

EVALUATING THE AGRICULTURAL KNOWLEDGE OF TEXAS STATE
UNIVERSITY-SAN MARCOS FRESHMEN

THESIS

Presented to the Graduate Council
of Texas State University-San Marcos
in Partial Fulfillment
of the Requirements

for the Degree

Master of EDUCATION

by

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San Marcos, Texas
December 2007

EVALUATING THE AGRICULTURAL KNOWLEDGE OF TEXAS STATE
UNIVERSITY-SAN MARCOS FRESHMEN

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ACKNOWLEDGEMENTS

There are numerous individuals who have been instrumental in seeing my graduate program through to its completion. Most particularly, I want to thank my wonderful daughter, Jillian Keith, and my parents John and Henrietta Baylor for all the love and support they have provided during this process. I have also been fortunate to have dear friends and colleagues who have provided me with much encouragement and fortitude, constantly reminding me of my goals and not allowing me to falter. Thank you all for your persistence when mine was waning.

Additionally, I want to thank my committee chair, Dr. Douglas Morrish for his ongoing support and willingness to accommodate my difficult schedule as we proceeded through this project together. Thank you also to my committee members, Dr. Tina Marie Cade and Dr. Hardin Rahe. Dr. Cade has been extremely supportive over the last three years and placed great confidence in my knowledge and abilities, as well as providing me with many plant related experiences. Lastly, Dr. Rahe provided the impetus for doing this study initially by offering me an opportunity I could not refuse if I proceeded with this research. This has been an interesting, challenging, and educational experience, and I am most grateful to everyone.

This manuscript was submitted on September 28, 2007.

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ABSTRACT

EVALUATING THE AGRICULTURAL KNOWLEDGE OF TEXAS STATE
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December 2007

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In 1988, the National Research Council recommended that students in grades K-12 receive some systematic instruction in agriculture. However, according to the Texas Farm Bureau, many central Texas schools do not actively participate in general agricultural education programs, causing concern about the level of agricultural knowledge of central Texas students. The purpose of this study, therefore, is to evaluate the agricultural knowledge of college freshmen at one central Texas university, Texas State University-San Marcos, based on the consideration that college-aged students are the voters, policy makers, and consumers of the future, and should be well-informed regarding the food and fiber supply.

Texas State University-San Marcos freshmen were invited via email to participate in the study, which consisted of the Food and Fiber Systems Literacy student assessment for grades 9-12. The instrument was administered using an online testing system, and results were evaluated using the variables of gender, type of high school (urban, suburban, rural), college major, participation in agricultural literacy programs in school,

and enrollment in agriculture classes in high school. A score of 70% was considered acceptable. The mean overall score, however, was 50.39%.

Overall mean scores based on gender were statistically significant at the 0.05 level ($p = 0.016$) with males achieving a mean score of 51.25% and females achieving a mean score of 49.85%. Type of high school (urban, suburban, rural) affected overall mean scores as well. Suburban high school students scored significantly higher (52.36%) than urban students (46.80%), while rural students scored 50.13%. In this case $p = 0.007$. Freshmen students who identified themselves as science majors at Texas State University-San Marcos achieved an overall mean score of 53.96% which was significantly higher ($p = 0.023$) than undecided majors, whose mean score was 47.36%.

The mean scores of students who participated in agricultural literacy programs in school and those who were enrolled in agriculture classes in high school yielded noticeably higher scores, but the overall scores were not statistically significant at the 0.05 level. Agricultural literacy program participants scored an overall mean score of 55.33% ($p = 0.153$), and students who were enrolled in high school agriculture classes achieved an overall mean score of 54.07% ($p = 0.22$).

The importance of the information gathered from this study was to recognize the possible insufficient level of agricultural knowledge, or literacy, of central Texas students. When agricultural literacy is recognized as a critical part of education in Texas, it is hoped that the appropriate authorities will act accordingly and encourage Texas educators to incorporate agriculture into existing curriculum.

CHAPTER I

INTRODUCTION

In 1988, the National Research Council (NRC) recommended that students in grades K-12 receive some systematic instruction in agriculture (NRC, 1988). This recommendation was heartily endorsed by agricultural literacy experts, citing that as voters, policy makers, and consumers, Americans should be well informed about their food and fiber system. The United States Department of Agriculture (USDA) sponsored Agriculture in the Classroom program, and the standards and benchmarks set by the Food and Fiber System Literacy program are valuable tools in achieving the NRC's recommendation. However, according to the Texas Farm Bureau, many schools in central Texas are not active participants in these programs, and the level of agricultural literacy in Texas students is in question (T. Duncan, personal correspondence, October 29, 2004).

