chemistry, began experimenting with food and drug adulteration. In 1906, Upton Sinclair's book, *The Jungle* chronicled labor conditions and animal treatment in the meat packing industry. The focus of that book was the conditions immigrants, who worked in the industry, experienced at the time. The book included graphic descriptions of the filth and poor hygiene in packing plants.

During the Industrial Revolution, when food began to be processed and packaged, no regulation existed and manufacturers were free to add whatever they liked to their products. Two acts were passed in 1906 by Congress and President Theodore Roosevelt. The Pure Food and Drug Act and the Beef Inspection Act were established to improve food safety conditions. The U.S Food, Drug, and Insecticide Administration or FDA was created to enforce the Pure Food and Drug Act. For the next 70 years, many amendments that expanded the FDA's regulatory

powers were established by lawmakers. In 1966, the FDA standardized the labels of products and required that labels provide honest information. The next major act was the Food Quality Protection Act of 1996. This act provided new regulations requiring implementation of Hazard Analysis and Critical Control Points (HACCP) for most food processors.

In 2009, President Barack Obama announced the creation of a new Food Safety Working Group to advise him on how to upgrade the U.S. food safety system. The Working Group is recommending a new, public health-focused approach to food safety based on three core principles: (a) prioritizing prevention; (b) strengthening surveillance and enforcement; and (c) improving response and recovery (President Obama Food Safety Working Group, 2009).

The FDA Food Code is based on science and best practices in the food industry. The FDA Food Code outlines federal recommendations for food safety regulations for the food service industry. Its development includes input from the Conference for Food Protection (CFP) representatives that come from the food industry, government, academia, and consumer groups. The FDA Food Code serves as a model for the state level regulatory authorities to adopt, update, and/or develop their state's food safety rules. Although the FDA recommends the food code adoption by each state, it cannot require it. FDA's federal recommendations are provided every two years and individual states usually accept the food code updates as the states try to be consistent with national food safety policies.

The Association of Food and Drug Officials (AFDO) reported in June 2005, that 48 of 56 states and territories have adopted food codes patterned after one of the five versions of the food code, beginning with the 1993 edition. Those 48 states and territories represent 79% of the U.S. population (Food and Drug Administration, 2012). In Texas, for example, the FDA food code is usually adopted and passed into law within that two-year period. The food code states the person

in charge of a food establishment is accountable for developing, carrying out, and enforcing procedures aimed at preventing food-borne illness (Food and Drug Administration, 2010). Texas requires food establishments' management or person in charge be trained in safe food handling practices but no such regulations for non-management employees. Food service workers often lack safe food handling knowledge, especially with respect to temperature control, personal hygiene, and sanitizing utensils (Manning & Snider, 1993). Some of the worst habits of staff working in the food and beverage sector include, touching prepared food with fingers, playing with his/her nose, scratching the head and acne, tasting food with unwashed and dirty spoons, not washing hands after touching the nose and mouth, using food preparation sinks for washing hands, and touching the inside of plates and glasses with the hands (Bas & Merdol, 2002).

The foodservice industry is dependent on millions of employees daily to ensure proper and safe food handling of food products consumed by the general public. Concern over food safety has prompted the federal government to develop food safety objectives for improving public health (Healthy People, 2010). Changes in food preparation habits, growth in foodservice establishments, increased consumption of food outside the home, and a lack of food safety training and education among food handlers and consumers has led to an increase in foodborne illnesses (Acikel et al., 2008; Motarjemi & Käferstein, 1999; Seamana & Evesb, 2006).

Foodservice employee food handling practices are a concern for public health. High foodservice employee turnover and limited food safety knowledge are pertinent issues. Supermarkets for example, employ many high school students who normally have not had food safety training. The foodservice industry and public health is dependent upon the learning process for serving the consumer safely in accordance with proper and safe food handling practices. The research design of this study has a primary concentration on food safety education

and training. Education is a process comprised of both teaching and learning (Gordon, 1974). Education should be repeated with specific intervals to ensure that learned information is turned into attitudes and behaviors; and procedures and processes should be controlled regularly (Sandlier, Comert, & Durlu-Ozkaya, 2009). Experience in educational institutions and corporate organizations have led and established observable facts and principles for learners in various learning initiatives. The grocery industry has taken food safety more seriously lately. Food handler training is seen as one strategy whereby food safety can be increased, offering long-term benefits to the food industry and sector (Smith, 1994).

According to Tucker, Whatley, and Sharp (2006), a survey study conducted by an international market research firm found that the respondents in 19 of 34 countries felt their food is less safe now than it was 10 years ago. The complex nature of global food systems, high labor turnover, and increasingly potent pathogens are challenging the food safety measures that foodservice employees face. Adopting and executing food safety training programs are more important than ever to foodservice operators.

Food safety professionals are embattled with many challenges including various age groups, socioeconomic levels, educational and ethnic backgrounds, as well as personal experiences of their trainees and customers. Many grocery stores are adding kitchens and unfamiliar equipment and processes to their businesses to better serve the more diverse food consumers. Products that are new to the traditional retail food industry like raw sushi, ceviche, and imported cheese cause more potential for improper handling of these food products. Ready-to-eat food preparation is a new venture for grocery stores, and current training programs do not exist for this area of the industry (McCulloch, 2009). Metro Food Markets, a 12-store supermarket chain in the Baltimore area, required each employee to become food safety certified

through a three-level training program (Litwak, 1998). Food safety training and certification are a crucial part of any food safety plan (Dummer, 1998).

Food safety can be defined as consuming or eliminating hazards that might contaminate food and cause foodborne illnesses (McSwane, Rue, & Linton, 2003). Estimates of the cost of a foodborne illness outbreak range between \$15,000 and \$75,000 (Binkley & Ghiselli, 2005). Effective food safety plans and a well-trained staff can help prevent an unwanted outbreak of foodborne illness. As food moves from farm to table, repeated handling increases the risk of temperature abuse, cross-contamination, lapses in sanitation, and a host of other potential hazards. Moreover, as the complexities of the food distribution and retailing system increase, so does the need for more stringent food safety controls. Because of this situation, food safety training and certification are an important part of any food safety plan (Dummer, 1998). The retail food industry has been entrenched in the forefront of these important training initiatives because their employees and customers may lack the proper food safety knowledge. Training consumers is considered one of the industry's top three food safety challenges (Binkley & Ghiselli, 2005). The USDA (2000) report on consumer food safety behaviors and consumer concerns stated that education was a determinant of risk-perception (Lyonga, 2009).

In addition to the operational risks, supermarkets must also consider the food safety knowledge of their consumers. The National Restaurant Association (NRA) reports that 945,000 restaurants in the United States generate \$566 billion in sales yearly, representing 4% of the gross domestic product (National Restaurant Association, 2009). Several studies have found that consumers are not knowledgeable about food safety, and those who are may not practice safe procedures in their own home (Anderson, Shuster, Hansen, Levy, & Volk, 2004). In fact, a study by Cody and Hogue (2003) assessed the food safety knowledge and practices of a sample of

persons responsible for the majority of home meal preparation in the United States (Staskel, 2006). Seventy percent of study's respondents did not think that it was common for people in the U.S. to get sick from foods prepared at home.

Statement of the Problem

Food borne illnesses affect millions of people annually and food establishment personnel is at the forefront of prevention. Furthermore, food companies liabilities are inherit as a result of food borne illnesses. Food companies could be sued and/or lose business due to the lack of food safety knowledge of its workforce. The food industry management's food safety knowledge and training have direct impact and affect on consumers.

Purpose

The purpose of this study is to investigate the food safety knowledge gained by certified food managers who attended two self-selected training courses. The study will examine if there was a difference in demographic characteristics and/or food safety knowledge level from two self-selected courses for certified food manager training.

Research Question

What is the food safety knowledge of certified food managers who attended two self-selected training courses?

Research Objectives

1. Describe the demographic characteristics of the participating certified food managers.
2. Determine the food safety knowledge level of the participating certified food managers who were certified from the two self-selected courses.
3. Describe the participating certified food managers' knowledge by each test questions.
4. Determine the level of certified food managers' knowledge by their demographic characteristics.

Limitations

The two self-selected food manager certification courses explored were not controlled in this study. These courses were established and conducted independent of the scope of this research. The research design could not control certain mitigating factors of the training courses, such as the course instructors. Availability of multiple languages factored into the study. The diversity of the foodservice industry was very apparent throughout the investigation. The certified food manager audience in this study showed that the demographic makeup of the participants were not similar to the total food industry ethnicity breakdown. Thus, the researcher decided to include the following details regarding the population. The researcher selected the sample based on convenience and accessibility to the two companies studied due to the researcher's management role within both organizations. Moreover, the researcher had direct accessibility to specific organizational leadership rosters that allowed for more potential participants. Additionally, the researcher's academic endeavors were well-known in both companies participating in the study. In fact, at the time of the instrument deployment, the researcher led bi-lingual certified food manager training for some of the participants, resulting in

a greater response from a particular group of participants. Korean native language participants responded at the highest rate and could be attributed to the aforementioned training led by the researcher. The researcher made assumptions that considered the diversity of the Texas workforce, in which multiple languages would factor into the results of the study. The food companies studied are very high volume and have tremendous emphasis on freshly prepared foods. As mentioned previously, the food companies are offering more fresh food production like ceviche, sushi and tortillas. An example of how training programs are factoring the native language demographic characteristic in recent years is the collaboration between an aerospace company and a local community college. The Goodrich Sensor Systems company partnered with Inver Hills Community College to develop and provide training to non-English speakers at Goodrich facilities in Minnesota in the early 2000's. The results included: (a) enhanced employee skills and improved ability to read technical drawings and job instructions; (b) improved level of participation by native English speakers in the work done by non-native English speaking employees; (c) increased appreciation of the challenges and obstacles non-native English speaking employees face in the workplace; (d) improved communication between managers and frontline employees; (e) manager participation in the training sent a positive message to employees; and (f) improving organizational communication (Minnesota State Colleges and Universities, 2012).

Definition of Terms

ADDIE – an instructional design model that stands for Analyze needs, Design instruction, Develop materials, Implement activities, and Evaluate participant progress and instructional effectiveness (Dick & Carey, 1996)

Andragogy – a term coined by Malcolm Knowles to describe the art and science of helping adults learn (Knowles, Holton, & Swanson, 1998).

FDA Food Code - the federal recommendations for food safety regulations for food and drug industries

Foodborne illnesses - illnesses resulting from the consumption of food

Food safety - eliminating hazards that might contaminate food and cause foodborne illnesses (McSwane, Rue, & Linton, 2003)

Hazard Analysis and Critical Control Points (HACCP) - a preventive management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards

Instructional Design (ID) – a system of procedures for developing education and training programs in a consistent and reliable fashion (Gustafson & Branch, 2002)

Irradiation - the process by which an object is exposed to radiation

Pasteurization - a process of heating a food to a specific temperature for a predefined length of time to destroy pathogens

Ready-to-eat food - food which does not need further processing, such as cooking

Summary

The food service industry is dependent on millions of employees daily to ensure proper and safe food handling of food products consumed by the general public. Texas requires food establishments' management or person in charge to be trained in food protection. The foodservice industry and public health is dependent upon the learning process for serving the consumer safely in accordance to proper food handling procedures. The purpose of this study was to investigate the food safety knowledge obtained via training and certification of food

managers in Texas retail food establishments. Furthermore, this study sought to investigate training courses that use instructional design and adult learning theory. The study examined the certified food managers' knowledge of food safety principles.

CHAPTER II

Review of Literature

Introduction

The scope of this study examined food safety knowledge gained by certified food managers who attended one of two self-selected training courses. During the literature review process, the researcher explored several food safety principles. The scope of the research was focused to include food safety control measures, such as safe food handling practices, hand washing, and food safety systems (HACCP). These food safety principle areas were chosen because of their importance to preventing foodborne illness. Hand washing is highly important to the spread and control of any disease, especially foodborne illness. Pathogens from food, food contact surfaces, and the foodhandler can easily transfer and cause a foodborne illness. Hand washing is critical to prevention and control of the pathogen transfer. Prevention and control are key principles of food safety systems, like HACCP. HACCP allows food companies to focus on control measures for the hazards of food. Throughout the flow of food, safe food handling activities remain paramount for food handlers. For example, the internal temperature of food at delivery is needed just as much as internal temperature when consumers purchase the food item. The researcher also explored two educational theories as they related to the three construct areas in the content of food safety education. The study's theoretical framework includes Instructional Design and Adult Learning theories. This chapter will demonstrate the alignment of this study with previous studies in the education discipline.

Adult Learning Foundation

As people mature intellectually and with age, the role of the learner changes. Tough (1968) stated that each adult learner engages in a learning activity for multiple reasons, including the use of knowledge or skills to take action. The root for adult learners' pursuit of learning is intriguing and grounded in personal growth opportunities. Adults can be ordered into a classroom and prodded into seats, but they can't be forced to learn (Zemke & Zemke, 1995). The findings of Gresh (1995) show that most adult learners preferred hands-on learning. In adult education, learners and teachers must share responsibility for their educational transactions (Knowles, 1970). Adult learners more willingly accept practices that can be demonstrated (Newcomb, McCracken, Warmbrod, & Whittington, 2004). Adults are motivated to learn by both intrinsic and extrinsic factors. These findings are in agreement with the findings of Deci and Ryan (1985) and Knowles (1980) that adults are motivated to learn by internal and external factors.

A pioneering theorist, Eduard C. Lindeman (1926), laid the foundation for systematic theory of adult education and identified key assumptions about adult learners (Knowles, Holton, & Swanson, 1998). Lindeman stated that adult education "represents a process by which the adult learns to become aware of and to evaluate his experience" (Knowles et al.). Cyril O. Houle (1982) performed extensive research to understand the adult education phenomenon. Houle's study of 22 subjects was designed to discover primarily why adults engage in continuing education, but it also helped explain how they learn (Knowles et al.). Houle found his subjects fit into three categories: goal-oriented, activity-oriented, and learning-oriented learners. The goal-oriented learners use education for accomplishing fairly clear-cut objectives (Knowles et al.). These learners were found to have a need for the identification of an interest.

The need for interest appears and the learners satisfy it through taking a course, joining a group, reading a book, or going on a trip (Houle, 1961). The activity-oriented learners take part because they find in the circumstances of the learning a meaning that has no necessary connection with the content or the announced purpose of the activity (Knowles et al, 1998). In Houle's study, all of the activity-oriented people interviewed were course-takers and group-joiners (Knowles et al.). They might stay within a single institution or they might go to a number of different places, but it was social contact that they sought and their selection of any activity was essentially based on the amount and kind of human relationships it would yield (Houle). The learning-oriented learners seek knowledge for its own sake (Knowles et al.). According to Knowles, et al. these learners have been engrossed in learning as long as they can remember. Furthermore, what these learners do has continuity, a flow and a spread that establishes the basic nature of their participation in continuing education (Knowles et al.). Adults are motivated to learn as they experience needs and interests that learning will satisfy; adults' orientation to learning is life-centered; experience is the richest resource for adults' learning; adults have a deep need to be self-directing; and individual differences among people increase with age (Knowles et al.).

The use of andragogical theory is making a difference in the way programs of adult education are being organized and operated, in the way teachers of adults are being trained, and in the way adults are being helped to learn (Knowles et al., 1998). The core adult learning principles are central to the individual and situational differences as well as the learner's purpose for learning. There is evidence that concepts of Andragogy are beginning to make an impact on the theory and practice of elementary, secondary, and collegiate education (Knowles et al.).

Andragogy can be defined as the art and science of helping adults learn (Knowles et al., 1998). Dusan Savicevic, a Yugoslavian adult educator, first introduced the concept and labeled andragogy into American culture in 1967 (Knowles et al.). Malcolm Knowles, known as the Father of Andragogy, theorized adult learning as a journey of learning. As one of the world's leading scholars of adult learning, Knowles' theory of Andragogy focuses on six core principles. The core Andragogy principles illustrated in Figure 1 are (a) the learner's need to know, (b) self-directed learning, (c) prior experiences of the learner, (d) readiness to learn, (e) orientation to learning and problem solving, and (f) motivation to learn (Knowles, 2005). Knowles suggests the learners' need to know centers around adults need to learn something before committing to learning it. Tough (1979) found that when adults undertake something on their own, they will invest considerable energy in probing into the benefits they will gain from learning it and the negative consequences of not learning it (Knowles et al.). The learners' self-directed learning conveys that adults have a self-concept of being responsible for their own decisions, and for their own lives (Knowles et al.). Next, prior experiences of learners factor into the adult learning process. Adults come into an educational activity with both a greater volume and a different quality of experience from that of youth (Knowles et al.). Any group of adults will be more heterogeneous in terms of background, learning style, motivation, needs, interests, and goals than is true of a group of youths. Hence, greater emphasis in adult education is placed on individualization of teaching and learning strategies (Knowles et al.). Readiness to learn suggests adults become ready to learn those things they need to know and are able to do so in order to cope effectively with their real-life situations. There are ways to induce readiness through exposure to models of superior performance, career counseling, simulation exercises, and other techniques (Knowles et al.). Adults are motivated to learn to the extent that they

perceive that learning will help them perform tasks or deal with problems that they confront in their life situations. Furthermore, they learn new knowledge, understanding, skills, values, and attributes most effectively when they are presented in the context of application to real-life situations (Knowles et al.). Bandura (1977) supports Knowles' principle of motivation as a piece of the formula for social learning—the learner will be more likely to adopt the new behavior if it will result in a behavior that is valued by that individual. Tough (1979) found in his research that all normal adults are motivated to keep growing and developing (Knowles et al., 1998). Merriam (1984) concluded that adult development and adult education are inexorably linked through the goals of educational intervention over the lifespan—to promote intellectual enrichment. Knowledge of adult development helps program administrators and planners to provide the type of support services necessary for older adult learners and sheds light on the barriers that older adults might face when going back to school (Bratrud, 1999). The view of social interaction was articulated as social constructivism by Russian philosopher, Lev Vygotsky as well as Albert Bandura. These early researchers proposed that learning is a social construction and for a group of learners whose efforts are to construct a core of knowledge.

The taxonomy of learning, created by a group of psychologists from the University of Chicago has been utilized for categorization of the level of intellectual behavior important in learning (Bloom, 1956). Bloom's taxonomy of learning includes critical levels of thinking separated into six competency categories. The levels of learning competencies increase with complexity through the categorized stages of academic structure.

The learning domain that focuses on objectives addressing the development of students' intellect and understanding is the cognitive domain (Eggen & Kauchak, 2006). Cognitive learning theory is grounded in six basic principles:

1. Learning and development depends on learners' experiences.
2. Learners construct understanding in an effort to make sense of experiences.
3. The understanding learners construct depends on what they already know.
4. Constructing understanding is facilitated by social interaction.
5. Learners learn to do well what they practice doing.
6. Learning experiences that are concrete and connected to the real world result in deeper understanding than those that are more abstract and disconnected. (Eggan & Kauchak, p. 27)

The aforementioned cognitive learning theory principles directly align with the adult learning approaches that Knowles describes in his adult learning theory. Additionally Knowles (1998) suggests the richest resources for learning resides in the adult learners themselves (Knowles et al., 1998). The andragogical processes or models ensure instructional designers consider the way adults learn (Lucas, 2008).

Instructional Design Theory

Reigeluth (1999) defines instructional design as the process used to create instruction, which may include an instructional design model, a framework, and an instructional system. Instructional design processes are closely related to instructional design theory in that different theories require different processes used to apply those theories to particular situations (Reigeluth). Food safety training is extremely important in the retail food industry because food service employees may lack adequate food safety knowledge. Thus, food safety training courses provided to these food service individuals need to be developed and delivered properly. For example, (Figure 2.1) the *Dick and Carey Model* (1985) details that instructional design process

from stating goals and writing objectives to developing materials, assessing instruction, and grading (Dick & Carey, 1985).

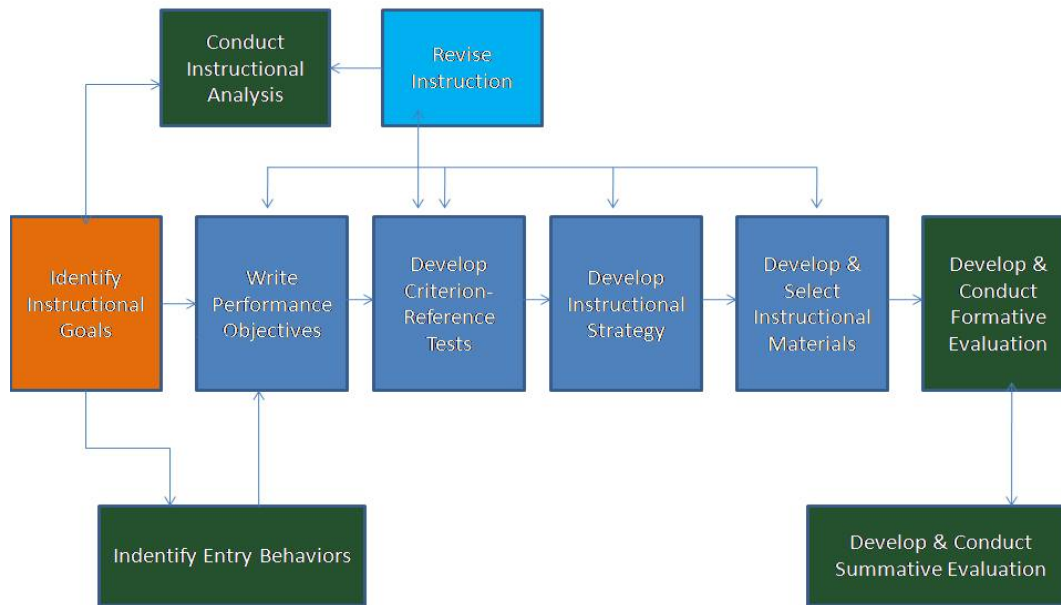


Figure 2.1 – Dick and Carey Design Model

Dick and Carey (1985) also suggested every instructional designer should have knowledge of the instructional design process. In 2005, James Carey joined Dick and Carey to publish the Dick, Carey, and Carey Model. The Dick, Carey, and Carey Model has 10 components:

1. Identify instructional goals.
2. Conduct instructional analysis.
3. Analyze learners and contexts.
4. Write performance objectives.
5. Develop assessment instruments.
6. Develop instructional strategy.

7. Develop and select instructional materials.
8. Design and conduct formative evaluation of instruction.
9. Revise instruction.
10. Design and conduct summative evaluation.

The “ADDIE” instructional design model is a colloquial term used to describe a linear, but systematic approach to instructional development (Molenda, 2003). The model seems not to have a single author, but rather it seems to have evolved informally through oral tradition (Gustafson & Branch, 2002). ADDIE is an acronym that depicts the major processes of this instructional design model process: analysis, design, development, implementation, and evaluation. The ADDIE instructional design model is aligned with the theoretical framework of constructivist learning theory of social constructivism.

Only during the latter part of the twentieth century has research sought to unravel the mysteries of the creative realm and place emphasis towards its value in the goals and methods of the United States educational system (Torrance & Goff, 1992). B.F. Skinner (1954) developed the learning theory emphasizing reinforcement. Education is perhaps the most important branch of scientific technology (Skinner). Skinner’s research suggested that programmed instruction could change and accelerate the educational process. Furthermore, Skinner’s research began with experimental works of reinforcement of the controlled response of pigeons. Skinner applied his experiment in learning to the educational discipline. Skinner’s programmed instruction learning theory has important characteristics that include: (a) immediate reinforcement for the correct response; (b) individualization of learning so individuals can proceed at their own rates; (c) each phase of learning is presented in a small step, termed a frame; and (d) teaching time can be better organized to allow the teacher more planned time with each student.

Skinner's (1954) programmed instruction learning theory has been influential to organizational and corporate training. Hughes and McNamara (1961) devised a programmed instruction for International Business Machines (IBM) Corporation employees. The programs covered a sixteen-week course. Compared to the controlled-conventional group using the lecture-discussion method, the experimental programmed learning group covered the same material in less time and with more learning achievement. The findings from the study suggest a reduction of employee training days, more decentralization of training, and better-trained employees. Programmed instruction and materials have also been used in the United States armed forces.

Through their involvement, students, peers, and their instructional designer can become fellow stakeholders in the educational process (Schussler, 2010). Regardless of delivery method, learning-oriented alignment will be evident when "articulation among learning objectives, content, instructional design, instructor expertise, technological affordances, and assessment strategies is as clear as possible" (Reeves, 2000, p. 106). For example, food safety subject matter experts like Laura Green-Brown and David McSwane are often called upon in the instructional design process for food manager certifications.

Despite this tendency, instructional designers who are prompted to envision ideal learning outcomes for their students may well be motivated to seek deeper approaches to learning (Fink, 2003). It is for this reason that it is vital to gather those involved in the instructional design process during the planning phase of an assessment activity to produce greater alignment between objectives, activities, and assessment strategies (Fink, 2003).

Community engagement allows stakeholders to work collaboratively to address the root causes of unsafe food handling practices by creating an environment in which there is a

collective movement toward higher food safety standards (Kauppi & Jenkins, 2010). Food managers and sanitarians have been integral to the certified food manager program through field testing and providing essential feedback to make improvements. National Restaurant Association's Solutions program credits their expert professional contributors for their curriculum. The strength of their programs is based on contributions from academia, the regulatory community, and industry sector (National Restaurant Association, 2010).

The literature also revealed instructional design theory as it related to the learning process as follows: "focuses on the results, performance, and events to enhance the learning" (Reigeluth, 1999, p. 6). According to Reigeluth, during the industrial-age paradigm of instructional design theory, the focus was on the cognitive domain. Cognitive learning encompasses gaining knowledge, acquiring skills, and developing intellectual abilities predominantly with memorization and procedure training (Dittmar, 2009). Complex food systems, high labor turnover, and increasingly dangerous pathogens are challenges that foodservice employees encounter daily. Knowledge of these critical elements is important to the success of all foodservice employees and it magnifies food safety systems like HACCP.

Foodborne Illnesses

Processed food might contain harmful microorganisms, such as bacteria, which are responsible for outbreaks of food poisoning (Ballard, 2009). Food poisoning is more technically known as foodborne illness. A foodborne illness is a disease transmitted to people by food (ServSafe, 2012). When two or more people have the same symptoms after eating the same food it is considered to be a foodborne illness outbreak (Servsafe). Some pathogens make you sick when you eat them; others produce poisons—or toxins—that make you sick (ServSafe). Pathogens should be destroyed when possible by cooking, pasteurization, or even irradiation.

Control measures can reduce the spread of pathogens by proper handwashing and safe food handling. A food may be perfectly safe for one person but potentially harmful for another (Ballard, 2009). Common symptoms of foodborne illness are diarrhea, vomiting, fever, nausea, abdominal, and jaundice. Individuals who are sick with a foodborne illness will not share all of these symptoms. Foodborne illnesses and symptoms can range from thirty minutes to as long as six weeks. The health and wellness of the individual dictates the severity of the illness. Certain groups of people have a higher risk of getting foodborne illness (ServSafe). The populations at high risk for foodborne illness are elderly people, young children, pregnant women, and people with compromised immune systems. These high-risk populations are highly susceptible to foodborne illness due to their immune system being weakened by age and/or medical condition. According to Ballard, medical conditions can also make it unsafe for a person to eat certain foods. In fact, special regulatory controls have been instituted to reduce the potential of foodborne illnesses for these individuals. Hospitals and nursing homes are not allowed by food safety regulations to serve raw seed sprouts like alfalfa or bean sprouts due to the pathogen concerns.

The first reported cases of foodborne illness were linked to a cook from Ireland named Mary Mallon. From 1900 to 1906, Mary Mallon later to be known as “Typhoid Mary” worked in New York. Reports show that Mary was a carrier of typhoid, which meant that she displayed no symptoms of the disease. As a carrier of the disease, Mary passed the germs on to others. Typhoid is an illness caused by a salmonella bacterium that is spread through food or water (Silverstein, 2008). “Typhoid Mary” most likely spread the disease when she cooked for people with unwashed hands after going to the bathroom (Silverstein). Investigations of the typhoid outbreak resulted in Mary Mallon being quarantined until 1910. In January 1915, there was a

typhoid outbreak in Manhattan where twenty-five people got sick, and two of them died (Silverstein). Evidence pointed to a cook named Mrs. Brown—who turned out to be Mary Mallon, using a fake name (Silverstein). This outbreak resulted in Mary Mallon being arrested and quarantined for the remainder of her life.

The private and public communities were greatly affected by these outbreaks linked to food and food preparation. The United States government realized that actions needed to be taken to protect the food supply. President Theodore Roosevelt signed the first food and drug act in 1906 (Kalbacken, 1998). The United States Food and Drug Administration (FDA) is federal agency responsible for the nation's food. Although it was not known by its present name until 1930, FDA's modern regulatory functions began with the passage of the 1906 Pure Food and Drugs Act, a law a quarter-century in the making that prohibited interstate commerce in adulterated and misbranded food and drugs (Food and Drug Administration, 2010). These regulatory organizations have drawn criticism for the rise in foodborne illness outbreaks in the last twenty years. Many critics and experts, alike have spoken out regarding the federal food safety programs. The Government Accounting Office reports that in 2007, fewer domestic food companies were inspected than in 2001, even though the number of firms under FDA's watch increased from about 51,000 to more than 65,500 (Food and Drug Administration, 2011). In a recent speech, President Obama noted that inadequate funding and staffing at FDA have led to a dramatic drop in inspections in recent years, leaving 95% of domestic food plants unexamined by federal officials (McSwane, 2009). The FDA Food Safety Modernization Act (FSMA), the most sweeping reform of our food safety laws in more than 70 years, was signed into law by President Obama on January 4, 2011 (McSwane). It aims to ensure the U.S. food supply is safe by shifting the focus from responding to contamination to preventing it (Food and Drug

Administration, 2010). The food industry has taken notice of these changes with FSMA. Thus, the food industry and state/local regulators await revisions of the FDA's Model Food Code. The FDA recommends each state adopt the Model Food Code, which is a science-based code of food safety regulations at the federal level. Each state then is strongly encouraged to adopt latest guidelines from the Model Food Code into their states' statutes as food law. The FDA inspects all food except meat, poultry, and eggs (ServSafe, 2012). The United States is often said to have a two-pronged food safety regulatory system, with the U.S. Department of Agriculture (USDA) responsible for inspecting meat, poultry, and eggs, while the FDA oversees the other fresh and processed foods that make up 80% of the food supply (Hargan, 2012). The USDA also plays a role in the nation's food safety. It has food safety regulatory mandates centering on the flow of the food system from farm to fork. Programs include food handling, food recalls, food irradiation, and foodborne illness prevention. Figure 3 further details the organizations that regulate food in the United States. The Center for Disease Control and Prevention (CDC) conducts research into the causes of foodborne illness outbreaks. The CDC also offers technical expertise, information and scientific tools to help the food safety efforts of the regulatory community. Food safety focuses are critical outside the United States as well. An international body called the World Health Organization (WHO) monitors food-related disease throughout the world (Ballard, 2009). The WHO provides information and guidance to countries on many topics, including:

1. Foodborne disease outbreaks and incidents of food contamination
2. How to improve the surveillance, identification, and isolation of foodborne disease outbreaks
3. How to contain the spread antibiotic resistant microorganisms from animals to humans

4. The safety of new types of food, including GM foods
5. The safe handling and preparation of food. (Ballard, 2009, p. 6)

Contaminants of food cause foodborne illnesses and these contaminants come from a myriad of sources. The presence of harmful substances in food can be biological, chemical, or physical. Many contaminants of food are found in the animals we use for food (ServSafe, 2012). Harmful microorganisms are called pathogens (ServSafe). The four types of pathogens that are known to cause foodborne illnesses are bacteria, viruses, parasites, and fungi.

Biological contaminants like these pathogens can affect farm animals such as poultry, cattle, sheep, and pigs. The farm animals may pick up an infection from other animals, from animal waste, or from contaminated equipment (Ballard, 2009). Biological contamination can occur easily from food handlers as they perform their daily foodservice activities. The pathogens can be passed from person to person, through sneezing or coughing, and touching dirty or raw foods without proper hand washing practices.

Physical contaminants occur when objects get into the food. Physical contaminants are common objects that get into food like metal shavings, fingernails, glass, jewelry, hair, and dirt. Some contaminants occur naturally in food, such as the bones in fish (ServSafe, 2012). Other contaminants like detergent solutions, equipment lubricants and polishes, and sanitizers are categorized as chemical contaminants. Chemicals have routinely been found to contaminate food when improperly stored. Certain types of kitchenware and equipment can be risks for chemical contamination (ServSafe). Zinc, copper, and pewter are a few of the types of metals that can cause contamination of food. These galvanized metals are very susceptible to contamination of food when used to prepare or store acidic foods, such as tomato sauce.

Prevention measures should be taken with foodservice chemicals and pesticides. Chemicals and

pesticides used in foodservice must be approved by regulatory authorities for use in food establishments. Pesticide chemicals are used to kill insects that might damage our food (Kalbacken, 1998). Chemicals and pesticides must be separated from and never applied above food and food-contact surfaces by spacing and partitioning (ServSafe). Additionally, proper use and application of the chemicals and pesticides according to the manufacturers' directions and current Materials Safety Data Sheet (MSDS) should be readily available. Control measures for contamination must be implemented at points in the flow of food, including the food source. Good agricultural and manufacturing practices are paramount in their respective industries. These practices are grounded in the aforementioned prerequisite programs of time and temperature control, contamination prevention, and personal hygiene programs. Many foodborne illnesses have been traced back to the farm or manufacturing facility. For example, wastewater may contain toxic chemicals that soak into the farmland soil and be taken up by plants and animals growing there. Ballard (2009) stated that research found traces of pollutants in some meat and meat products.

Twelve times in 2007 and 2008, the FDA found strains of salmonella at the Peanut Corporation of America's processing plant in Blakely, Georgia (Ballard, 2009). In 2009, one of the United State's most publicized foodborne illness outbreaks involved a household staple, peanut butter. Dr. David McSwane, a professor of public health and chair of the Division of Epidemiology and Environmental Health Science in the Department of Public Health at the Indiana University School of Medicine, published an essay summarizing the impacts of peanut butter foodborne illness outbreak (McSwane, 2009). The foodborne disease outbreak linked to products containing salmonella-contaminated peanut butter produced by the Peanut Corporation of America (PCA) has adversely affected the health and economy of our country and consumer

confidence in our nation's food supply. This multi-state outbreak has caused at least 691 people in 46 states to become ill and contributed to nine deaths. More than 2,100 products in 17 categories have been voluntarily recalled by more than 200 companies, and the list continues to grow. While the true cost of the outbreak and the recall it triggered won't be known for some time, experts estimate the total cost may easily exceed \$1 billion. A survey conducted by the Food Industry Center at the University of Minnesota revealed that fewer than one in four consumers think the United State's food supply is safer now than it was a year ago, a drop of more than 20 percent since the salmonella outbreak in peanut butter. PCA suspended operation of its Plainview, Texas facility on February 10, 2007 at the request of the Texas DSHS, after several conditions that posed human health risk were discovered (Food and Drug Administration, 2011).