Since agriculture is the basis of a society, the apparent lack of agricultural literacy among the general population in twenty-first century America is a growing concern. Previous research indicated that nearly 90% of the American population is two to three generations removed from production agriculture (Leising et al., 1998, p. 618). The result of this separation from agriculture is a population that knows little about its food supply, a situation which agricultural educators consider potentially dangerous. By

evaluating the level of agricultural knowledge of Texas State University-San Marcos freshmen, educators can assess current agricultural literacy education in Texas schools and adjust curriculum accordingly.

Problem Statement

The research problem was to determine the level of agricultural knowledge among Texas State University-San Marcos freshmen, using the Food and Fiber Systems Literacy student assessment for grades 9-12. This measure of cognitive ability using a multiple choice test is one of many methods of assessing agricultural knowledge.

Purpose and Objectives

The purpose of this study was to evaluate the agricultural knowledge of Texas State University-San Marcos freshmen. The information gathered will assess if agricultural literacy programs need to be expanded in Texas public schools, and create awareness of the importance of such knowledge.

Specific objectives of the study were:

1. Determine demographics of Texas State University-San Marcos freshmen.
2. Determine if Texas State University-San Marcos freshmen could achieve a score of at least 70% on the Food and Fiber Systems Literacy student assessment for grades 9-12.
3. Determine if test scores differ among gender, type of high school (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and agriculture classes in high school, based on the five thematic areas of the Food and Fiber Systems Literacy framework.

Hypothesis

The cognitive agricultural knowledge of Texas State University-San Marcos freshmen will not differ significantly based on the variables of gender, type of high school, college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school.

Limitations

The research had the following limitations:

1. Since school students frequently change school districts during their school careers, inferences made regarding school district cannot be entirely relied upon.
2. The possibility exists that students other than freshmen will respond to the survey. These responses will be included in the results.
3. Ex post facto, it was discovered that a single word had been inadvertently changed from the original test when developing the online version of the instrument. Although it is unlikely, the possibility exists that the wording could have had an effect on the answer choice.
4. All freshmen students at Texas State University-San Marcos were invited to participate in this study, and all who responded did so voluntarily. However, since the participants responded voluntarily, and were not randomly selected, the respondents will not necessarily be representative of the entire freshmen population at the university.
5. College major choices in demographic questions did not directly correspond in all cases with major choices at Texas State University-San Marcos.

Definition of Terms

The following terms are reported as defined in *A Guide to Food and Fiber Systems Literacy* (Leising et al., 1998):

Agricultural Literacy - Possessing knowledge and understanding of Food and Fiber Systems. An individual possessing such knowledge can synthesize, analyze, and communicate basic information about agriculture.

Benchmark – Statement identifying expected or anticipated skill or understanding relating to Food and Fiber Systems at various developmental levels. The statement may be declarative, procedural, or contextual in the type of understanding it describes.

Food and Fiber System – Term used synonymously with the term agriculture.

Food and Fiber Systems Literacy – Term used synonymously with the term agricultural literacy.

Food and Fiber Systems Literacy Framework – A curriculum model with five thematic areas delineating what a person should know to be agriculturally literate. Descriptions of each theme's standards, and accompanying grade-grouped benchmarks are included.

Standard – Describes what a student should understand relative to Food and Fiber Systems.

Basic Assumptions

It was assumed that all participants in this research were Texas State University-San Marcos freshmen. Additionally, it was assumed that participants were representative of central Texas students, and that participants answered test questions honestly.

CHAPTER II

REVIEW OF LITERATURE

Historical Background

Agriculture is the basis of a society. It “determines a nation’s general welfare and standard of living” (Leising et al., 1998, p. 618). Yet, in twenty-first century America, a large percentage of the population is two to three generations removed from direct contact with production agriculture, creating a population that knows little about the production, processing, marketing, distribution, regulation, and research that make up its food and fiber supply (Leising et al., 1998, p. 618). This apparent lack of agricultural literacy among the general population is, therefore, a growing concern (Mabie & Baker, 1996, p. 1).

In 1988, the National Research Council (NRC) recommended that American students in grades K-12 should receive some systematic instruction in agriculture. The Council stated that:

“...an agriculturally literate person’s understanding of the food and fiber system would include its history and its current economic, social and environmental significance to all Americans. This definition is purposely broad, and encompasses some knowledge of food and fiber production, processing, and domestic and international marketing. As a complement to instruction in other

academic subjects, it also includes enough knowledge of nutrition to make informed personal choices about diet and health. Agriculturally literate people would have the practical knowledge needed to care for their outdoor environments, which include lawns, gardens, recreational areas, and parks” (NRC, 1988, p. 8-9).

This proclamation has been the impetus of agricultural literacy programs since its publication, and has also provided validation for agricultural educators to develop new programs and studies on a subject previously treated as unimportant.