Botulism is the deadliest form of food poisoning in history (Silverstein, 2008). Botulism has been linked to improperly canned goods. The first reported outbreak was in 1973, in Germany. It affected thirteen people, killing six of them, after they ate contaminated blood sausage (Silverstein). Sausage poisoning was named botulism, which is Latin for “sausage” (Silverstein, p. 24).

In September 2006, grocery stores in more than twenty states had to pull bags of prepackaged spinach off the shelves. Outbreaks of food poisoning affecting more than one hundred people—including at least one death—had been traced to fresh spinach grown on a farm in California (Silverstein, 2008). Wild pigs were linked to the field where the spinach was grown and they could have transferred the bacteria through their waste to the irrigation water used on the spinach crop (Silverstein).

Norovirus is a leading cause of illness from contaminated food in the United States (Centers for Disease Control and Prevention, 2011). According to the CDC, about 50% of all outbreaks of food-related illness are caused by norovirus. Recently, cruise ships have been implicated in norovirus outbreaks. In February 2012, two Princess Cruise Line ships reported more than a one hundred cases of norovirus onboard. Cruise ships have struggled with containing the threat of the norovirus, which is common in the general population but which spreads easily among large groups in concentrated areas (Wagner, 2012). According to the CDC, there are about 23 million land-based norovirus cases in the United States each year, affecting one in twelve people, or eight percent of the population (Wagner, 2012). Proper handwashing practices are the most effective preventive measure for norovirus.

In early 1990's Jack in the Box restaurants experienced a foodborne illness outbreak involving hamburgers that piqued this researcher's interest in food safety education. On January 15, 1993, the Washington State Health Department alerted Robert Nugent, president of Jack in the Box, that the *E. coli* outbreak they had been informed of two days earlier was at least partly attributed to hamburgers purchased at Jack in the Box restaurants (Sellnow & Ulmer, 1995). The source of the contamination was identified as undercooked ground beef. Jack in the Box's parent company claimed they first learned of the potential contamination on January 17, 1993 and their initial responses were to destroy 20,000 pounds of potentially contaminated meat, to switch meat suppliers, to set up a toll-free number for complaints, and to raise cooking temperatures. Collectively this response was seen as a positive move (Soeder, 1993). Reports indicate that four individuals died and hundreds were sickened by the *E.Coli* outbreak. Brianne Kiner was one of more than seven hundred people across four states affected by the *E. Coli*-tainted Jack in the Box burgers in 1993 (Silverstein, 2008). As a result, Jack in the Box made significant changes to

their food safety and operational policies including implementing HACCP principles into all of their facilities.

Hazard Analysis Critical Control Point (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 (Food and Drug Administration, 2011). According to the National Restaurant Association (NRA) (2009), food safety must be scientific and risk-based. In cooperation with federal and state health officials, the NRA has developed state-of-the-art model regulations and educational and informational materials based upon current science, risk, and HACCP. HACCP has been mandated for meat, seafood, and poultry processing facilities since the 1990s. Voluntary HACCP has been implemented in many retail food establishments and highlights those organizations' food safety focus. For example, a small south Texas company developed and implemented a HACCP program for its retail operations in 2003. Not only did their food safety performance improve, but so did the company's product sales. Food safety systems like HACCP need to be built upon strong prerequisite procedures and safe food handling practices to reduce the potential for foodborne illness.

HACCP was developed in the 1960s by the Pillsbury Company while working with NASA and the U.S. Army. The intent was to provide safe food for space expeditions. HACCP has been widely used by the food industry since the late 1970s. In 1995, the FDA issued regulations that made HACCP mandatory for fish and seafood products, and in 2001 they issued regulations for mandatory HACCP in juice processing and packaging plants. In addition, a voluntary HACCP program was implemented (Goodrich, Schneider & Schmidt, 2008). The

1996 Washington state *E. coli* O157:H7 outbreak that resulted in 66 ill and one person dead, brought about change in the regulation of HACCP in the juice industry (Lucas, 2008).

The HACCP systems allow control of food production to assure that contaminants, pathogenic microorganisms, processes, distribution, storage, or consumer usage that could contribute to a perceived or real hazard are controlled (Cross, 1995). Significant hazards for a particular food product are identified after a review of all of the processing steps and use of scientific information (Goodrich et al., 2008). These hazards are categorized into three types: physical, chemical, and microbiological. The critical control point (CCP) is the point at which the aforementioned hazards are prevented, eliminated, or reduced to safe levels. HACCP includes prerequisite food safety programs like basic food handling practices, time and temperature control, as well as elements of Quality Control, Total Quality Management, and Good Manufacturing Practices. The National Advisory Committee on Microbiological Criteria for Foods (NACMCF) defined HACCP as a systematic approach to the identification, evaluation, and control of food safety hazards in foods based on seven principles:

1. Conduct a hazard analysis, whereby food safety hazards are identified and evaluated.
2. Identify critical control points (CCPs).
3. Establish critical limits for each critical control point.
4. Establish critical control point monitoring procedures.
5. Establish corrective actions.
6. Establish verification procedures.
7. Establish record-keeping and documentation procedures. (NACMCF, 1997)

Principle 1 - conducting a hazard analysis entails identifying and assessing potential hazards in the food process. These hazards are physical, chemical, and microbiological. For example, the

process should begin with the review of the food menu to determine food items and how they were received, stored, prepared, cooked and served. Principle 2 – determining CCPs is the point in the food process at which the hazard can be prevented, eliminated, or reduced to safe levels. CCPs are steps or processes that are scientifically based. The food process is not limited one CCPs per control measure. For example, the microbiological hazard, *E. coli* O157:H7, which could be present in ground meat, is eliminated with time and temperature application of heat at 155F for 15 seconds. The internal temperature is the temperature of the food, not the oven (Silverstein, 2008). A thermometer can be used to ensure accurate internal temperature is met. Beef roasts and steaks should be cooked to at least 145F (Silverstein). Principle 3 – establishing critical limits for each CCP. This principle establishes a criterion that must be met for each preventive measure associated with a critical control point. Critical limits are minimum and maximum parameters for safety which need to be specific and exact. The critical limits must be met to prevent or eliminate the physical, chemical, and microbiological hazard. Principle 4 – establishing monitoring procedures for each critical limit. Routine checks of the critical limits are paramount to measure and control the food safety process. Hourly temperature checks with a calibrated, clean, and sanitized thermometer used on grilled chicken, for example, by the Executive Chef, is a method for monitoring in a restaurant. Principle 5 – identifying corrective actions that will be taken when a critical limit is not in compliance. When there is a deviation from a critical limit, there are actions that need to occur to regain control of the food process. Under the right conditions—a warm, moist environment with plenty of food germs can grow and multiply (Silverstein). For example, a chef is cooking a hamburger. The chef measures the internal temperature at 145F. The chef has not met the critical limit for ensuring the hamburger is free of *E. coli* O157:H7, which could be present in ground meat. Undercooked food can

contain microorganisms that can multiply inside the body after food is eaten, causing food poisoning (Ballard, 2009). Although some people like to eat their meat pink or rare, it is safer to cook it thoroughly (Ballard). The chef's corrective actions should include the continuation of the cooking process until the hamburger reached an internal temperature of at least 155F for 15 seconds. The USDA recommends an internal temperature of 161F for hamburger. Principle 6 – establishing verification procedures at which the system is evaluated on a regular basis. This principle ensures that the HACCP plan is working effectively on a day-to-day basis. A Texas food service company, for example, utilizes a cross-functional team HACCP committee to verify their system bi-annually. Principle 7 - establishing record-keeping and documentation procedures complete the HACCP process. This principle establishes a documentation system for the HACCP plan. Lastly, this principle includes all of the documents, plans, and records utilized in the HACCP system.

Safe Food Handling

Safe food handling is essential to preventing foodborne illness. The USDA recommends four guidelines to keep food safe: a) Clean—wash hands and surfaces often; b) Separate—don't cross-contaminate; c) Cook—cook to proper temperature; and d) Chill—refrigerate promptly (United States Department of Agriculture, 2009). The University of Northern Illinois (UNI) found that their foodservice employees' food safety knowledge needed to be improved. UNI decided to build their total food programs to maintain a training system that was effective, efficient, and accessible.

In 1878, Louis Pasteur published a paper detailing his “germ theory” of disease (Silverstein, 2008, p. 24). Pasteur's experiment used heat to kill harmful microorganisms in beer and wine. He found that the wine-spoiling creatures could be destroyed by heating the wine to

135F (Silverstein). Harmful microorganisms in milk were destroyed when the milk was heated to 161F (Silverstein). By 1917, most major cities in the U.S. had laws requiring that milk be pasteurized (Silverstein). Many of the safe food handling activities involve employee physical labor; therefore, the hands-on modules aforementioned have to be considered.

Activity Theory, which provides a way of looking at activity that incorporates the individual and the contextual setting (Barab, Evans, & Baek, 2003), was used as the theoretical basis to analyze these data to describe and understand the instructional design process as it occurs in corporate settings (Fortney, 2009). Temperature monitoring, for example, is regarded as one of the most important foodservice activities of the food safety process. Topics related to time and temperature control include minimizing time in the food temperature danger zone; proper steps for thawing, cooking, cooling, hot holding, cold holding, re-heating, and storage; and working with small batches and time as a public health control (McSwane, 2010). Failures in this area have attributed to more than 50 percent of the reported foodborne illnesses annually in the U.S. (McSwane).

At every step in the flow of food, food handlers can contaminate food (ServSafe, 2012). Contaminants come from animals, soil, dirt, water as well as many more sources. Any food handling should begin with clean hands, clean cooking tools, and a clean work area (Kalbacken, 1998). Cross-contamination can be avoided by using separate equipment for each type of food, proper cleaning and sanitizing of all equipment, prepping foods at different times, as well as purchasing food from approved reputable suppliers. Improper food handling actions can easily facilitate pathogen transfer from a food handler to a food and/or food contact surface. For example, pathogens can contaminate food through cross contamination from an unwashed hand of a food handler to a ready to eat food like deli sandwich. Proper storage guidelines are equally

important to preventing cross-contamination. Food should be stored in a clean, dry location away from dust and other contaminants (ServSafe). Storage order should ensure that raw meats, poultry, and seafood are separated and placed below ready to eat and cooked foods.

Actions like scratching the scalp, rubbing an ear, coughing, and sneezing can contaminate food via the food handler. Sound personal hygiene practices are critical to the food safety practices of any food handler. A good personal hygiene program also in helps everyone feel confident in the cleanliness of the business (ServSafe, 2012). Personal hygiene programs should include proper hand practices anchored by strong hand washing policies. Personal cleanliness and wellness is also critical. Food handlers should maintain good health, cover wounds, and report illnesses to management. One of the more critical sources of contamination involves fecal-oral transfer of pathogens. For example, a food handler doesn't wash their hands after using the restroom and proceeds to handle food and/or food contact surfaces. The CDC suggests that consumers can protect themselves from food poisoning by properly washing hands for 20 seconds with soap and running water.

Hand Washing

In the conjunction with the aforementioned HACCP food safety controls and safe food handling practices; hand washing is critical to reducing the spread of harmful bacteria. The hands of foodservice staff can be vehicles in the spread of foodborne disease because of poor personal hygiene. A study by York, Brannon, Shanklin, Roberts, Howells, & Barrett (2009) found that hand-washing knowledge improved after training, but overall knowledge, knowledge of thermometer usage, and proper handling of work surfaces did not improve (York et al.). This study concluded that hand-washing knowledge continued to be better than baseline levels after

the intervention, suggesting the intervention may have reinforced knowledge gained through training (York et al.).

The Texas Food Establishment Rules (TFER) or the Texas Food Law, states food employees shall keep their hands and exposed portions of their arms clean (TFER, 2006). Poor personal hygiene causes more than 90% of the sanitation problems in the foodservice industry. Government statistics show improper hand washing alone accounts for more than 25% of all foodborne illnesses (Weinstein, 1991). Bacteria can be spread throughout the kitchen and get onto hands, cutting boards, utensils, counter tops, and food. The TFER further prescribes that food employees shall adhere to a hands- and arms-cleaning procedure. Food employees must wash their hands with warm water and soap for at least 20 seconds before and after handling food (TFER, 2006). Frequency of hand washing is also detailed in the Texas Food Law that include time when hands have been potentially contaminated after using the bathroom, handling raw foods, touching any parts of the body, and after handling soiled utensils or equipment.

A hand washing study conducted by Montville (2002) simulated factors that influence the levels of bacteria on foodservice workers' hands. The information collected included: initial bacterial counts on hands and water faucet spigots, bacterial population changes during hand washing as effected by soap type, sanitizing agent, drying method, and the presence of rings. During food handling and preparation, bacteria on raw foods can be transferred to the hands of a food worker and subsequently to other surfaces (Montville). According to the United States Food and Drug Administration Center for Food Safety & Applied Nutrition (2004), hands may become contaminated when employees engage in activities such as handling raw animal foods, using the restroom, or handling soiled tableware. Hands are a common vehicle for the transfer of harmful bacteria and viruses to food products.

The hand is also a potentially critical point for cross contamination for ill and asymptomatic food workers who may shed high levels of pathogens in their feces (Rocourt & Cossart, 1997). Ring wearing was found to decrease the efficacy of hand washing. The analysis revealed that the primary factors influencing the final bacterial counts on the hand were (a) sanitizer use, (b) soap use, and (c) drying method (Montville, 2002). Proper hand washing can reduce the risk of bacterial contamination on hands. The lack of convenient hand washing facilities and/or supplies of hand cleanser/drying devices may contribute to the lack of proper hand washing. Reinforcing the importance of hand washing should be supported by a management system that includes proper employee training and monitoring of the frequency and effectiveness of hand washing practices (Montville). While hand washing continues to be a primary concern, the results from the Montville study show a relatively high In Compliance percentage (90.4%) for preventing direct hand contamination with food in delis. The retail food management in delis operations appears to be making a concerted effort to eliminate bare hand contact with ready-to-eat foods (FDA/CFSN, 2004).

In 2002, the UK's Food Standards Agency found that 39 percent of 539 managers and 477 staff of catering companies in Great Britain and Northern Ireland did not wash their hands after visiting the lavatory and 53 percent did not wash their hands before preparing food (Hertzman, 2007). Several studies have investigated the relationship between the food employees' knowledge of food safety and their safe food handling behavior. For example, managers rated staff with good hygiene knowledge the most important aspect ensuring safe food (Kramer & Scott, 2004). It only takes one food handler infected with Hepatitis A to cause a food borne illness outbreak. One research study conducted on the gap between food handler self-reported behavior and food safety knowledge illustrates a link to the food safety knowledge

question. Fifty-nine percent of workers said they sometimes or often did not carry out all food safety actions they knew they should (Clayton, D., Griffith, C., Price, P., & Peters, A. 2002). Stivers and Gates (2000) study identified a safe food handling connection between knowledge and self-reporting behavior. Only 40% of workers knowledgeable about the safe seafood handling practices also reported engaging in safe seafood handling practices (Stivers & Gates). Though some called this connection weak there is still worthy examination of the role that the food safety knowledge and behavior play in the food handling process. Workers' observed hand-washing behavior did not improve after training (Howes, McEwen, Griffiths & Harris, 1996). Only 28% of workers knowledgeable about hand hygiene washed their hands when they should have (Oteri & Ekanem, 1989). In these studies, the researchers examined the linkage between the food handlers' individual knowledge and their observed behaviors.

Lin, Jensen, and Yen (2005) found that awareness of microbial pathogens is associated with consumers' food safety perceptions, knowledge of potentially risky foods and food safety hazards, food safety behaviors, and demographics (Lyonga, 2009). This is supported by other research, most notably by Altekruze et al. (1995) who reported that respondents with a basic knowledge of microbiology tend to be motivated to use safe food storage, handling, and preparation practices (Bolton & Kennedy, 2002).

Several researchers examine the link between knowledge and behavior indirectly with food establishment inspection results (Green-Brown, 2010). These studies investigate the connection via health department inspections rather than the observed food handlers' actions and/or behavior. This research is inconsistent. For example, one research study found that critical violations and inspection scores improved after managers completed a 15-hour food safety training program (Cottrchio, M.J., Gunn, T., Cofill, P., Tormey, X. & Barry, A., 1998).

No differences in inspection scores were found between restaurants with food safety and restaurants without (Wright & Feun, 1986).

Training and Certification

One of the most important aspects of food safety training is being able to match the content and format of the training with the needs and learning styles of the learners. The retail food industry is noted for having a very diverse workforce. For many employees, English is not their native language. Retail food workers could be illiterate in both English and their native language. This can create significant communication barriers when trying to teach food safety principles and practices (McSwane, 2010). A study by Gettings and Kiernan (2001) validates previous research emphasizing the important role that educators can play in food safety education and extends the implications to the high-risk population (Finch & Daniel, 2005). The United States' ever-changing demographics also pose challenges for the foodservice industry. For example, a Prevention Magazine/NEC poll found that 29 percent of those surveyed wait two hours or more before eating takeout foods from restaurants without having first refrigerated them (Larson, 1998). Many grocery stores are adding kitchens and unfamiliar equipment and processes to their businesses to better serve the more diverse food consumers. Products that are new to the traditional retail grocery industry like raw sushi, ceviche, and imported cheese cause more potential for improper handling of these food products.

Training is a tool needed to make food workers aware of the hazards associated with foods and the food safety practices that must be used to prevent foodborne illness (Bryan, 2002). Food Safety training and certification are a crucial part of any food safety plan (Dummer, 1998). In fact, certification is required in Texas for any person in charge of retail food establishments. The Texas Department of State Health Services (DSHS), Certified Food Manager (CFM)

Program has been accrediting food manager training courses since 1988. In 2010, the Texas DSHS made significant changes to their CFM program including extending the renewal requirements from two years to five years. In the year 2000, Florida made changes to their food safety regulations, mandating that all employees in food service must receive food safety training (Hammond, 2005). Training is a necessary tool needed to make food workers aware of the hazards associated with foods and the food safety practices that must be used to prevent foodborne illness (Bryan). Rowell's (2011) study suggests that many individuals in the food service industry have some form of training. Another study by Cates (2002), suggests that food establishments with certified kitchen managers present were less likely to have critical violations for personnel, food handling, warewashing, and facility and equipment requirements. However, the Cates' study indicated that having a certified kitchen manager does not prevent all violations and that improvements are needed to ensure that employees understand food temperature and time control. A study conducted by Dooley, Van Lannen, and Fletcher in 1999 concluded that there was a substantial increase in self-reported knowledge of the HACCP concept and principles after attending the TAEX training, as compared to before the training. Furthermore this research team suggested that one can conclude that the Food Safety Instructor Training using distance education was very effective in disseminating the concept and principles of HACCP to the FPM instructors (Dooley et al.).

Summary

Adult education and training programs in agriculture should use appropriate and effective instructional methods (Creswell & Martin, 1993). Creswell and Martin's linkage between adult education and instructional design as it is related to agriculture echoes the researcher's desire to investigate this study regarding certified food manager training courses. The mission of

agricultural education is to help people improve their lives through an educational process using scientific knowledge focused on issues and needs (Trede & Wade, 1993).

The National Restaurant Association (NRA) has developed tools to support education through its philanthropic educational foundation. *ServSafe* and *ManageFirst* are examples of educational resources that the NRA provides for the foodservice industry. *ServSafe* and *ManageFirst* both utilize andragogy and programmed instruction learning theory principles for program and curriculum development. The NRA also enlists support in developing its educational tools from the restaurant and foodservice industry and academic partnerships it has formed over the last 90 years. *ServSafe* is a nationally recognized certification course that conveys food safety curriculum to ensure a learner's knowledge is at an acceptable level.

Learning outcomes are precise statements of what faculty expects students to know and to be able to do in some measurable way as a result of completing a program, course, unit, or lesson (Anderson 2006; Huba & Freed 2000). Proper training is vital for getting food workers to remember important concepts about food safety and implement proper practices and procedures on a consistent basis to ensure that food served or sold is safe and secure (McSwane, 2010).

CHAPTER III

Methodology

Introduction

In this chapter, the researcher will outline the methods used to study food safety knowledge gained by certified food managers who attended training course A and training course B. The participants were all previously certified as a result of successfully passing a certification examination. Successful food manager certification is achieved with a score 75% or greater on the food manager certification exam at the conclusion of their training from the two self-selected courses. Certified food managers are required by the state of Texas and many local municipalities to ensure retail food establishment have the necessary knowledge to serve and sell food safely. As a mutual benefit, the certified food manager training program reduces the food companies' liabilities as it relates to consumers' illnesses from food.

The researcher had intimate knowledge of both courses; in fact, the researcher had first-hand experience delivering the content, examination, and certification of each. The researcher's professional experience includes food safety education and has been exposed to several different food certification training courses, including the two courses explored in this study. In fact, the researcher provided certified food manager training utilizing the two self-selected courses for more than three years in each company participating. As previously mentioned, at the time of the instrument deployment the researcher had recently led training and certification for some of the participants. Korean native language participants responded at the highest rate and could be attributed to the aforementioned training led by the researcher. Furthermore, the survey identified several of the participants that had also been students of trainings the researcher led for both companies of the two self-selected courses. The participating certified food managers had

two primary choices for their Certified Food Manager (CFM) training. This study was not intended to suggest either of the two self-selected courses as superior. The researcher's objectives for the study were as follows, (a) to describe the demographic characteristics of the participating certified food managers, (b) to determine the level of certified food managers' knowledge for each course type, (c) to describe the certified food managers' knowledge by test questions, and (d) to determine the level of certified food managers' knowledge by their demographic characteristics.

The training courses A and B are both recognized and accepted by the Texas Department of State Health Services. The Texas Department of State Health Services(DSHS), Certified Food Manager (CFM) Program has been accrediting food manager training courses since 1988 (Texas Department of State Health Services, 2012). The American National Standards Institute (ANSI) is the accrediting organization and any CFM accredited course in Texas must meet ANSI standards. The ANSI-CFP Accreditation Committee (ACAC) was created as the vehicle with which to implement this agreement, and is responsible for accrediting personnel certification bodies that certify food protection managers (Conference for Food Protection, 2012). Standards for accreditation of Food Protection Manager Certification Programs were met by both training courses. Thus, the two self-selected certification course examinations must also meet the ANSI-CFP standard. Each course examination studied entailed different test questions, but each course's test questions equally address the food safety areas as required by ANSI-CFP and Texas DSHS-CFP. The food safety areas included the examinations were also explored in this study; safe food handling practices, hand washing, and food safety systems. Training course A and B food manager certificates issued received Texas state-wide reciprocity. In Houston, for example, the training courses A and B Certified Food Managers are able to receive local reciprocity. The

certified food manager would receive certification by the City of Houston and not need additional certification training.

Training course A used instructional design and adult learning theory in the development of the course. This training course design was performed by professional instructional designers, food safety and industry experts, and academia. Training course A combines the *FDA Food Code*, food safety research, and food safety training experience to meet national standards to be used in multiple states. Training course A is by federal, state, and local food regulatory authorities. Training course A has multiple delivery capabilities, including online and traditional, face-to-face classroom lecture. This course delivery flexibility and was accompanied by learning activities, like student worksheets, case studies, and multi-media. All content and materials were based on actual job tasks and responsibilities of foodservice operations. The researcher found that training course A can be delivered in a variety of timeframes. Four hour, eight hour, fifteen hour, ten-week and sixteen-week timeframes were found as course offerings for training course A. In addition, this training course was available to diverse audiences. The course that utilized instructional design and adult learning theory was available in English, Korean, Spanish, and Chinese, which meets the needs of a more diverse food handler population. Materials and examinations were also available in multiple languages. Lastly, training course A instructors were required to be certified food managers and complete a formal application including an instructor-level examination.

Training course B was created without instructional design and adult learning theory. Training course B was developed by a group of experienced food safety professionals within a food company to meet the state of Texas Food Establishment Rules. This standard course utilized guidelines prescribed by the aforementioned Texas Department of State Health Services,

Certified Food Manager (CFM) Program. Training course B entailed regulatory requirements directly from the Texas Food Establishment Rules, in which each instructor trains using more food industry related terms instead of the regulatory jargon. Course B training delivery was classroom lecture accompanied by learning activities, retail scenarios, and multi-media presentation. All content and materials were based on the food company's actual foodservice operations. The researcher found that training course B could be delivered in two timeframes. Eight hour and fifteen hour course offerings for training course which were led by one to three instructors. Furthermore, training course B instructors were approved by Texas Department of State Health Services based on formal instructor application, years of food experience, and being a current Texas certified food manager. The course materials and examinations were offered in English.

A primary objective of the current study was to describe the population of the certified food managers participating in this research. The certified food manager audience in this study showed that the demographic makeup of the food industry was important. In addition to training course type, demographic characteristic collected in the instrument included first or native language, gender, years of experience in the food industry, and certification year. First or native language of the participants will be discussed in great detail throughout chapters four and five.

Years of experience in the food the industry was surveyed to ascertain the participants' experience level. The researcher categorized the years of experience of the participants in the instrument to five groups of experience.

The food manager certification year was also collected in the instrument. The certification year was surveyed to better understand the regulatory context of participants' certified food manager training and education. Routinely, the regulatory requirements update to

the latest recommendation for the Food and Drug Administration (FDA). The two courses researched in this study, utilized the 2001, 2005, and 2009 FDA Model Food Codes for development. In Texas, for example, the 2001 FDA Food Code was the model for the current 2006 Texas Food Establishment Rules (TFER). Thus, courses that only utilized the 2006 TFER as the basis for the certified food manager certification training could miss important and updated food safety information.

Research Design

In designing this research project, including instrument development, data collection methods, and sampling approaches, the researcher considered the elements of food safety training and foodservice operations. Food safety training and certification are a crucial part of any food safety plan (Dummer, 1998). The instrument used was titled Food Safety Knowledge Test and was developed by the researcher. The instrument consisted of questions adapted from the training courses A and B course instructor guides. The purpose of the instrument was to assess the food safety knowledge of the certified food manager who attended the two self-selected courses. The survey instrument was emailed to participants or mailed by U.S. certified mail to participants who did not have email capability.

Safe food handling practices account for the remainder of the reported foodborne illnesses incidents. Safe food handling includes time and temperature control, prevention of cross contamination, and proper personal hygiene. Preventative food safety systems were also important to the proper flow of food. Hazard Analysis Critical Control Point system is the most recognized food safety systems in the food industry. Preventive food safety systems like HACCP incorporate proper safe food handling and hand washing as core control measures to the

foundation of the food process. These food safety control measures allow for this study to be solidly positioned relating its findings to the food industry.

Sample

The sample population for the study consisted of certified food managers within two food companies located in Texas. As noted previously, a convenience sampling technique was utilized in this study. All participants worked at the same two food company, where they were employed as foodservice personnel within a five-year period. The food companies encompassed more than 300 physical locations and employed more than 50,000 individuals. The researcher had access to the names, email addresses, and business addresses of 750 certified food managers in two Texas food companies. This listing of names was found on two company rosters of management personnel to include foodservice CFMs from various specialty areas. These specialty areas ranged from freshly pre-prepared, raw meats, cooked meals, baked goods, and bulk foods. The listing was alphabetically ordered by name of the geographic location of the food establishment. There were 100 foodservice operations participating in the study. The researcher chose the first fifty names of certified food managers from each list to participate in this research study. Due to the non-random selection process, more than one participant could from each location could participate. The researcher sought the representation certified food managers within multiple food service areas to add to the scope of knowledge explored in this study.

In a brief letter prepared by the researcher, participants were provided with a clear explanation of the purpose of the study and how the research data would be used. The participants were told that participation in the study was voluntary.

Instrumentation

As this research project included human subjects, a research statement was submitted to and approved by the Texas Tech University Institutional Review Board. In addition, the instrumentation design was created with a voluntary and anonymous structure to reduce the likelihood of acts of dishonesty by participants, such as cheating on the knowledge test and/or questionnaire. There were more than thirty-five counties in Texas represented that included both urban and rural areas. According to the U.S. Census Bureau (2000), an urban area consists of densely settled territory that contains 50,000 or more people or counties containing urban areas having at least 200,000 people each. The knowledge level of the participating certified food managers was central to this research study and to collect such data empirically the researcher explored various peer-reviewed studies. At the time of this study's instrumentation, no such food safety knowledge test instrument existed. Thus, the researcher utilized the course guide books of the two self-selected courses to develop a knowledge test instrument. The intent of the instrument was to assess the level of food safety knowledge of the certified food manager participants in this study. The certified food managers' knowledge was studied quantitatively through an instrument, titled Food Safety Knowledge Test. The instrument consisted of two sections. The first section consisted of four questions concerned with demographics. The second section was comprised of thirty questions related to food safety knowledge in the areas of time and temperature control, cross contamination, HACCP, safe food handling, and hand washing.

The questions asked in the food safety knowledge test were sequenced by the food safety control measure area in the instrument to assess the knowledge level of the certified food managers. The instrumentation focused mainly on the safe food handling, as this food safety measure is the leading factor in the prevention of foodborne illness. Instrument questionings

ranged from cooking and cooling requirements to protection of food during food service activities. The instrument further assesses the participants' knowledge of safe food handling, time and temperature control, hand washing, preventing contamination and preventative food safety systems, such as HACCP.

Dillman's (2000) Tailored Design Method was used to guide the design of the instrument used in this study. Based on a review of literature, the researcher developed an instrument to collect data related to the objectives of the study (Dillman, 2000). As noted previously, the instrument was delivered via electric mail or certified mail to the participants. For the participants who received the instrument via email, the instrument was delivered under a secure email server during the month of March 2010. Procedures for handling non-respondents were outlined by Lindner, Murphy, and Briers (2001). Incomplete knowledge tests were treated as non-response. There were 100 certified food managers participating in the study and 90 responded for a 90% response rate.

Validity and Reliability

The study utilized an expert panel of nine food safety professionals with more than five years of experience to evaluate the instrument. This panel was recruited by the researcher via personal email seeking assistance with doctoral research in food safety education. The researcher received acceptance from 9 and 6 declined the invitation of the 15 potential participants. The researcher utilized two rounds of questionnaires to engage the expert panel and to reduce threats to validity. A cover letter explaining the research project and their role as a participant in the expert panel was emailed to each of the expert panel members.

The first round of questionnaires was emailed to the expert panel on January 15, 2010 and the experts had until February 26, 2010 to complete and return the questionnaires via email.

The expert panel recommended the instrumentation design provide an adequate sample of the types of questions in the certified food managers' exam. For example, the two self-selected course certification examinations consisted of 90 and 75 questions, respectively. Additionally, the expert panel indicated that the instrument should be mindful of the time required to complete a food safety test. The researcher compiled and applied the suggestions submitted by the expert panel regarding the research instrument from February 1 to February 14, 2010. "Subject may be absent during the collection of data or fail to complete tests, questionnaires, or other instrument (Fraenkel & Wallen, 2006) To address internal mortality threats to validity the expert panel suggested that the knowledge test instrument be reduced from 73 to 30 questions. The expert panel and researcher considered this threat to validity as participants are food service workers and are extremely busy with their full-time positions. The researcher attempted to control mortality threats by promoting the importance of their contribution to this research. The instrument was revised and titled Food Safety Knowledge Test.

The second round of questionnaires with 30 questions was emailed to the expert panel on February 15, 2010 and the experts had until February 26, 2010 to complete and return via email. The content validity of the revised Food Safety Knowledge Test format and language appropriateness was confirmed by the expert panel. The researcher made additional considerations of the diversity of the Texas workforce, in which multiple languages would factor into the results of the study. The participants' native languages were collected as the researcher had intimate knowledge of the diversity of the population. Thus, the researcher provided English and Korean versions of the instrument to all participants with Korean surnames. Korean translation was handled by a professional translator familiar with the research and content areas of the study. This translation was also verified by two members of the expert panel.

Data Collection

The data collection instrument was given the name Food Safety Knowledge Test and was electronically formatted in plain text with the subject line reading Food Safety Knowledge Test. The e-mail and letter began with a brief statement explaining the rationale for the survey. This communication also included the specifics on the voluntary nature of the survey. When the surveys were returned, the data was imported into a Microsoft Excel spreadsheet. The survey was assessed utilizing an answer key developed by the researcher and based on the aforementioned instructor course books. Computation of knowledge test score was measured for each of the surveys returned. Statistical analyses of the data files were completed using the SPSS for Windows version 15.0.

The risks associated with the study were minimal. That is, the risks were not outside the ordinary risks of daily life. Every effort was made to assure that all responses were confidential and data was reported as means, averages, summaries, and so on. Data were collected without identifying information fields. Once the survey instrument was completed and submitted, there were not any identifying items that would link the data to any of the participants. The descriptive data were collected for 90 participants and then coded into nominal scales. Descriptive statistics were utilized for the five demographic characteristics of the research instrument and reported as frequency and percentages. Inferential statistics and t-tests were used to examine the means among demographic groups. Alpha levels of 0.05 were considered as significant.

The researcher measured the knowledge level of the participants by computing the knowledge test score. The knowledge score was based on the number of correct answers on the instrument test. The participants' knowledge test scores ranged from 46% to 96%. The

researcher analyzed the knowledge test scores with inferential statistics. Further statistical analysis was conducted to explore the certified food managers' knowledge results by each question in the instrument as well as their demographic characteristics.

The researcher sought to address the study's second research objective by conducting independent samples t-tests to determine the food safety knowledge level of certified food managers. The study's third research objective was to describe the food safety knowledge level by test questions as it relates to participants' responses. In the final research objective, the researcher examined the relationship of certified food managers' demographic characteristics by food safety knowledge test scores. The knowledge scores of certified food managers' were examined by utilizing a one-way analysis of variance (ANOVA) among the participants' native language, gender, and years of experience.

CHAPTER IV
Results

The first objective of the study was to describe the population of certified food managers who participated. The following Tables (4.1 – 4.5) will describe certified food managers by gender, food industry experience, native language, certified food manger training course type, and certification year. Descriptive statistics for the demographic variables are shown in Tables 4.1- 4.7. Table 4.1 illustrates the gender of certified food managers who participated in the study. Fifty-nine percent of the certified food managers were male and 41.1% were female (see Table 4.1).

Table 4.1 Gender of Certified Food Managers (N = 90)

	Frequency (n)	Frequency Percent (%)
Gender		
Male	53	58.9
Female	37	41.1

Table 4.2 shows a frequency distribution for variables associated with food industry experience of the certified food managers in the study. Eight percent (n =8) of participants identified their experience group as less than 1 year. Twenty-seven percent (n =25) of the individuals identified their experience as 1 to 5 years. The number of certified food managers who defined their experience range as 6 to 9 years was 27% (n =25). The 10 to 15 years of experience group accounted for 13% (n =12) of the total. The final experience range was for those certified food managers who had more than 15 years. This group contained 20 individuals and accounted for 22% of the respondents (see Table 4.2).

Table 4.2 Experience of Certified Food Managers (N = 90)

	Frequency (n)	Frequency Percent (%)
<i>Experience</i>		
Less than 1 year	8	8.9
1 – 5 years	25	27.8
6 – 9 years	25	27.8
10 – 15 years	12	13.3
> 15 years	20	22.2

The Korean language as a native or first language represented the largest group at 45.6%. Frequency data for native or first languages of the respondents revealed the following, forty-three percent (43.3%) of the population spoke English, 6.7% of the population spoke Spanish, and 2.2% of the population spoke Chinese or Other, respectively (see Table 4.3).