Over the years, many individuals and organizations have exercised various techniques for promoting literacy in agriculture, aimed at both youth and adults. In Ohio, “Agricultural Extension educators receive numerous requests to speak about agriculture, providing an opportunity to increase agricultural awareness and knowledge among diverse community audiences” (Mechling, 1997, p. 1). Mechling (1997) utilized quizzes to stimulate discussion about agricultural issues with an audience. Developed from Ohio agricultural publications, quiz questions consisted of general agricultural issues, as well as local issues, and have been used with approximately three hundred people over a period of six years. The results from non-agricultural audiences indicated “a better awareness of the industry and its importance to the local economy” (Mechling, 1997, p. 2). Farm audiences became more aware about the importance of agricultural exports that were previously unrealized. The quiz method provided a non-threatening method of addressing agricultural issues.

Lack of understanding about agriculture and agricultural issues can also lead to public misunderstandings about agriculture, “...the environmental impact of agriculture,

the utilization efficiency of resources in agriculture, and the safety of the food supply” (Nordstrom et al., 2000, p. 1). Additionally, as farming becomes more concentrated, and rural populations increase, the lack of knowledge about farming and farming systems becomes more evident, as well as problematic, including such problems as excessive manure, “and the potential for problems with such things as odors, flies, and groundwater contamination” (Nordstrom, et al., 2000, p.2). Focus groups were utilized in Pennsylvania to help alleviate public concerns about animal agriculture (Nordstrom et al., 2000, p. 2). Results indicated that “participants felt that placing an emphasis on educating students in their early stages of education (elementary and middle school) could reduce the efforts necessary to educate adult members of the public” (Nordstrom et al., 2000, p. 4).

In 1993, students in two inner-city Los Angeles schools participated in a study to evaluate agricultural knowledge and the effectiveness of experiential activities in improving that knowledge (Mabie & Baker, 1996, p. 1). The students, a combination of fifth and sixth graders, who were primarily African-American and Hispanic, were pre-tested about their knowledge of agriculture. “The students participating in the study appeared to know little about the food and fiber system” (Mabie & Baker, 1996, p. 2). They were asked to define agriculture, list three crops growing in California, and recognize common agricultural terminology, such as irrigation and drought. The study recommended that:

“It is critical to ensure that today’s youth grow up with a basic understanding of the food and fiber system. People should be capable of making educated decisions on issues in the voting booth as well as in their personal lives. Such

knowledge should be a part of every child's education, starting in kindergarten and continuing through higher education" (Mabie & Baker, 1996, p. 4).

"Today, estimates of the number of people involved in farming and ranching range from 1% to 2% of our population" (Terry, 2004, p. 6). Put in perspective, 1% to 2% of Americans provide food and fiber for the remaining 98% to 99% of Americans (Ag literacy programs seed for future, 2002). Terry continues,

"...there is no arguing the fact that all of us interact with agriculture, no matter how narrowly or broadly you define it, on a daily basis. The abundant availability of agricultural products for a multitude of purposes is critical to our way of life today. A strong case can be made for people understanding basic concepts of agriculture on the basis of consumer awareness" (Terry, 2004, p. 6).

Bellah, Dyer and Casey suggest that "agricultural literacy must be viewed as lifelong learning..." (Bellah et al., 2004, p. 24). Furthermore, the education system must make a conscious effort to address agricultural literacy, and redesign vocational agriculture.

Limited knowledge can become problematic regarding media reporting on agricultural and scientific issues as well, and can lead to misunderstandings in the public (Shelton & Roush, 2000, p. 36). "Mainstream print media, such as general-interest newspapers and magazines, serve agriculture indirectly by covering agricultural events and issues of the non-farming public, which depends on that coverage for much of its understanding of agricultural topics" (Reisner & Walter, 1994, p. 525). However, that coverage can be "...lacking in comprehensive understanding (i.e. from a farm perspective) of agricultural issues and inclined toward flashy events and 'cute and folksy' feature stories" (Reisner et al., 1994, p. 525). The Louisiana State University

Agricultural Center communications group has tested the various media methods - newspaper, radio, and television – in an effort to determine which method is most effective in delivering accurate agricultural information to the public. The results of the study indicated that newspaper and television were the more effective means of sharing information (Soileau & Kotrlik, 2004, p. 14). However, understanding of that material would be enhanced by greater understanding and appreciation of what agriculture means to society, and would aid in avoiding public misunderstanding of agriculture in general.

In 2003, Doerfert summarized published research studies related to agricultural literacy within the agricultural education profession since the release of the National Research Council report on systematic instruction in agriculture in 1988 (NRC, 1988). He found that more studies had been conducted using non-experimental research designs, and evaluated agricultural knowledge and perceptions more often than other variables such as attitudes, opinions, or concerns. Additionally, the populations studied were more focused on non-agriculture teachers (non-college) and elementary, middle school and high school students. He concluded that “Research efforts by agricultural educators on the topic of agricultural literacy must advance in both research design and collaboration if the goals of agricultural literacy are to be realized (Doerfert, 2003, p.12).