Table 4.3 Native or First Language of Certified Food Managers (N = 90)

	Frequency (n)	Frequency Percent (%)
<i>Language</i>		
English	39	43.3
Spanish	6	6.7
Korean	41	45.6
Chinese	2	2.2
Other	2	2.2

The certification year of the certified food managers was also requested. Results demonstrated that 55.6% (n =50) of participants identified their certification year as 2010 as shown in Table 4.4. There were 18.9% (n =17) of the certified food managers who identified their certification year as 2009. The number of certified food managers who described their certification year as 2008 was 10% (n =9). There were 11.1% of certified food managers who were certified in 2007, and 1.1% who were certified in 2006. The final group of certified food managers was certified in 2005 or before. This group contained 3 individuals and accounted for 3.3% of the respondents (see Table 4.4).

Table 4.4 Certification Year of Certified Food Managers (N = 90)

<i>Year</i>	Frequency (n)	Frequency Percent (%)
2010	50	55.6
2009	17	18.9
2008	9	10.0
2007	10	11.1
2006	1	1.1
2005 or Before	3	3.3

The final element of the demographic characteristics section in the instrument was to describe certified food managers by certified food manger training course type. Table 4.5 illustrates the training courses of certified food managers in the study. Sixty-five percent (65.6%) of the certified food managers were certified by course A and 34.4% certified by course B (see Table 4.5).

Table 4.5 Training Program of Certified Food Managers (N = 90)

	Frequency (n)	Frequency Percent (%)
<i>Course Type</i>		
Course A	59	65.6
Course B	31	34.4

The second objective of the study was to determine the knowledge level of certified food managers by certified food manger training course type. Certified food mangers have two primary choices for their CFM training, either course A or course B. Table 4.6 summarizes the participants’ responses to the knowledge test. The test score results indicated in Table 4.6 shows a percentage-based score as the researcher sought to provide a more realistic score of participants’ food safety knowledge level. Course A (n=59) resulted in a mean of 21.86 or 72.9% on the knowledge test. Course B (n=31) resulted in a mean of 20.71 or 69.0% on the knowledge test (see Table 4.6). The CFM training courses were categorized by the use of instructional design and adult learning theory (course A) and standard without the use of instructional design and adult learning theory (course B). Table 4.6 also displays the independent samples t-test summary of knowledge test score and course type. The p-value was 0.07 and the t-value (1.86) was not significant at an alpha level .05.

Table 4.6 CFM Results of Knowledge Test (N = 90)

Course	<i>N</i>	Test Score ^a	<i>M</i>	<i>SD</i>	<i>T</i>	<i>p</i>
ID used	59	72.9%	21.86	2.85	1.86	0.07
Standard	31	69.0%	20.71	2.70		

Note: Test Score^a = $M/30$

Table 4.7 shows that 87 (97.8%) of the participants know that elderly people at higher risk for food borne illness because “their immune systems have weakened with age.”

Table 4.7 Responses to Q1 “Why are elderly people at higher risk for food borne illness?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. They are more likely to spend time in a hospital.	1	1.1
B. Their immune systems have weakened with age.	87	97.8
C. Their allergic reactions to chemicals used in food production might be greater than those of younger people.	2	2.2
D. They are likely to have smaller appetites.	0	0

As shown in Table 4.8, 76.7% of the respondents demonstrated they knew that dry conditions are “not a common characteristic of potentially hazardous food.” Certified food managers are taught that characteristics that support the growth of pathogens in potentially hazardous food are protein foods, moist, and have pH that is neutral or slightly acidic.

Table 4.8 Responses to Q2 “Which is not a common characteristic of potentially hazardous food?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. They are moist.	7	7.8
B. They are dry.	69	76.7
C. They have a pH that is neutral or slightly acidic.	6	6.7
D. They contain protein.	8	8.9

Table 4.9 shows that 79 (87.8%) of the participants knew that “2” people must experience that same illness after eating the same food to be considered a food borne illness “outbreak.”

Table 4.9 Responses to Q3 “For a food borne illness to be considered an “outbreak” how many people must experience that same illness after eating the same food?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 1	4	4.4
B. 2	79	87.8
C. 10	7	7.8
D. 20	0	0

Table 4.10 shows that 71 (78.9%) of the participants knew that “raw bean sprouts” are “potentially hazardous foods.” Eleven participants (12.2%) responded incorrectly that “bread” was “potentially hazardous food.”

Table 4.10 Responses to Q4 “Which items is a potentially hazardous food?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Raw carrots	8	8.9
B. Dry rice	0	0
C. Bread	11	12.2
D. Raw bean sprouts	71	78.9

As shown in Table 4.11, 71.1% of the respondents knew that “pork” is “not a common food allergen.” Thirteen (14.4%) of the participants responded with “peanuts,” 7.8% answered with “eggs,” and 6.7% chose “dairy products.”

Table 4.11 Responses to Q5 “Which is not a common food allergen?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Eggs	7	7.8
B. Dairy products	6	6.7
C. Peanuts	13	14.4
D. Pork	64	71.1

Table 4.12 shows that 16 (17.8%) of the participants knew that “storing Ready-to-eat food away from other cooked food will not prevent food from becoming contaminated.”

Table 4.12 Responses to Q6 “Which will not prevent food from becoming contaminated?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Labeling chemical spray bottles	36	40.0
B. Closely inspecting food during receiving	26	28.9
C. Storing products in food-grade containers	12	13.3
D. Storing Ready-to-eat food away from other cooked food	16	17.8

Table 4.13 shows that 87 (96.7%) of the participants knew that “after you have washed your hands, “single-use paper towels” should be used to dry them.”

Table 4.13 Responses to Q7 “After you have washed your hands, which item should be used to dry them?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Your apron	0	0
B. Wiping cloths	3	3.3
C. Common cloth	0	0
D. Single-use paper towels	87	96.7

Table 4.14 shows that 88 (97.8%) of the participants responded with “all of the above.” Thus, indicating that touching your hair, eating, and using a tissue are all activities that require hands to be washed after performing that activity.

Table 4.14 Responses to Q8 “Hands should be washed after which activity?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Touching your hair	2	2.2
B. Eating	0	0
C. Using a tissue	0	0
D. All of the above	88	97.8

Table 4.15 shows that 89 (98.9%) of the participants responded with “all of the above.” Thus, indicating that “rings,” “watch,” and “bracelet” can contaminate food when food handlers wear them.

Table 4.15 Responses to Q9 “Which item can contaminate food?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Rings	1	1.1
B. Watch	0	0
C. Bracelet	0	0
D. All of the above	89	98.9

Table 4.16 shows that 88 (97.8%) of the participants responded with “She failed to wash her hands and put on new gloves after handling raw meat and before handling the ready-to-eat buns.”

Table 4.16 Responses to Q10 “Sue wore disposable gloves which she formed raw ground beef into patties. When she was finished, she continued to wear the gloves while she sliced hamburger buns. What mistake did Sue make?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. She failed to wash her hands and put on new gloves after handling raw meat and before handling the ready-to-eat buns.	88	97.8
B. She failed to wash her hands before wearing the same gloves to slice the buns.	1	1.1
C. She failed to wash and sanitize her gloves before handling the buns.	0	0
D. She failed to wear reusable gloves.	1	1.1

Table 4.17 shows that only 62 (68.9%) of the participants knew that “Food handlers should be restricted from working with or around food if they are experiencing sore throat with fever.”

Table 4.17 Responses to Q11 “Food handlers should be restricted from working with or around food if they are experiencing which symptom?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Headache	16	17.8
B. Sore throat with fever	62	68.9
C. Itching	2	2.2
D. Soreness	10	11.1

Table 4.18 shows that 79 (87.8%) of the participants know that “Beef stew must be cooled from 135F to 70F within 2 hours and from 70F to 41F or lower in the next 4 hours.”

Table 4.18 Responses to Q12 “Beef stew must be cooled from 135F to 70F within ____ hours and from 70F to 41F or lower in the next ____ hours.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 4, 2	1	1.1
B. 2, 4	79	87.8
C. 3, 2	6	6.7
D. 2, 3	4	4.4

Table 4.19 shows that 57 (63.3%) of the participants knew that “Stuffed pork chops must be cooked to a minimum internal temperature of 165F for 15 seconds.”

Table 4.19 Responses to Q13 “Stuffed pork chops must be cooked to a minimum internal temperature of 165F for 15 seconds.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 135F for 15 seconds	1	1.1
B. 145F for 15 seconds	15	16.7
C. 155F for 15 seconds	17	18.9
D. 165F for 15 seconds	57	63.3

Table 4.20 shows that 56 (62.2%) of the participants knew that “Grilled catfish must be cooked to a minimum internal temperature of 145F for 15 seconds.”

Table 4.20 Responses to Q14 “Grilled catfish must be cooked to a minimum internal temperature of 145F for 15 seconds”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 135F for 15 seconds	16	17.8
B. 145F for 15 seconds	56	62.2
C. 155F for 15 seconds	10	11.1
D. 165F for 15 seconds	8	8.9

Table 4.21 shows that 68 (75.6%) of the participants knew that “If an employee exhibits symptoms of a gastrointestinal illness such as diarrhea, vomiting, and fever, they must be sent home and not allowed to come back to work without a doctor’s note.”

Table 4.21 Responses to Q15 “If an employee exhibits symptoms of a gastrointestinal illness such as diarrhea, vomiting, and fever, they must be sent home and not allowed to come back to work without a doctor’s note.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Be restricted to non-food handling duties in the establishment.	21	23.3
B. Always use gloves when working with food.	1	11.1
C. Take medication to control the symptoms while working with food.	0	0
D. Be sent home and not allowed to come back to work without a doctor’s note.	68	75.6

Table 4.22 shows that 74 (75.6%) of the participants knew that “Hepatitis C is not one of the “Big 5” foodborne illnesses.”

Table 4.22 Responses to Q16 “Which of the following is not one of the “Big 5” foodborne illnesses?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. <i>Shigella</i>	8	8.9
B. <i>E. COLI 0157:H7</i>	2	2.2
C. Hepatitis C	74	82.2
D. <i>Salmonella</i>	6	6.7

Table 4.23 shows that 50 (55.6%) of the participants knew that “A foodborne disease outbreak is likely to have occurred when 2 or more persons became ill after consuming the same product.”

Table 4.23 Responses to Q17 “A foodborne disease outbreak is likely to have occurred when 2 or more persons became ill after consuming the same product.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 2 or more persons became ill after consuming the same product.	50	55.6
B. 1 person was diagnosed with Botulism or chemical poisoning.	3	3.3
C. Both A and B.	35	38.9
D. None of the above	2	2.2

Table 4.24 shows that 84 (93.3%) of the participants knew that “Seed spouts and cut melons are considered a Potentially Hazardous Food (PHF).”

Table 4.24 Responses to Q18 “Seed spouts and cut melons are considered a Potentially Hazardous Food (PHF).”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. True	84	93.3
B. False	6	6.7

Table 4.25 shows that 65 (72.2%) of the participants knew that “*Clostridium Botulinum* is a microorganism that would be a concern when working with reduced oxygen packaging (ROP).”

Table 4.25 Responses to Q19 “Which microorganism would be a concern when working with reduced oxygen packaging (ROP):”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Clostridium Botulinum	65	72.2
B. Salmonella	9	10.0
C. Coli	12	13.3
D. Influenza Virus	4	4.4

Table 4.26 shows that 74 (82.2%) of the participants responded with “Sanitization is the process of reducing microorganisms on the food contact surfaces of utensils and equipment by 99.999 percent.”

Table 4.26 Responses to Q20 “Sanitization is the process of reducing microorganisms on the food contact surfaces of utensils and equipment by what percent?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 10	4	4.4
B. 50	1	1.1
C. 99.999	74	82.2
D. 100	11	12.2

Table 4.27 shows that 83 (92.2%) of the participants responded with “With the exception of milk, Molluscan shellfish, and whole shell eggs, should all potentially hazardous food (PHF) be received at 41 °F or less temperature.”

Table 4.27 Responses to Q21 “With the exception of milk, Molluscan shellfish, and whole shell eggs, at what temperature should all potentially hazardous food (PHF) be received?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 50 °F or less	1	1.1
B. 41 °F or less	83	92.2
C. 38 °F or less	5.6	5.6
D. 55 °F or less	1	1.1

Table 4.28 shows that 85 (94.4%) of the participants responded with “Chemical, Biological, and Physical are three types of (HACCP) food safety hazards associated with food.”

Table 4.28 Responses to Q22 “There are three types of (HACCP) food safety hazards associated with food. What are they?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Chemical, Additives, and Physical	3	3.3
B. Chemical, Biological, and Physical	85	94.4
C. Biological, Cholesterol, and Additives	2	2.2

Table 4.29 shows that 65 (72.2%) of the participants knew that “the proper cooking time and internal temperature for comminuted (ground) beef is 155⁰F for 15 seconds.”

Table 4.29 Responses to Q23 “What is the proper cooking time and internal temperature for comminuted (ground) beef?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 145 ⁰ F for 1minute	7	7.8
B. 150 ⁰ F for 1 minute	4	4.4
C. 155 ⁰ F for 15 seconds	72	80.0
D. Both B and C are correct	7	7.8

Table 4.30 shows that 76 (84.4%) of the participants knew that “When cooking poultry products such as ground turkey or chicken, the poultry must meet a minimum internal temperature of 165⁰F for 15 seconds.”

Table 4.30 Responses to Q24 “When cooking poultry products such as ground turkey or chicken, the poultry must meet a minimum internal temperature of 165F for 15 seconds.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 145 ⁰ F for 15 seconds	4	4.4
B. 155 ⁰ F for 15 seconds	9	10.0
C. 165 ⁰ F for 15 seconds	76	84.4
D. 180 ⁰ F for 15 seconds	1	1.1

Table 4.31 shows that 76 (84.4%) of the participants knew that “When using raw salmon to make sushi, the salmon must be frozen throughout to a temperature of -4⁰F or below for 168 hours and/or -31⁰F or below for 15 hours in a blast freezer.”

Table 4.31 Responses to Q25 “When using raw salmon to make sushi, the salmon must be frozen throughout to a temperature of -4F or below for 168 hours and/or -31F or below for 15 hours in a blast freezer.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. -4 ⁰ F or below for 168 hours	4	4.4
B. -31 ⁰ F or below for 15 hours in a blast freezer	9	10.0
C. A and B above.	76	84.4
D. None of the above	1	1.1

Table 4.32 shows that 75 (83.3%) of the participants know that “The Temperature Danger Zone is considered to be 41⁰F to 135⁰F.”

Table 4.32 Responses to Q26 “The Temperature Danger Zone is considered to be:”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 41 ⁰ F TO 100 ⁰ F	6	6.7
B. 41 ⁰ F TO 135 ⁰ F	75	83.3
C. 45 ⁰ F TO 90 ⁰ F	6	6.7
D. 65 ⁰ F TO 120 ⁰ F	3	3.3

Table 4.33 shows that 66 (73.3%) of the participants knew that “When using time as a public health control, the food establishment must have written procedures and must also tag the product with a “Use by/Discard by” time no longer than how many 4 hours”

Table 4.33 Responses to Q27 “When using time as a public health control, the food establishment must have written procedures and must also tag the product with a “Use by/Discard by” time no longer than how many hours?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. 1	7	7.8
B. 2	7	7.8
C. 4	66	73.3
D. 6	10	11.1

Table 4.34 shows that 79 (87.8%) of the participants knew that “HACCP means Hazard Analysis Critical Control Points.”

Table 4.34 Responses to Q28 “What does HACCP mean?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Hazards Abolished Cleaning Correctly Project	6	6.7
B. Hazard Analysis Critical Control Points	79	87.8
C. Helping Always Cleaning Critical Parts	5	5.6
D. Hardly Assures Clean Cuisine Place	0	0

Table 4.35 shows that only 19 (21.1%) of the participants know that “HACCP was developed by Pillsbury and NASA.”

Table 4.35 Responses to Q29 “HACCP was developed by Pillsbury and NASA.”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Pillsbury and NASA	19	21.1
B. Food and Drug Administration	58	64.4
C. United States Department of Agriculture	7	7.8
D. Food Service Inspection Service	6	6.7

Table 4.36 shows that only 34 (37.8%) of the participants knew that “Conduct a hazard analysis is the first step in developing HACCP.”

Table 4.36 Responses to Q30 “What is the first step in developing a HACCP plan?”

<i>Groups</i>	<i>Frequencies</i>	<i>Percentages</i>
A. Identify corrective actions	9	10.0
B. Conduct a hazard analysis	34	37.8
C. Establish monitoring procedures	4	4.4
D. Determine critical control points	43	47.8

The certified food managers’ native or first language results were reduced to English and Korean due to the small number of participants in the three other groups of native or first language. The researcher deemed that Spanish, Chinese, and Other language groups’ frequencies were not appropriate for inferential statistics. Table 4.37 displays the independent samples t-test summary of knowledge test score and native or first language. The p-value was 0.26 and the t-value (2.26) was significant at an alpha level .05.

Table 4.37 CFM Results to Knowledge Test by Native Language (N=90)

Language	<i>N</i>	Test Score ^a	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
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English	39	74.2%	22.26	2.88	2.26	0.26
Korean	41	69.6%	20.88	2.56		

Note: Test Score^a = M/30

Table 4.38 displays the independent samples t-test summary of overall knowledge score and gender of certified food managers. The p-value was 0.67 and the t-value (4.31) was not significant at an alpha level .05. There is no significant relationship between male and female participants' food safety knowledge test score.