Pense and Leising, in a study of high school seniors in Oklahoma high schools, evaluated agricultural knowledge based on type of high school (urban, suburban, or rural) and between agriculture students and general education students using a criterion-referenced multiple choice test. The results of the study indicated that “agriculture students and general education students did not differ in their overall mean agricultural knowledge scores” (Pense & Leising, 2004, p. 86). Additionally, mean agricultural

knowledge scores of rural students were lower than the mean scores of urban or suburban students. Mean scores overall were below 50%, although the agriculture students did score higher than general education students.

Agricultural Literacy Programs

Agricultural literacy can be differentiated from agricultural education by identifying the purpose of each. Literacy in agriculture is providing education about agriculture and its connection to every day life, while agricultural education provides career training in agriculture. This distinction is important when discussing agricultural education programs. (C. Igo, personal correspondence, October 2, 2004)

Many agriculture producer organizations provide educational materials for teachers' use in teaching about agriculture. Examples would be the *Corn Growers Association*, the *American Farm Bureau*, and the *Organic Farmers Commodity Association*. However, two programs, *Agriculture in the Classroom*, and *A Guide to Food and Fiber Systems Literacy*, stand out in providing helpful materials and guidelines to promote literacy in agriculture nationwide. These programs, while not formally connected (C. Igo, personal correspondence, November 7, 2004), provide teachers with valuable information, including lesson plans and curriculum, to integrate agriculture into core academic areas. What follows is a description of these two important programs.

Agriculture in the Classroom

The United States Department of Agriculture (USDA) sponsored Agriculture in the Classroom (AITC) program was established in 1981, and is the "largest public effort to educate people about agriculture" (AITC, Final Report, 2004, p. 1). Its goal, according to the AITC website, is "to help students gain a greater awareness of the role of

agriculture in the economy and society, so that they may become citizens who support wise agricultural policies” (AITC, November 27, 2004). The concept for AITC began when the USDA invited representatives from various agricultural, educational, and governmental businesses and organizations to discuss agricultural literacy. A task force was developed, which then recommended that the agency assist states in the organization of agricultural literacy programs.

Following the advice of the task force, USDA provided opportunities for each state to administer its own AITC program. Individual states base programs on the needs and interests of the state farm organizations and governments. As a result, the level of commitment to AITC varies widely from state to state. However, the USDA supports state programs in such ways as helping to develop AITC programs, and providing materials and information.

AITC programs are aimed primarily at elementary and secondary school students. Teacher training seminars are held during the summer months, and consist of educating teachers about the importance of agriculture, in addition to providing guidance in the integration of agriculture into the various curriculum. Workshops often include farm and agribusiness tours, as well as educational activities.

During the 2002 school year, the USDA, in association with the Department of Agricultural Education at Oklahoma State University, conducted a study to evaluate agricultural literacy. The study, *The Impact of Selected Agriculture in the Classroom Teachers on Student Agricultural Literacy*, took place in Arizona, Montana, Oklahoma, and Utah, and concluded “that AITC trained teachers make a positive difference in student acquisition of knowledge about agriculture. Students in the AITC classrooms

demonstrated more agricultural knowledge achievement compared to students in classrooms with no AITC training.” (AITC Final Report, 2004, p. 2). The value of the AITC programs can be summarized as follows:

“The strength of Agriculture in the Classroom comes from its grassroots organization and the fact that educators are very much a part of the movement. Giant strides have been made since 1981. Agriculture in the Classroom is regarded as a refreshing, flexible educational program designed to supplement and enhance the teacher’s existing curriculum” (AITC, November 27, 2004).

Food and Fiber Systems Literacy

In response to the NRC mandate suggesting that students receive “systematic instruction in agriculture” (C. Igo, personal correspondence, November 7, 2004, C. Igo, 1998), researchers embarked on an effort to create standards to assist educators in evaluating student knowledge about agriculture. The effort began in 1994 at the University of California, Davis, in collaboration with several California agricultural organizations and the Milton Hershey School in Pennsylvania. Framework development continued in 1995-1996 at Oklahoma State University, with grant funding from the W.K. Kellogg Foundation, and concluded in 1997-1998 with field testing the program in schools (Leising et al., 1998, p.5). The final result was *A Guide to Food and Fiber System Literacy, A Compendium of Standards, Benchmarks, and Instructional Materials for Grades K-12*.

The *Guide to Food and Fiber Systems Literacy (FFSL)* “summarizes what America’s youth should know about Food and Fiber Systems to be agriculturally literate by the time they graduate from high school” (Leising et al., 1998, p. 4). Prior to the

FFSL guide the emphasis in the education sector was on the development of educational materials (Leising & Pense, 2001). Although the guide contains suggestions for using the FFSL, and bringing the food and fiber curriculum to the classroom, the emphasis is on providing standards for measuring agricultural knowledge based on five themes and standards:

1. Understanding Food and Fiber Systems
 - A. Understand the meaning of Food and Fiber Systems/agriculture.
 - B. Understand the essential components of Food and Fiber Systems.
 - C. Understand Food and Fiber Systems' relationship to society.
 - D. Understand the local, national, and international importance of Food and Fiber Systems.
 - E. Understand Food and Fiber Systems careers.
2. History, Geography, and Culture
 - A. Understand Food and Fiber Systems' role in the evolution of civilizations.
 - B. Understand Food and Fiber Systems' role in societies throughout world history.
 - C. Understand Food and Fiber Systems' role in U.S. history.
 - D. Understand the relationship between Food and Fiber Systems and world cultures.
 - E. Understand how different viewpoints impact Food and Fiber Systems.
3. Science, Technology, and Environment
 - A. Understand how ecosystems are related to Food and Fiber Systems.
 - B. Understand Food and Fiber Systems dependence on natural resources.

- C. Understand management and conservation practices used in Food and Fiber Systems.
 - D. Understand science and technology's role in Food and Fiber Systems.
4. Business and Economics
- A. Understand Food and Fiber Systems and economics are related.
 - B. Understand Food and Fiber Systems have an impact on local, national, and international economies.
 - C. Understand government's role in Food and Fiber Systems.
 - D. Understand factors influencing international trade of food and fiber products.
5. Food, Nutrition, and Health
- A. Understand Food and Fiber Systems provide nourishment for people and animals.
 - B. Understand Food and Fiber Systems provide healthy diet components.
 - C. Understand Food and Fiber Systems provide food choices.
 - D. Understand Food and Fiber Systems promote a safe food supply. (Leising et al., 1998, p. 36)

Benchmarks for each grade level are included in the guide, as well as example lessons. "Breaking the standards into grade-grouped benchmarks, K-1, 2-3, 4-5, 6-8, the Framework provided a systematic means of addressing agricultural literacy" (Igo et al., 1999, p. 50)

In 1999, at the 26th Annual National Agricultural Education Research Conference, a study, *An Assessment of Agricultural Literacy in K-8 Schools*, was presented that

evaluated the effectiveness of the FFSL Framework. The study was done in schools in three states, Montana, Oklahoma, and California. The stated purpose was “to assess food and fiber knowledge of selected students in kindergarten through eighth grade before and after receiving instruction based upon the Food and Fiber Systems Literacy Framework standards and benchmarks” (Igo et al., 1999, p. 50). The study concluded that the FFSL was an effective guide for instruction in agriculture for grades K-8.

In the years following the K-8 study, Pense and Leising developed and tested a measurement instrument for students in grades 9-12 based on the FFSL standards and benchmarks for that age group (Pense & Leising, 2004, p. 89). A study took place in Oklahoma, and consisted of students from six high schools who were expected to graduate in the spring of 2002. The stated purpose was “to assess the food and fiber systems knowledge of twelfth grade students in Oklahoma” (Pense & Leising, 2004, p. 88). The study concluded that, based on the FFSL standards and benchmarks, students did have some agricultural knowledge, but in overall agricultural knowledge “did not demonstrate that they were agriculturally literate, as defined by the FFSL Framework” (Pense & Leising, 2004, p. 94).

The FFSL Framework was used as the guide for measuring the previously mentioned AITC study. By identifying student strengths and weaknesses in the thematic areas of agriculture, it was thought that program leaders would be better able to identify where gaps in student knowledge of agriculture occur and focus efforts in instructional material development and teacher training (AITC Final Report, p. 3). The Food and Fiber Systems Literacy standards and benchmarks have proven valuable in the area of agricultural literacy.

Agricultural Literacy in Texas

Although the level of participation of Texas schools in agricultural literacy programs is unclear, such programs do exist in the state. The Texas Department of Agriculture provides resources for teachers and schools, and Agriculture in the Classroom workshops occur every summer. Following is an evaluation of these two programs that promote agricultural literacy in Texas.

Texas Department of Agriculture

The Texas Department of Agriculture (TDA) indicates that agriculture education is a high priority. Department initiatives include providing programs, research, workshops, urban school grants, and internships (TDA, November 6, 2004). According to the TDA website, “The focus is on educating people on the science behind agriculture and how it affects their everyday lives” (TDA, November 6, 2004). However, little information was found for use in the classroom.

In the recent past TDA offered instructional materials for use by teachers through a program known as Project TEACH. Project TEACH provided lesson plans and other educational ideas about food, nutrition, and agriculture for use in Texas classrooms (TDA, October 5, 2004). How many schools and teachers actually utilized these materials, however, was not known.

TDA has now abandoned Project TEACH in favor of a nutritionally based program known as Square Meals (L. Hopson, personal correspondence, October 11, 2004), since TDA is the administering state agency for the USDA’s Child Nutrition Programs. The department’s new Food and Nutrition Division is now its connection with Texas schools. The Square Meals program focuses on teaching children about nutrition

and making wise food choices. Although the Square Meals program undoubtedly provides an important addition to education, it is not the equivalent of Project TEACH in regard to agricultural literacy.