Table 4.38 CFM Results to Knowledge Test by Gender (N=90)

Gender	N	Test Score ^a	M	SD	t	p
Male	53	71.2%	21.36	3.08	4.31	.67
Female	37	72.1%	21.62	2.49		

Note: Test Score^a = M/30

A one-way ANOVA was conducted to evaluate the association between certified food managers' years of experience and knowledge scores. Table 4.39 shows a summary of knowledge score associated with the number of years of food industry experience of the certified food managers in the study. The participants' years of experience results were re-coded and re-analyzed due to the small number of participants in two of groups, less than 1 year and 11 to 15 years of experience. The researcher deemed that these groups' frequencies were not appropriate for inferential statistics.

Table 4.39 Knowledge Scores Summary for CFM Years of Experience (N=90)

Groups	N	Test Score ^a	M	SD	Range
0 - 5 years	8	74.6%	22.38	3.34	17 – 26
6 - 10 years	25	71.2%	21.36	3.30	14 – 28
11 or more years	12	68.6%	20.58	1.56	17 – 23

Note: Test Score^a = M/30

As shown in Table 4.40, the results of the one-way ANOVA did not indicate a statistically significant difference, $F(2, 87) = 0.03$, $p = 0.97$, among five different categories for the years of experience with the overall food safety knowledge score of certified food managers.

Table 4.40 ANOVA Knowledge Score for Years of Experience

	<i>Sum of Squares</i>	<i>Df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig</i>
Years of Experience	0.49	2	0.25	0.03	0.97
Error	715.91	87	8.23		
Total	716.40	89			

CHAPTER V

SUMMARY, CONCLUSIONS AND RECCOMENDATIONS

Summary

Daily, the food service industry is dependent on millions of employees to ensure proper and safe food handling of food products consumed by the general public. The FDA Food Code states the person in charge of a food establishment is accountable for developing, carrying out, and enforcing procedures aimed at preventing food-borne illness (U.S. Food and Drug Administration, 2012). The state of Texas requires food establishments' management or person in charge be trained in food protection. The food service industry and public health is dependent upon the learning process for serving the consumer safely in accordance to proper food handling procedures. The current study aligns with the National Research Agenda's Agricultural Education, Extension and Outreach initiatives. Food service operations need formalized food safety training programs to improve the public's knowledge, views, and openness regarding the agri-food and natural resource system. The current study also shows that there is a continuous need for education and training of food service operations.

Background

Adult education and training programs in agriculture should use appropriate and effective instructional methods (Creswell & Martin, 1993). The agricultural education and food safety education linkage between adult education and instructional design inspired the researcher to investigate the two self-selected certified food manager training courses. The mission of agricultural education is to help people improve their lives through an educational process using scientific knowledge focused on issues and needs (Trede & Wade, 1993). Food safety affects the lives of everyone and training of food operators serves a critical role in prevention of illness.

Three food safety prevention areas were the focus of the literature review because of their importance to preventing foodborne illness. These prevention areas were: safe food handling practices, hand washing, and food safety systems (HACCP). Hand washing is highly important to the spread and control of any disease, especially foodborne illness. Pathogens from food, food contact surfaces, and the foodhandler can easily be transferred and cause a foodborne illness. Hand washing is critical to prevention and control of the pathogen transfer. Prevention and control are key principles of food safety systems, like HACCP. HACCP allows food companies to focus on control measures for the hazards of food. Throughout the flow of food, safe food handling activities remain paramount for food handlers. For example, the internal temperature of food at delivery is needed just as much as internal temperature when consumers purchase the food item.

Purpose

In this study, the researcher studied the knowledge gained by certified food managers from two food companies and two certification courses. Food borne illnesses affect millions of people annually and food establishment personnel is at the forefront of prevention. Furthermore, food companies liabilities are inherit as a result of food borne illnesses. Food companies could be sued and/or lose business due to the lack of food safety knowledge of its workforce. Food industry management's food safety knowledge and training directly affect its consumers.

The scope of the study was to explore the food safety knowledge of two self-selected certified food managers in Texas. The researcher explored two educational theories that are often utilized in the agricultural education discipline.

Methods

The research methods used to study food safety knowledge by certified food managers who attended two self-selected food manager certification courses. The data was collected through the use of a food safety knowledge test instrument. There were 90 food service operations that participated in the study. The researcher had intimate knowledge of both courses; in fact the researcher had firsthand experience delivering the content, examination, and certification of each.

Research Objectives

1. Describe the demographic characteristics of the participating certified food managers.

Conclusions

Food safety knowledge of participants who spoke English or Korean as their native language was analyzed closely as they represented the largest population of the participants. Korean as a native language represented the largest group at 45.6% of the population. English as a native language represented the second largest group at 43.3% of the population.

Certified food managers self-selected the training courses explored in the study. Sixty-five percent (65.6%) of the certified food managers were certified by course A and 34.4% certified by course B.

Implications

Native language presents a challenge to knowledge gained from certified food manager training. The researcher is led to suggest that native languages should be considered as learning outcomes are developed. Native languages of those who attended courses could cause learners to miss out on importance information during the training. The food service industry has a

vested interest in ensuring that the food safety training is readily available to meet the needs of those food managers that have native languages other than English. For example, the researcher's current food company has a need for certified food manager training materials in a language that is not currently available by any course provider in Texas.

Recommendations

The researcher recommends further research on affects of native language on training. Future research should explore the participant's native language in a course taught in English and compare the outcomes to those who attended courses in their native language.

Research Objectives

2. Determine the food safety knowledge level of the participating certified food managers who were certified from the two self-selected courses.

Conclusions

The second objective of the study was to determine the knowledge level of certified food managers by certified food manger training course type. Considering that certified food mangers have two primary choices for their CFM training, course A and course B. The knowledge test score were as follows: Course A (n=59) resulted 72.9% and Course B (n=31) resulted 69.0%. The resulting t-test was determined to the knowledge test score of course A and course B were not statically significant at an alpha level .05. The researcher concludes instructional design and adult learning theory did not have an impact on the knowledge level of participants in this study.

Implications

This study was not intended to suggest either of the two self-selected courses to be superior, but explored if the instructional design and adult learning theory influence showed in the results. Training course A is a well respected course for years and has certified more than

four million food managers. Training course B is was success for its' food company for over ten years, but is no longer in existence due to the 2011 discontinuation of Texas DSHS CFM program and examination. Training course B was been replaced by another certified food manager program.

CFM Students are often non-essential or not the person in charge. CFM providers, like agricultural extension agents provide important food safety information to areas, often rural, that are seeking the important required CFM knowledge. Instructional design practices to learning and CFM. Many CFM courses are designed throughout the State of Texas and the researcher is lead to believe that many lack formal instructional design theories for course development. An additional implication of the study is that further research is needed on the design of these types of food manager and food safety education programs.

Recommendations

This research study discusses potential improvements that may be implemented in future research for certified food management training. Future researchers should consider utilizing more food manager training courses that were designed with and without instructional design and adult learning theories. The scope of this study utilized two self selected courses that were available to the participating certified food managers. For example, the Food Safety Knowledge Test instrument which was developed specifically for the scope of this research. Although this instrument was only used once it served as a suitable tool for this research project and could serve as a guide for the development of future research instruments. The researcher suggests that future researchers consider utilizing a tested and established research instrument. A study with a broader scope including courses supported by other National and State level accreditation organization as well as increasing the number of participant; may yield additional findings.

Research Objectives

3. Describe the certified food managers' knowledge by instrument test questions.

Implications

The participants' knowledge level of what deemed a food borne disease outbreak was low. The certified food manager training courses are intended to ensure the participants have knowledge to prevent food borne illness. This leads the researcher to wonder if the participants really learned the information during the training courses, remembered information for examination only, or if the participants didn't retain the pertinent food borne disease outbreak at all. Furthermore, questions can be asked about the amount of time before the certified food managers' certification expires. The training courses explored in this study provided five certifications. The researcher mentioned in chapter II, the fact that in Texas requirements regarding renewal was increased from two years to five years. It could also lead one to believe that this topic is not a high priority for of the participating certified food managers.

Conclusions

The study's third research objective was to describe the knowledge test questions as it relates to participants' responses. The thirty questions were related to food safety knowledge in the foodborne illness prevention areas of time and temperature control, cross contamination, HACCP, safe food handling, and hand washing.

Over 97% of the participants know that elderly people at higher risk for food borne illness because "their immune systems have weakened with age." The researcher concluded the participants had high level of knowledge regarding the higher populations and their risk for food borne illness because their weaken immune systems. Conversely, only 55.6% of the participants

knew that foodborne disease outbreak is likely to have occurred when 2 or more persons became ill after consuming the same product.

Questions related to food safety knowledge in cross contamination showed that only 68.9% of the participants knew that food handlers should be restricted from working with or around food if they are experiencing sore throat with fever. Time and temperature control knowledge of the participants were tested and analyzed. For example, 62.2% of the participants knew that grilled catfish must be cooked to a minimum internal temperature of 145F for 15 seconds. Additionally, 83.3% of the participants knew that the Temperature Danger Zone is considered to be 41⁰F to 135⁰F. The researcher concluded time and temperature control knowledge varied. Lastly, food safety systems knowledge results showed that 87.8% of the participants knew that HACCP means Hazard Analysis Critical Control Points.

Recommendations

The researcher recommends future studies include a retrospective post survey methodology on the food safety knowledge instrument. The retrospective pretest at the end of the program is more accurate because it's answered in the same frame of reference as the posttest (Rockwell, 1989). This study was challenging in the instrumentation phase due to the use of an expert panel. There was a limited pool of the experts available and accessible to the researcher. This researcher suggests more recruitment of potential panelists to include food safety professionals, instructional designers, agricultural extension agents, and academics.

Research Objectives

4. Determine the level of certified food managers' knowledge by their demographic characteristics.

Implications

The study's results showed no significant relationship between male and female participants' food safety knowledge test scores. In fact, gender as a demographic characteristic had no impact on the study. The researcher suggests that gender not be included in future studies inferential analyses. Instead, the researcher suggests that further information is needed about the certified food manager population with respect to job type, food industry type, and certification rationale. Certification rationale should include groups such as re-certification, job requirement, career and advancement. Future studies should explore the aforementioned areas of the food manager population for supermarkets and fine dining establishments for example.

The participants' knowledge level of what deemed a food borne disease outbreak was low. One possible implication of this study could be the food service industry and public health officials working in collaboration to encourage more media coverage on CFMs and their training role in food safety education of their staff. Many private/public firms are investing more resources into food safety practices and policies to better protect their foods and customers from FBI outbreaks. In fact, one certified food manager course dedicates instructional content to self-inspections and the benefits to the food safety of the establishments. Additionally, the course states that self-inspections lead to higher performance on regulatory inspections.

Conclusions

Differences were found within the demographic characteristic of native or first languages. The certified food managers who identified as English and Korean native or first language resulted a statistically significant comparison when analyzed via independent t-test. English and Korean native or first language participants' knowledge test score means were statistically significant at an alpha level .05. The researcher concluded that the difference between the means signaled that English and Korean native or first languages were significant to certified food manager's knowledge test score.

No significant differences were found within the remaining demographic characteristics. There is no significant relationship between male and female participants' food safety knowledge test scores. The years of experience with the overall food safety knowledge score of certified food managers did not indicate a statistically significant difference among categories. Turnover in the foodservice industry is very high and the experience necessary to perform food handling duties vary. The foodservice industry consists of a diverse workforce and often the level of experience of food handlers were dependent on the need of the demand of the hiring firm's customer base.

Recommendations

The study's results showed no significant relationship between male and female participants' food safety knowledge test scores. In fact, gender as a demographic characteristic had no impact on the study. The researcher suggests that gender not be included in future studies inferential analyses. Instead, the researcher suggests that further information is needed about the certified food manager population with respect to job type, food industry type, and certification rationale. Certification rationale should include groups such as re-certification, job requirement, career and

advancement. Future studies should explore the aforementioned areas of the food manager population for supermarkets and fine dining establishments for example.

Final Implication

The primary implication of this study was to confront the CFM knowledge problem and increasing the exploration of solutions of preventing foodborne illness. The current study aligns with the National Research Agenda's Agricultural Education, Extension and Outreach initiatives. Food service operations need formalized food safety training programs to improve the public's knowledge, views, and openness regarding the agri-food and natural resource system. An additional implication is food safety education provided by land grant universities' agricultural extension services through their CFM programs. Certified food managers are provided the foundation of food science, safe food handling practices and information regarding their role as a CFM during training. CFMs are called upon to share their food safety knowledge gained through CFM with their staffs to ensure food safety compliance is achieved at the highest level in their retail food establishments. This can be achieved in many ways, such as hands-on training, explanations on food protection and modeling of proper safe food handling practices. Food handlers come to the training courses with concerns of food safety. The CFM training and certification process has the potential to bridge these gaps in knowledge. Agricultural Extension agents are often the area food safety expert and can provide resources for their food industry and regulatory clients as well as looked to solve problems that arise at retail food establishments. An additional implication of this study is that more of the public will seek food safety information from the Agricultural Extension Service.

This study explored adult learning theories and their role it plays in food safety education. The training and education processes of adults have been examined in many arenas.

An implication of the study could be that more research is done on the delivery systems used to get the latest food safety information to the general public. This study identified the elements of the adult learner and what motivates learning to them. Some CFM may learn enough to obtain certification and not for the long-term in the food establishment operation. Further research could be done to explore how to motivate food workers seeking CFM to learn for the long-term. Agricultural Extension programs have been dedicated to providing training and resources to the public. Texas A&M Extension AgriLife programs have been providing CFM courses throughout the state of Texas since the mid-1990's. The learner sought to outline the adult learning theories in this certified food manager programs and current knowledge level of the participants who were previously certified. Certification programs have long been a recognized process for established level of knowledge. In the same fashion, the higher education system has established processes for established knowledge of individuals that have obtained B.S., Masters, and terminal degrees such as Doctor of Education.

Final Conclusion

Foodservice employee food handling practices are a concern for the public's health. Food handler training is seen as one strategy whereby food safety can be increased, offering long-term benefit to the food industry and sector (Smith 1994). With the increasing demand from government and consumers for safe, high quality food, this new training series provides supermarket managers and their staff the information they need to help protect customers from food borne illness, says Nancy Quay, executive director, NSF Center for Public Health Education (Frozen Food Age, 2005). Adopting and executing a food safety training programs are more important than ever to foodservice operators.

Adult education and training programs in agriculture should use appropriate and effective instructional methods Creswell and Martin (1993) inferred a linkage between adult education and instructional design as it related to agriculture. This study explored the phenomenon regarding certified food manager training courses and knowledge gained through certification. In agricultural education, lives are affected through education and training. Trede & Wade (1993) suggested that agricultural education helps people improve their lives through an educational process using scientific knowledge.

REFERENCES

- Acikel, C., Ogur, R., Yaren, H., Gocgeldi, E., Ucar, M. & Kir, T. (2008). The hygiene training of food handlers at a teaching hospital. *Food Control*, 19, 186–190.
- Altekruse, S. F., Yang, S., Timbo, B. B., & Angulb, F. J. (1999). A multi-state survey of consumer food-handling and food consumption practices. *American Journal of Preventive Medicine*, 16, 216-221.
- American Association for Agricultural Education. (2007). *National research agenda for agricultural education and communication: Research priority areas and initiatives*. Gainesville, FL: University of Florida.
- Anderson, J.B., Shuster, T.A., Hansen, K.E., Levy, A. S., & Volk, A. (2004). A camera's view of consumer food-handling behaviors. *Journal of the American Dietetic Association*, 104(2), 186-191.
- Anding, J., Boleman, C. & Thompson, B.. (2007). Self-reported changes in food safety behaviors among foodservice employees: Impact of a retail food safety education program. *Journal of Food Science Education*, 6, 72-76.
- Ballard, C. (2008). *Is our food safe?* Mankato, MN: Arcturus.
- Barab, S. A., Evans, M., & Baek, E. (2003). Activity theory as a lens for charactering the participatory unit. In D. Jonassen (Ed.). *International handbook on communication technologies* (Vol. 2, pp. 199-214). Mahwah, NJ: Erlbaum.
- Biggs, J.B. (2003). *Teaching for quality learning at university* (2nd ed.). Buckingham: Open University Press/Society for Research into Higher Education.
- Binkley, M., & Ghiselli, R. (2005). Food safety issues and training methods for ready-to-eat foods in the grocery industry. *Journal of Environmental Health*, 68(3), 27-31.
- Bloom B. S. (1956). *Taxonomy of educational objectives, handbook I: The cognitive domain*. New York: McKay.
- Boud, D. (1991). *HERDSA green guide no 5. Implementing student self-assessment* (2nd ed.). Campbelltown: The Higher Education Research and Development Society of Australia (HERDSA).
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn*. Washington, DC: National Academy Press.
- Bryan, F. L. (1988). Risks of practices, procedures and processes that lead to outbreaks of foodborne diseases. *Journal of Food Protection*, 51, 663-673.

- Cates, S. (2002, September). Presented at the meeting of Thinking Globally-Working Locally: A Conference on Food Safety Education, Orlando, FL. Retrieved from http://www.fsis.usda.gov/Orlando2002/presentations/scates/scates_pdf
- Cates, S. C. Muth, M.K., Karns, S.A., Penne, M. A., Stone, C. N., & Harrison, J. E. (2009). Certified kitchen managers: Do they improve restaurant inspection outcomes? *Journal of Food Protection*, 72(2), 384-391.
- Centers for Disease Control and Prevention. (2011). Estimates of Foodborne Illness in the United States. Retrieved from <http://www.cdc.gov/foodborneburden/index.html>
- Clayton, D. & Griffith, C. (2008). Efficacy of an extended theory of planned behaviour model for predicting caterers' hand hygiene practices. *International Journal of Environmental Health Research*, 18, 83-98.
- Clayton, D., Griffith, C., Price, P., & Peters, A. (2002). Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research*, 12, 25-39.
- Cody, M. M. and M. A. Hogue (2003) "Results of the home food safety - It's in your hands 2002 survey: Comparisons to the 1999 benchmark survey and health people 2010 food safety behavior objective." *American Dietetic Association* 103(9): 1115-1125.
- Cohen, E., Reichel, A. & Schwartz, Z. (2001). The efficacy of an in-house training program: Statistical measurements and practical conclusions. *Journal of Hospitality Tourism Research*, 25, 5-16.
- Conference for Food Protection. (2012). The Conference Standards for Accreditation of Food Protection Manager Certification Programs. Retrieved from <http://www.foodprotect.org/manager-certification/>
- Cotterchio, M.J., Gunn, T., Cofill, P., Tormey, X. & Barry, A. (1998). Effect of a manager training program on sanitary conditions in restaurants. *Public Health Report*, 113, 353-358.
- De Waal, C.S. (2003). Safe food from a consumer perspective. *Food Control*, 14, 75-79.
- Dummer, J. (1998). Food safety in a grocery environment. *Supermarket Journal*, Retrieved from <http://www.gftc.ca/articles/1998/grocery.cfm>
- Dick, W. & Carey, L. (1985). *The systematic design of instruction* (2nd ed.). Glenview, IL: Scott, Foresman.
- Dillman, D.A. (2000). *Mail and internet surveys: The tailored design methods*. New York: John Wiley & Sons, Inc.

- Dittmar, E. (2009). *An investigation of instructional design roles and practices used to develop and maintain interactive web-based learning* (Unpublished doctoral dissertation). Capella University, United States -- Minnesota.
- Dooley, K. E., Van Laanen, P. G, & Fletcher, R. D. (1999). Food safety instructor training using distance education. *Journal of Extension*, 37(3), 1-7.
- Finch, C., & Daniel, E. (2005, May). Food safety knowledge and behavior of emergency food relief organization workers: Effects of food safety training intervention. *Journal of Environmental Health*, 67(9), 30-34.
- Fink, A. (2003). *The survey handbook*. Thousand Oaks, CA: Sage.
- Food Marketing Institute. (2007). Food retailing in the 21st century – Riding a consumer revolution. Retrieved from <http://www.fmi.org/docs/media/bg/FoodRetailing.pdf>
- Fortney, K. (2009). *Across organizational boundaries: Horizontal expertise in instructional design*. Unpublished doctoral dissertation, Northern Illinois University, Available from ProQuest Dissertation and Theses: Full Text database. (Publication No. ATT 3359010.)
- Frankel, J.R. & Wallen, N.E. (2006). *How to design and evaluate research in education* (6th ed.). New York: McGraw-Hill.
- Gagné, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of instructional design* (4th ed.). New York: Harcourt Brace Janovich College Publishers.
- Gettings, M. A., & Kiernan, N. E. (2001). Practices and perceptions of food safety among seniors who prepare meals at home. *Journal of Nutrition Education*, 33, 148-154.
- Green, L., Radke, V., Mason, R., Bushnell L., Reimann D.W., Mack J., Motsinger, M.D., Stigger T., & Selman C. (2007). Factors related to food worker hand hygiene practices. *Journal of Food Protection*, 70, 661-666.
- Green, L. & Selman, C. (2005). Factors impacting food workers' and managers' safe food preparation practices: A qualitative study. *Food Protection Trends*, 25, 981-990.
- Green, L.R., Selman, C.A., Radke, V., Ripley, D., Mack, J., Reimann, D., Stigger, T., Motsinger, M. & Bushnell, L. (2006). Food worker hand washing practices: An observation study. *Journal of Food Protection*, 69, 2417-2423.
- Gordon, J. (2003). Risk communication and foodborne illness: Message sponsorship and attempts to stimulate perceptions of risk. *Risk Analysis*, 23(6), 1287-1296.
- Government Accounting Office. (2010). Government Accountability Office Report. Retrieved from <http://www.fda.gov/NewsEvents/Testimony/ucm211163.htm>

- Hammond, R.M., Brooks, R.G., Schlottman, J., Johnson, D., & Johnson, R.L. (2005). Assessing the effectiveness of food worker training in Florida: Opportunities and challenges. *Journal of Food Protection*, 68,19-24.
- Handwashingforlife.com. (2010). *Safe hands safe food implementation guide*. Retrieved from www.handwashingforlife.com
- Healthy People. (2010). About healthy people. Retrieved from: <http://www.healthypeople.gov/document/HTML/Volume1/10Food.htm>
- Hedberg, C.W., & Osterholm, M.T. (1993). Outbreaks of foodborne and waterborne viral gastroenteritis. *Clinical Microbiological Review*, 6, 199-210.
- Hedberg, C.W., Smith, S.J., Kirkland, E., Radke, V., Jones, T.F., Selmon, C.A., & EHS-NET Working Group. (2006). Systematic environmental evaluations to identify food safety differences between outbreak and non-outbreak restaurants. *Journal of Food Protection*, 69, 2697-2702.
- Hertzman, J.L. (2007). *Identifying the characteristics of and quality indicators for associate degree culinary programs: A survey of educators and industry*. (Unpublished doctoral dissertation). University of Nevada Las Vegas, Las Vegas, NV.
- Houle, C. (1961). *The inquiring mind*. Madison, WI: The University of Wisconsin Press.
- Houle, C. (1980). *Continuing learning in the professions*. San Francisco: Jossey-Bass.
- Houle, C. (1982). The three kinds of adult learners. In R. Gross (Ed.), *Invitation to lifelong learning* (pp. 132-142). Chicago: Follett.
- Houle, C. (1984). *Patterns of learning*. San Francisco: Jossey-Bass.
- Howells, A.D., Roberts, K.R, Shanklin, C.W, Pilling, V.K., Brannon, L.A., & Barrett, B.B. (2008). Restaurant employees' perceptions of barrier to three food safety practices. *Journal of the American Dietetic Association*, 108, 1345-1349.
- Howes, M., McEwen, S., Griffin, M, & Harris, L. (1996). Food handler certification by home study: Measuring changes in knowledge and behavior. *Dairy Food Environmental Sanitation*, 16, 767-744.
- Kalbacken, J. (1998). *Food safety*. New York: Children's Press.
- Kassa, H. (2001). An outbreak of Norwalk-like viral gastroenteritis in a frequently penalized food service operation. *Journal of Environmental Health*, 64, 9-12
- Knowles, M.S., Holton III, E.F., & Swanson, R.A., (2005). *The adult learner*. Elsevier. San Diego.

- Larson, E.L., Norton-Hughes, C.A., Pyrek, J.D., Sparks, S.M., Catgatay, E.U., & Bartkus, J.M. (1998). Changes in bacterial flora associated with skin damage on hands of health care personnel. *American Journal of Infectious Control*, 26, 513-521.
- Lindner, J., Murphy, T., & Briers, G. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, 42, 43-53.
- Linton, R.H., McSwane, D.Z. & Woodley, C.D. (1998). A comparison of perspectives about the critical areas of knowledge for safe food handling in food service establishments. *Journal of Environmental Health*, 60(8), 8–15.
- Litwak, D. (1998). Safety's seal of approval. *Supermarket Business*, 53 (9), 216.
- Liu, S.S. & Comer, L. (2007). Salespeople as information gatherers: Associated success factors. *Industrial Marketing Management*, 36 (5), 514-521.
- Manning, C., & Snider, S. (1993). Temporary public eating places: Food safety knowledge, attitudes, and practices. *Journal of Environmental Health*, 56, 24–28.
- McCulloch, A. (2009). *A preassessment for developing a food safety training program for self service food bars in grocery stores* (Unpublished master's thesis). Texas Tech University, Lubbock, TX.
- McElroy, C.M., & Cutter, C.N. (2004). Self-reported changes in food safety practices as a result of participation in a statewide food safety certification program. *Food Protection Trends*, 24, 150-161.
- McSwane, D., Rue, N., & Linton, R. (2003). *Essentials of food safety and sanitation* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.
- Medeiros, L., Hillers, V., Kendall, P. & Mason, A. (2001). Evaluation of food safety education for consumers. *Journal of Nutrition Education Behavior*, 33, S27–S34.
- Merriam, S. B., & Caffarella, R. S. (1999). *Learning in adulthood: A comprehensive guide* (2nd ed.). San Francisco: Jossey-Bass.
- Minnesota State Colleges and Universities (2012). Retrieved from <http://www.mnscu.edu/business/workforceeducation/multiplelanguages.html>
- Montville, R., Chen, Y., & Schaffner, D. W. (2002) Risk assessment of hand washing efficacy using literature and experimental data. *International Journal of Food Microbiology*, 73 (23), 305-313.
- National Advisory Committee on Microbiological Criteria for Foods. (2004). Recommendations on bare hand contact with ready-to-eat foods. Retrieved from

http://www.fsis.usda.gov/regulations_&_policies/national_advisory_committee_on_microbiological/index.asp

- Newcomb, L. H., McCracken, J. D., Warmbrod, J. R., & Whittington, M. S. (2004). *Methods of teaching agriculture* (3rd ed.). Upper Saddle River, NJ: Pearson/ Prentice Hall.
- Ngale Lyonga, A.N. (2009). *Culture and food safety awareness: A study of international college students' need for food safety training in the U.S.* (Unpublished doctoral dissertation). North Dakota State University, Available from ProQuest Dissertation and Theses: Full Text database.
- Notermans, S., Zwietering, M.H., & Mead, G.C. (1994). The HACCP concept: Identifications of potentially hazardous micro organisms. *Food Microbiology*, *11*, 203–214.
- Nunnally, J.C. (1967). *Psychometric theory*. McGraw-Hill Book Company, Inc, New York.
- Pragle, A.S., Harding, A.K., & Mack, J.C. (2007). Food worker's perspective on handwashing behaviors and barriers in the restaurant environment. *Journal of Food Protection*, *69*, 27-32.
- President Obama Food Safety Working Group. (2009, December). Retrieved from <http://www.foodsafetyworkinggroup.gov/>
- Reeves, T. (2000). Alternative assessment approaches for online learning environments in higher education, *Journal of Educational Computing Research*, *23*(1), 101–111.
- Reigeluth, C. M. (1999). *Instructional design theories and models: A new paradigm of instructional theory* (Vol. 2). Mahwah, NJ: Erlbaum.
- Roberts, K.R., Barrett, B.B., Howells, A.D., Shanklin, C.W., Pilling, V.K., & Brannon, L.A. (2008). Food safety training and foodservice employees' knowledge and behavior. *Food Protection Trends*, *28*, 252-260.
- Rocourt, J., & Cossart, P. (1997). *Listeria monocytogenes*. In M.P. Doyle, L.R. Beuchat, & T.J. Montville (Eds.), *Food microbiology—Fundamentals and frontiers*. (pp. 337– 352). ASM Press: Washington, DC.
- Rowell, A.E. (2011). *Evaluation of food safety knowledge and practices employed in maintaining and operating hot/cold self-service bars in food retailing* (Unpublished doctoral dissertation). Texas Tech University, Lubbock, TX.
- Seaman, P. (2009). Food hygiene training: Introducing the food hygiene training model. *Food Control*, *21*, 381-387
- Seaman, P. & Evesb, A. (2006). The management of food safety – the role of food hygiene training in the UK service sector. *Hospitality Management*, *25*, 278–296.

- Sellnow, T. L. & Ulmer, R. R. (1995). Ambiguous argument as advocacy in organizational crisis communication. *Argumentation & Advocacy*, 31 (3), 138-150.
- ServSafe® Essentials (2008). National Restaurant Association Educational Foundation. Update with 2009 FDA Food Code, 5th edition.
- ServSafe® Manager (2012). National Restaurant Association Educational Foundation., 6th edition.
- Silverstein, A., Silverstein, V. B., & Nunn, L. S. (2008). *The food poisoning update*. Berkeley Heights, NJ: Enslow Publishers.
- Smith, R. (1994). Food hygiene training: The chance to create a coherent training policy. *British Food Journal*, 96(7), 41–45.
- Soeder, J. (1993). Anatomy of an avoidable tragedy. *Restaurant Hospitality*, 77, 34.
- Springfield, H. (2008). *Feed and farm supply store managers' perceptions of employee training as a contributor to competitive advantage*. (Unpublished doctoral dissertation), Texas A&M University, College Station, TX.
- Staskel, D.M., & Briley, M.E. (2007). Food safety knowledge and behaviors of foodservice staff in Texas child-care centers. *Food Protection Trends*, 27:90-94
- Stivers, T.L. & Gates, K.W. (2000). Survey of grocery store seafood employees. *Dairy, Food, and Environmental Sanitation*, 20:746 –752.
- Texas Department of State Health Services (2012). Certified food manager (CFM) program. Retrieved from <http://www.dshs.tx.gov>
- Texas Food Establishment Rules. (2006). Retrieved from <http://www.dshs.state.tx.us/foodestablishments/pdf/TFERFIMSeptember28206>
- Todd, E.C.D. (1989). Costs of acute bacterial food-borne disease in Canada and the USA. *International Journal of Food Microbiology*, 9, 313–326.
- Trede, L. D., & Wade, M. W. (1993, Summer). Educational technology tools used by extension professionals in the north central region. *Journal of Agricultural Education*, 85-92.
- United States Census Bureau. (2000). Texas statistics and demographics. Retrieved from <http://www.areaconnect.com/state.htm?s=TX>
- United States Department of Agriculture. (2009) Retrieved from <http://www.usda.gov>
- United States Department of Commerce. Retrieved from

<http://www.cfsan.fda.gov/~dms/fc05-toc.html>

United States Food and Drug Administration. (1997). Food safety from farm to table: A national food safety initiative report to the president. Retrieved from <http://www.foodsafety.gov/~dms/fsreport.html>

United States Food and Drug Administration. (2010). Endorsement letter. Retrieved from <http://www.foodsafety.gov>

United States Food and Drug Administration. (2012). FDA Food Code. Retrieved from <http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm2006808.htm>

Wagner, J. & Palm Beach Post Online. (2012). Norovirus hits two cruise ships out of Lauderdale, affects hundreds. Retrieved from <http://www.palmbeachpost.com/news/state-regional/norovirus-hits-two-cruise-ships-out-of-lauderdale-/nl3p4/>

Weiner, B. (1986). Attribution theory. Retrieved from <http://tip.psychology.org/weiner.html>

Weinstein J. (1991). The clean restaurant. II: Employee hygiene. *Restaurants & Institutions*, 101(13), 138-9, 142, 144.

York, V.K., Brannon, L.A., Shanklin, C.W., Roberts, K.R., Howells, A.D., & Barrett, E.B. (2009). Foodservice employees benefit from interventions targeting barriers to food safety. *Journal of the American Dietetic Association*, 109, 1576–1581.

APPENDICES

Appendix A

Food Safety Knowledge Test

SECTION 1

The questions you are about to answer are designed to assess individual characteristics regarding you and your training activity.

What is your gender?

Male

Female

How many years of experience do you have in the food industry?

Less than 1

1 – 5 years

6 – 10 years

11 – 15 years

Over 15 years

What is your native or first language?

English

Spanish

Korean

Chinese

Other

What year did you receive your last CFM?

2010

2009

2008

2007

2006

2005 or before

Which training program did receive your last CFM?

Texas Department of Health Service (TDH) – Course A

National Restaurant Association (ServSafe) – Course B

SECTION 2

The questions you are about to answer are designed to assess the food safety knowledge when received from your certified food manager training.

1. Why are elderly people at higher risk for food borne illness?
 - A. They are more likely to spend time in a hospital.
 - B. Their immune systems have weakened with age.
 - C. Their allergic reactions to chemicals used in food production might be greater than those of younger people.
 - D. They are likely to have smaller appetites.

2. Which is not a common characteristic of potentially hazardous food?
 - A. They are moist.
 - B. They are dry.
 - C. They have a pH that is neutral or slightly acidic.
 - D. They contain protein.

3. For a food borne illness to be considered an “outbreak” how many people must experience that same illness after eating the same food?
 - A. 1
 - B. 2
 - C. 10
 - D. 20

4. Which items is a potentially hazardous food?
 - A. Raw carrots
 - B. Dry rice
 - C. Bread
 - D. Raw bean sprouts

5. Which is not a common food allergen?
 - A. Eggs
 - B. Dairy products
 - C. Peanuts
 - D. Pork

6. Which will not prevent food from becoming contaminated?
 - A. Labeling chemical spray bottles
 - B. Closely inspecting food during receiving
 - C. Storing products in food-grade containers
 - D. Storing Ready-to-eat food away from other cooked food

7. After you have washed your hands, which item should be used to dry them?
 - A. Your apron
 - B. Wiping cloths
 - C. Common cloth
 - D. Single-use paper towels

8. Hands should be washed after which activity?
 - A. Touching your hair
 - B. Eating
 - C. Using a tissue
 - D. All of the above

9. Which item can contaminate food?
 - A. Rings
 - B. Watch
 - C. Bracelet
 - D. All of the above

10. Sue wore disposable gloves which she formed raw ground beef into patties. When she was finished, she continued to wear the gloves while she sliced hamburger buns. What mistake did Sue make?
 - A. She failed to wash her hands and put on new gloves after handling raw meat and before handling the ready-to-eat buns.
 - B. She failed to wash her hands before wearing the same gloves to slice the buns
 - C. She failed to wash and sanitize her gloves before handling the buns
 - D. She failed to wear reusable gloves

11. Food handlers should be restricted from working with or around food if they are experiencing which symptom?
 - A. Headache
 - B. Sore throat with fever
 - C. Itching
 - D. Soreness

12. Beef stew must be cooled from 135F to 70F within ____ hours and from 70F to 41F or lower in the next ____ hours.
 - A. 4, 2
 - B. 2, 4
 - C. 3, 2
 - D. 2, 3

13. Stuffed pork chops must be cooked to a minimum internal temperature of
 - A. 135F for 15 seconds
 - B. 145F for 15 seconds
 - C. 155F for 15 seconds
 - D. 165F for 15 seconds

14. Grilled Catfish must be cooked to a minimum internal temperature of
 - A. 135F for 15 seconds
 - B. 145F for 15 seconds
 - C. 155F for 15 seconds
 - D. 165F for 15 seconds

15. If an employee exhibits symptoms of a gastrointestinal illness such as diarrhea, vomiting, and fever, they must:
 - A. be restricted to non-food handling duties in the establishment.
 - B. always use gloves when working with food.
 - C. take medication to control the symptoms while working with food.
 - D. be sent home and not allowed to come back to work without a Dr's note.