The Urban Schools Grants Program began in 1999, and is a TDA initiative that offers elementary schools in certain urban school districts an opportunity to receive grant money for “demonstration agricultural projects or other projects designed to foster an understanding and awareness of agriculture...” (TDA, November 7, 2004). Schools may receive up to \$2,500.00 per grant cycle for proposals relating to agricultural projects. The proposal must demonstrate “the educational benefits of the project, including how the project will improve the students’ understanding of agriculture” (TDA, November 7, 2004). Although this program would appear to be a valuable opportunity for urban schools to increase student agricultural literacy, only twenty-nine proposals were received for the 2005 grant year cycle. Additionally, TDA indicates that eight to twelve proposals will be granted, based on available funds (T. Powers, personal correspondence, November 8, 2004).

Although TDA does provide educational materials for Texas schools, the extent to which they are utilized is unclear. Thus, Texas students could seemingly benefit from TDA initiatives if the agency promoted agricultural literacy in a more positive fashion. Ultimately, however, Texas educators must accept agriculture as an important part of education.

Agriculture in the Classroom

In Texas, the Agriculture in the Classroom program is administered through the Texas Farm Bureau, the Texas division of the American Farm Bureau. The Texas Farm

Bureau (TFB) is a membership directed organization, “one of the largest groups of farmers, ranchers and rural families in the world” (TFB, November 6, 2004). In addition to administering the AITC programs, the TFB represents its membership by addressing issues such as economic improvements to increase farm income and improving the image of agriculture to the public.

Each summer TFB sponsors the Summer Agricultural Institute, a workshop for elementary school teachers to learn how to integrate agriculture into the classroom. In 2003, forty-five teachers from across the state gathered to attend one of two one-week sessions, many sponsored by county Farm Bureau scholarships. Participants attended seminars and field trips designed to inform educators of the importance of agriculture in their own lives, as well as those of their students. The TFB AITC effort also includes a resource guide for teachers, which includes lesson plans for grades 1-6, as well as videos and a newsletter (TFB, November 6, 2004).

Participation in AITC workshops in Texas appears to be minimal, perhaps as a result of the programs not being well promoted. In personal communication with two Texas teachers from urban school districts, it was learned that neither had ever heard of AITC, nor have ever been encouraged to teach any aspect of agriculture in their classrooms (S. Taylor, personal correspondence, October 12, 2004; S. Tedford, 2004). As a result, teachers in the more urban central Texas area, according to Tad Duncan, TFB Education Director (T. Duncan, personal correspondence, October 29, 2004), have not been well represented at the AITC workshops. During the fifteen years from 1987 to 2002, the years in which today’s college students would have attended public school, 150 teachers from seven central Texas counties attended the workshops. Ten different school

districts were represented in the seven counties, which included Bastrop, Blanco, Caldwell, Comal, Hays, Travis, and Williamson counties.

TFB does appear to be taking steps to increase participation in its AITC programs (AITC, November 28, 2004). The organization plans to follow models from other state AITC programs by contacting universities across the state to work with future teachers. Additionally, several one-half to one-day seminars are being held throughout the state to expose teachers to the importance of including agriculture in the curriculum (AITC, November 28, 2004). The largest obstacle, however, is likely to be the state-mandated achievement test, the Texas Assessment of Knowledge and Skills, (S. Tedford, 2004) which does not include agriculture. Therefore, in school districts where teachers are expected to plan lessons for the purpose of higher test scores, inclusion of agriculture in the curriculum is unlikely.

Need for Research

Since many elementary and secondary students in central Texas appear to have little exposure to agricultural literacy programs, there is concern for the future of Texas regarding food and fiber systems. As an example, in comparing Texas' AITC program to other state AITC programs, the Texas program lags behind. In North Carolina in 2004, eight-hundred teachers were trained in AITC workshops, whereas the Texas AITC program reports that "nearly 350 elementary teachers participated in AITC teacher training workshops" (AITC, November 28, 2004). Utah, another state with an active AITC program, indicated that AITC training occurs at all state universities, as compared to Texas, which held a total of four teacher training sessions at Texas A&M University (AITC, November 28, 2004). Therefore, unless the Texas AITC programs become better

promoted and utilized, the level of agricultural knowledge of many Texas students could be considered less than adequate.

Today's college students are the future voters, policy makers, and consumers of this country. Awareness of the food and fiber system is vital in order for citizens to make informed decisions regarding agriculture and land development (Torres & Hopper, 2000). If Texans do not understand where their food, clothing, and shelter comes from, how can informed decisions be made?

This study proposes to evaluate existing agricultural knowledge, and assess if agricultural literacy programs need to be expanded in Texas. It is hoped that future studies might extend the area of study to the entire state. Based on the above information, it is vitally important to learn what Texas State University-San Marcos freshmen know about agriculture, and therefore determine what must be included in the education of Texans. The future depends on it.

CHAPTER III

METHODOLOGY

The purpose of the study was to determine the level of agricultural knowledge of Texas State University-San Marcos freshmen. As a result, the information gathered will also assess if agricultural literacy programs need to be expanded in Texas public schools.

Specific objectives of the study were:

1. Determine the demographics of Texas State University-San Marcos freshmen.
2. Determine if Texas State University-San Marcos freshmen could achieve a score of at least 70% on the Food and Fiber Systems Literacy student assessment for grades 9-12.
3. Determine if test scores differ among gender, type of high school (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school. The evaluation was based on the five thematic areas of the Food and Fiber Systems Literacy framework.

Instrumentation

The instrument used in this study was a criterion-referenced multiple-choice test designed by James G. Leising, Seburn L. Pense, and Matthew T. Potillo for a study associated with Oklahoma State University in 2001. Permission to use the instrument

was granted by Dr. Leising on November 9, 2004 (see Appendix A). The purpose of the test was to evaluate knowledge of the food and fiber system, according to the standards and benchmarks in the Guide to the Food and Fiber Systems Literacy (FFSL). Test content was validated by three methods, the first of which consisted of referencing the test questions to the five thematic areas of the FFSL. Secondly, test questions were written by three credentialed agricultural education teachers and three agricultural education graduate students. Finally, a panel of secondary school teachers validated the questions based on the FFSL benchmarks, grade appropriate language, and content appropriate for the designated grade levels.

The instrument was pilot tested on two occasions. The first pilot test took place at a small, rural high school in Oklahoma, where a reliability coefficient of $\alpha = 0.85$ was computed using the Kuder/Richardson-20 (KR-20). Following the first test, the instrument was reviewed multiple times, adjusting questions as deemed necessary, and a second pilot test took place in September 2001 at another small, rural high school in Oklahoma. After the second pilot test, the reliability coefficient was $\alpha = 0.93$ (Pense & Leising, 2004). The resulting instrument was known as the Food and Fiber Systems Literacy student assessment for grades 9-12 (see Appendix C).

The issue of at what level an individual is considered agriculturally literate was discussed with Dr. James Leising, one of the original test designers. According to Dr. Leising, “the real value of the test is that it does give insight into the areas of agricultural knowledge that the student has and areas that need to be improved in the curriculum” (Leising, personal communication, 2004). However, since teachers generally consider a score of 70% as representing acceptable knowledge, the same will be used in this study.

Sample Population

In November 2006, Texas State University-San Marcos had 27,485 registered students, 4,571 of whom had completed zero to twenty-nine credit hours and were considered freshmen (Texas State University, 2007). Since the purpose of the study was to evaluate the agricultural knowledge of Texas State University-San Marcos freshmen, a determination had to be made as how best to acquire a satisfactory number of freshmen in order to justify the results, which, according to the Krejcie and Morgan table, was a sample population of 354 students. The ease and availability of electronic mail (email) made it possible to include the entire freshmen population in the sample, and it was decided to offer the opportunity to all of them to voluntarily participate.

The population sample for this study, therefore, consisted of freshmen enrolled at Texas State University-San Marcos. Registered freshmen at the university were invited to participate in the study via an online test. Electronic mail (email) addresses for all Texas State University-San Marcos freshmen were provided to Dr. Douglas Morrish, supervising professor, by the university registrar in response to a request by this researcher. Following the receipt of the email addresses, the invitation to participate was initiated.

Students who opted to respond did so voluntarily. After comparing demographic makeup of the respondents to the non-respondents, it was noted that the participants accurately represented the freshmen student population at the university (Dillman, 2000). University freshmen consisted of 2,066 males (45%) and 2,505 females (55%) for a total of 4,571 students, whereas 39% of respondents were male and 61% were female. Additionally, 28.2% of the university freshmen were undecided about their major area of

study, and 27.9% of respondents classified themselves as undecided.

In addition to gender and college major, other demographic information requested from respondents included age and type of high school attended. The majority of respondents by far (86%) were aged eighteen and nineteen years old. According to the Texas State University-San Marcos Office of Institutional Research, 79% of registered freshmen in 2006 were eighteen to nineteen years old (Texas State University, 2007). Respondents were also asked to classify the type of high schools from which they graduated as urban, suburban, or rural. Webster (1981) defines urban as “characteristic of a city.” Suburban refers to “a district outside of, but adjoining a city,” and rural “pertains to the country, or country life.” These definitions were applied to any reference to “type of high school” throughout this study.