16. Which of the following is not one of the "Big 5" foodborne illnesses:
 - A. *Shigella*
 - B. E. COLI 0157:H7
 - C. Hepatitis C
 - D. *Salmonella*

17. A foodborne disease outbreak is likely to have occurred when:
 - A. 2 or more persons became ill after consuming the same product.
 - B. 1 person was diagnosed with Botulism or chemical poisoning.
 - C. both A and B.
 - D. none of the above.

18. Seed spouts and cut melons are considered a Potentially Hazardous Food (PHF).
 - A. True
 - B. False

19. Which microorganism would be a concern when working with reduced oxygen packaging (ROP):
 - A. Clostridium Botulinum
 - B. Salmonella
 - C. Coli
 - D. Influenza Virus

20. Sanitization is the process of reducing microorganisms on the food contact surfaces of utensils and equipment by what percent?

- A. 10
 - B. 50
 - C. 99.999
 - D. 100
21. With the exception of milk, Molluscan shellfish, and whole shell eggs, at what temperature should all potentially hazardous food (PHF) be received?
- A. 50 °F or less
 - B. 41 °F or less
 - C. 38 °F or less
 - D. 55 °F or less
22. There are three types of (HACCP) food safety hazards associated with food. What are they?
- A. Chemical, Additives, and Physical
 - B. Chemical, Biological, and Physical
 - C. Biological, Cholesterol, and Additives
23. What is the proper cooking time and internal temperature for comminuted (ground) Beef?
- A. 145 °F for 1minute
 - B. 150 °F for 1 minute
 - C. 155°F for 15 seconds
 - D. Both B and C are correct
24. When cooking poultry products such as ground turkey or chicken, the poultry must meet a minimum internal temperature of:
- A. 145 °F for 15 seconds
 - B. 155 °F for 15 seconds
 - C. 165 °F for 15 seconds
 - D. 180 °F for 15 seconds
25. When using raw salmon to make sushi, the salmon must be frozen throughout to a temperature of:
- A. -4 °F or below for 168 hours
 - B. -31°F or below for 15 hours in a blast freezer
 - C. A and B above.
 - D. None of the above.
26. The Temperature Danger Zone is considered to be:
- A. 41 °F to 100 °F

- B. 41 °F to 135°F
 - C. 45 °F to 90 °F
 - D. 65 °F to 120 °F
27. When using time as a public health control, the food establishment must have written procedures and must also tag the product with a “Use by/Discard by” time no longer than how many hours?
- A. 1
 - B. 2
 - C. 4
 - D. 6
28. What does HACCP mean?
- A. Hazards Abolished Cleaning Correctly Project
 - B. Hazard Analysis Critical Control Points
 - C. Helping Always Cleaning Critical Parts
 - D. Hardly Assures Clean Cuisine Place
29. HACCP was developed by:
- A. Pillsbury and NASA
 - B. Food and Drug Administration
 - C. United States Department of Agriculture
 - D. Food Service Inspection Service
30. What is the first step in developing a HACCP plan?
- A. Identify corrective actions
 - B. Conduct a hazard analysis
 - C. Establish monitoring procedures
 - D. Determine critical control points

Appendix B

식품 안전 지식 테스트

문제를 풀기 전에 다음 지시사항을 먼저 읽어주시기 바랍니다.

참여 여부에 대하여

여러분께서 이 연구에 참여하시는 것은 완전히 본인의 의사에 달려있음을 알려드립니다. 참여하지 않기로 하셔도 될 뿐 아니라, 특정 문제에 답하지 않으셔도 됩니다. 그렇게 하셔도 전혀 불이익을 당하지 않을 것입니다.

여러분의 정보

여러분께 관한 정보는 연구자들에게만 제한된 기밀사항이 될 것입니다. 여러분의 개인적인 응답과 정보는 연구팀 밖으로는 나가지 않을 것입니다. 여러분이 응답한 내용은 다른 참여자들의 것과 통계를 내어 모두 합쳐진 전체 통계로만 알려질 것입니다. 그러므로 여러분이 어떻게 답했는지는 누가 알아볼 수 없습니다.

여러분의 응답은 안전한 전자 서버를 사용해서 수집되고 유지될 것입니다. 오직 연구자들만이 그 서버의 데이터를 알게 됩니다. 권한이 없는 사용자가 불법으로 그 정보에 손을 댈 가능성이 있으므로 저희는 여러분의 응답을 기밀로 하기 위해 가능한 모든 예방책을 사용할 것입니다.

감사의 말씀

여러분께서 이 연구에 참여해주시면 저희 팀이 더 좋은 훈련 프로그램을 개발하는데 도움이 될 것입니다. 그래서 여러분께서 기여하시는 바는 매우 중요합니다. 본 연구에 참석하시려면, 다음의 식품안전 지식 테스트를 완성해주시면 됩니다.

참여하기 원치 않으시는 분은 본 문서를 폐기해주시기 바랍니다.

제1부

다음 질문사항은 참여자와 참여자의 트레이닝 활동에 관한 개별 특성을 정의하기 위한 것입니다.

본인의 성은 무엇입니까?

- 남성
- 여성

식품업계에 종사한 경험은 몇 년입니까?

- 1년 미만
- 1 - 5 년
- 6 - 10 년
- 10 - 15 년
- 15 년 이상

본인의 모국어는 무엇입니까?

- 영어
- 스페인어
- 한국어
- 중국어
- 기타

본인이 가장 최근 CFM을 수료한 년도는?

- 2010
- 2009
- 2008
- 2007
- 2006
- 2005 이전

본인의 가장 최근 CFM은 어떤 트레이닝 프로그램입니까?

- Texas Department of Health Service (TDH)
- National Restaurant Association (ServSafe)

제2부

다음 질문 사항은 참여자의 CFM 트레이닝의 식품 안전에 관한 지식을 알아보기 위한 것입니다.

1. 노인들이 식품매개질환에 걸릴 위험이 더 많은 이유는?
 - A. 병원에서 시간을 더 보내기 때문에
 - B. 면역 기능이 나이가 들에 따라 약해지기 때문에
 - C. 젊은 사람들보다 식품제품에 사용된 화학제품에 대한 알러지반응이 커지기 때문에
 - D. 식욕이 더 적기 때문에

2. PHF(상하기 쉬운 음식)의 일반적인 특징이 아닌 것은?
 - A. 습도가 높다
 - A. 건조하다
 - B. pH가 중성 혹은 약산성이다
 - C. 단백질을 함유한다

3. 식품매개질환으로 판명되려면 같은 음식을 먹고 동일한 질병을 경험하는 사람이 몇 명 발생해야하는가?
 - A. 1
 - B. 2
 - C. 10
 - D. 20

4. 어떤 식품이 PHF(상하기 쉬운 음식)인가?
 - A. 날 당근
 - B. 쌀(건조한)
 - C. 빵
 - D. 날 콩나물류

5. 흔한 식품 알러지원이 아닌 것은?
 - A. 달걀

- B. 낙농식품
 - C. 땅콩
 - D. 돼지고기
6. 다음 중 식품이 오염되지 않도록 방지하는 방법이 아닌 것은?
- A. 화학제품 스프레이에 레이블을 붙여놓는다
 - B. 식품 입수기간동안 식품을 면밀히 점검한다
 - C. 식품을 담게 되어있는 컨테이너에 제품을 보관한다
 - D. 완전조리식품(ready-to-eat food)을 다른 익힌 식품과 따로 보관한다
7. 손을 씻은 후에, 손을 말릴 때 쓰는 것은?
- A. 앞치마
 - B. 행주
 - C. 일반 수건
 - D. 1회용 종이 타올
8. 다음 중 어떤 항목 후에 손을 씻어야만 하는가/
- A. 머리카락을 만진 후에
 - B. 음식을 먹은 후에
 - C. 티슈를 사용한 후에
 - D. 위의 모든 항목 후에
9. 다음 중 어떤 항목이 식품을 오염시킬 수 있는가?
- A. 반지
 - B. 시계
 - C. 팔찌
 - D. 위의 모든 항목
10. 한 직원이 같은 날 소고기로 햄버거 패티를 만들기 위해 1회용 장갑을 착용했다. 그 일이 끝나고나서 그 장갑을 계속 낀 채로 햄버거 번을 슬라이스했다. 여기서 이 직원이 잘못된 것은 어떤 부분인가?
- A. 날 고기를 처리한 후, 완전조리식품인 햄버거 번을 다루기 전에 손을 씻고 새로운 장갑으로 바꿔끼지 않은 것
 - B. 햄버거 번을 슬라이스하기 위해 손을 씻지 않은 것
 - C. 햄버거 번을 처리하기 전에 장갑을 씻고 소독하지 않은 것

D. 재활용 장갑을 끼지 않은 것

11. 식품 취급자는 다음 중 어떤 증상을 일으킬 때 일터의 식품과 관련된 일을 하지 말아야 하는가?

- A. 두통
- B. 열이 있고 목구멍이 아플 때
- C. 가려움증
- D. 근육통

12. 비프 스투는 135F에서 70F로 _____ 시간 내에 냉각되어야 하고 70F에서 41F이하로 _____ 시간 내에 냉각되어야 한다.

- A. 4, 2
- B. 2, 4
- C. 3, 2
- D. 2, 3

13. 속을 넣은 pork chops)은 최소내부온도가 얼마가 될 때까지 조리되어야 하는가?

- A. 135F 에서15 초간
- B. 145F 에서15 초간
- C. 155F 에서15 초간
- D. 165F 에서15 초간

14. 구운(grilled)) 메기는 최소내부온도가 얼마가 될 때까지 조리되어야 하는가?

- A. 135F 에서15 초간
- B. 145F 에서15 초간
- C. 155F 에서15 초간
- D. 165F 에서15 초간

15. 직원이 설사, 구토, 열과 같은 소화계통의 질병 증상을 보일 때, 어떻게 해야 하는가?

- A. 식품설비에서 식품과 관련되지 않은 일만 할 수 있도록 일내용을 제한해야 한다.
- B. 식품과 관련된 일을 할 때는 항상 장갑을 사용한다.
- C. 식품 관련된 일을 하되 증상 완화를 위한 약을 복용한다.
- D. 귀가조치를 취하며 다시 일터로 나오려면 의사의 허가가 있어야 한다.

16. “다섯 가지 5 대” 식품 매개 질환이 아닌 것은?
A. 쉬겔라
B. 대장균
C. C형 간염
D. 살모넬라
17. 식품매개질환 발병은 다음의 어떤 경우인가?
A. 같은 제품을 섭취한 후 2명 이상이 아프게 되었을 때
B. 보툴리즘이나 화학적 중독으로 1명이 진단받았을 때
C. A와 B 모두
D. 위의 어떤 경우도 아님
18. 나물류 및 썰어놓은 멜론류는 PHF(상하기 쉬운 음식)로 통한다. 맞는가 틀리는가?
A. 맞다
B. 틀리다
19. 다음 중 어떤 미생물이 ROP(산소 줄임 포장)에서 위험할 수 있는가?
A. CLOSTRIDIUM BOTULINUM(보툴리즘)
B. SALMONELLA(살모넬라)
C. E. COLI(대장균)
D. INFLUENZA VIRUS(인플루엔자 바이러스)
20. 소독이란 식기류나 장비의 음식접촉 표면에 있는 미생물을 몇 %까지 줄이는 과정을 말하는가?
A. 10
B. 50
C. 99.999
D. 100
21. 우유, 조개류, 계란을 제외한 PHF(상하기 쉬운 음식)는 몇 도에서 입수해야 하는가?
A. 50 °F 미만
B. 41 °F 미만
C. 38 °F 미만
D. 55 °F 미만
22. 식품과 관련하여 식품안전에 위해가 되는 요소의 형태 세 가지는?

- A. 화학적, 식품 첨가제, 물리적
- B. 화학적, 생물학적, 물리적
- C. 생물학적, 콜레스테롤, 식품첨가제

23. 같은 소고기의 적절한 조리 시간 및 내부 온도는?

- A. 145 °F 에서 1분간
- B. 150 °F 에서 1분간
- C. 155°F 에서 15초간
- D. B 와 C 가 맞다

24. 같은 칠면조 고기나 닭고기와 같은 닭고기류 제품을 조리할 때, 최소 내부 온도는?

- A. 145 °F 에서 15초간
- B. 155 °F에서 15초간
- C. 165 °F에서 15초간
- D. 180 °F에서 15초간

25. 날 연어고기를 사용하여 스시를 만들 때, 연어는 어떤 상태에서 냉동되었어야 하는가?

- A. -4 °F 혹은 이하에서 168 시간
- B. 급속 냉동기에서 -31°F 혹은 이하에서 15 시간
- C. A 와 B
- D. 다 틀리다

26. 온도 위험 지역이란?

- A. 41 °F - 100 °F
- B. 41 °F - 135°F
- C. 45 °F - 90 °F
- D. 65 °F - 120 °F

27. 식품 설비시설에서 식품보관을 위한 시간제어법을 사용할 때, 유효시간/폐기시간을 기록해놓는다. 이 때 식품은 몇 시간 후 폐기해야 하는가?

- A. 1
- B. 2
- C. 4
- D. 6

28. HACCP란?

- A. Hazards Abolished Cleaning Correctly Project(위험 폐지 바른 세척 프로젝트)
- B. Hazard Analysis Critical Control Points(위험 요소 중점 분석)
- C. Helping Always Cleaning Critical Parts(세척 중점 부분 협조)
- D. Hardly Assures Clean Cuisine Place(요리 장소 세척 보장)

29.HACCP이 개발된 곳은?

- A. Pillsbury 및 NASA
- B. Food and Drug Administration(식품 의약청)
- C. United States Department of Agriculture(미국 농업부)
- D. Food Service Inspection Service(식품 서비스 검사 서비스)

30.HACCP 계획을 세우기 위한 첫번째 단계는?

- A. 올바른 행동조치를 취한다.
- B. 위험 분석을 한다.
- C. 모니터링 과정을 세운다.
- D. 중점 제어 요소를 결정한다.

Appendix C

DRAFT PRENOTICE LETTER

Dear _____,

In the next few days you will be receiving an email requesting information about your educational needs regarding food safety. Please do not discard this email! You have been selected based on your role in the food industry to represent the views of a substantial number of certified food protection managers. Your responses are important.

Your answers the questions will be handled in an anonymous manner. You will also have the option to complete the questionnaire using traditional mail if you would prefer. Please take a few minutes to answer the questions and submit the document. Thanks in advance for your support. We look forward to hearing from you.

Sincerely,

Larry Sean Payton, M. Ed.
Doctoral Student
Ag Education and Communications
Texas Tech University

Appendix D

May 3, 2010

Dr. M Todd Brashears
Ag Ed & Communications
Mail Stop: 2131

Regarding: 502382 How does a food safety training program that uses instructional design and adult learning theory compare in knowledge gain or retention to one that does not?

Dr. M Todd Brashears:

The Texas Tech University Protection of Human Subjects Committee approved your claim for an exemption for the proposal referenced above on April 30, 2010.

Exempt research is not subject to continuing review. However, any modifications that (a) change the research in a substantial way, (b) might change the basis for exemption, or (c) might introduce any additional risk to subjects must be reported to the IRB before they are implemented.

To report such changes, you must send a new claim for exemption or a proposal for expedited or full board review to the IRB. Extension of exempt status for exempt projects that have not changed is automatic.

The IRB will send annual reminders that ask you to update the status of your research project. Once you have completed your research, you must inform the Coordinator of the Committee either by responding to the annual reminder or by notifying the Coordinator by memo or e-mail (donna.peters@ttu.edu) so that the file for your project can be closed.

Sincerely, Rosemary Cogan, Ph.D., ABPP
Protection of Human Subjects Committee
Box 41075 | Lubbock, Texas 79409-1075 | T 806.742.3905 | F 806.742.3947 | www.vpr.ttu.edu
An EEO/Affirmative Action Institution

Appendix E

Cover letter for Expert Panel

January 15, 2010

Dear Food Safety Professional,

Thank you for agreeing to participate as a member of our expert panel. This research study is aimed at identifying if there is a difference of knowledge obtained between certified food managers who in attend different certified food managers courses in Texas.

As a member of our expert panel, you may receive up to two rounds of questionnaires regarding certified food manager training knowledge. Responses will be compiled, and if necessary, a second questionnaire will be emailed to you on or about February 15, 2010. Based on results of the surveys with our expert panel, a survey instrument will be developed and emailed to a sample of certified food managers in the State of Texas.

We request that you complete the attached questionnaire and return via email to larryseanpayton@hotmail.com no later than January 26, 2010.

Best Regards,



**Larry Sean Payton, Doctoral Candidate
Texas Tech University
Texas A & M University**