Data Collection and Analysis

The test was administered through an online electronic test system provided for use by the Episcopal Theological Seminary of the Southwest in Austin, Texas. James Thomas administered the survey using PHPSurveyor, version 1.0. Dr. James G. Leising of Oklahoma State University, one of the original test designers, provided an electronic version of the instrument which was loaded into the survey program for distribution to Texas State University-San Marcos freshmen.

The registrar’s office at Texas State University-San Marcos provided the 4,571 freshmen electronic mail (email) addresses, which were entered into an electronic survey program for online distribution. On September 11, 2006, the initial mailing was distributed. The email contained an introduction from the researcher, an explanation of the survey, an invitation to participate, and a link to the online test (see Appendix B).

Once the link was opened, the participant was provided with additional information about the survey, including a statement regarding the approval from the Institutional Review Board and a contact number of the university for questions about the legitimacy of the survey. A follow-up email reminder was sent one week later.

Responses generated from the reminder email were low. Since an insufficient number of responses had been received, the decision was made to offer an incentive to potential respondents. Therefore, on October 12, 2006, another email was distributed, with a follow-up on October 25, stating that all participants would be entered into a drawing for a \$100.00 gift card and that every 250th respondent would receive a \$10.00 gift card. The survey was closed on October 31, 2006, having generated 501 responses, which is a response rate of 11%.

The data were entered into an SPSS 13.0 data file and was analyzed using descriptive statistics and analysis of variance (ANOVA). Descriptive statistics included mean, standard deviation, aggregate mean, and frequencies, and were compared using the variables of gender, type of high school attended (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school. The ANOVA compared overall agricultural literacy test scores as well as each of the five thematic areas with type of high school attended (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school.

CHAPTER IV

RESULTS

The purpose of the study was to determine the level of agricultural knowledge of Texas State University-San Marcos freshmen. As a result, the information gathered will also assess if agricultural literacy programs need to be expanded in Texas public schools.

Specific objectives of the study were:

1. Determine the demographics of Texas State University-San Marcos freshmen.
2. Determine if Texas State University-San Marcos freshmen could achieve a score of at least 70% on the Food and Fiber Systems Literacy student assessment for grades 9-12.
3. Determine if test scores differ among gender, type of high school (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school. The evaluation was based on the five thematic areas of the Food and Fiber Systems Literacy framework.

Findings Related to Objective One

In order to evaluate the agricultural knowledge of Texas State University-San Marcos freshmen, it was first necessary to determine the demographics of the respondents. Of the 501 participants in the study, which represents a response rate of

11%, 194 were male and 307 were female. These students came from a mixture of high school types (urban, suburban, rural), although the majority of participants, 260 out of 501 (51.9%), described the high school they attended as suburban, while 135 (26.9%) participants described their high school as urban and 106 (21.2%) described their school district as rural (Table 1).

Table 1

Gender of Texas State University-San Marcos Freshmen Participants According to Type of High School Attended

Type of High School	Male		Female		Total
	<i>n</i>	%	<i>n</i>	%	
Urban	56	41.5	79	58.5	135
Suburban	97	37.3	163	62.7	260
Rural	41	38.7	65	61.3	106
Total	194		307		501

Table 2 indicates that the majority of students by far graduated from high schools in Texas. Of the 501 participants, 476 graduated from Texas high schools.

Table 2

Type of High Schools Attended by Texas State University-San Marcos Freshmen Participants Inside and Outside of Texas

Type of High School	In Texas		Outside Texas		Total
	<i>n</i>	%	<i>n</i>	%	
Urban	127	94.1	8	5.9	135
Suburban	247	95.0	13	5.0	260

Table 2 - Continued

Type of High School	In Texas		Outside Texas		Total
	<i>n</i>	%	<i>n</i>	%	
Rural	102	96.2	4	3.8	106
Total	476		25		501

The remaining 25 participants graduated from nine other states in the United States, as well as from Europe and Japan as shown in Table 3.

Table 3

Texas State University-San Marcos Freshmen Participants Who Attended High School Outside of Texas

State/Country	<i>n</i>
Alaska	1
Arizona	1
California	3
New Jersey	2
New York	2
Pennsylvania	3
Oklahoma	1
Oregon	1
Unknown	6
Europe	1
Japan	4
Total	25

The overwhelming majority of participants (87.4%) indicated that they did not take any type of agriculture classes in high school, as shown in Table 4. There was little difference among those who did not take agriculture classes based on the type of school district attended, although, as might be expected, a higher percentage of students from rural school districts (36.8%) did take agriculture classes versus those from urban or suburban school districts (12.6% and 12.3% respectively).

Table 4

Texas State University-San Marcos Freshmen Participants Who Did or Did Not Take High School Agriculture Classes Based on Type of High School

Type of High School	Took Ag classes		No Ag classes		Total
	<i>n</i>	%	<i>n</i>	%	
Urban	17	12.6	118	87.4	135
Suburban	32	12.3	228	87.7	260
Rural	39	36.8	67	63.2	106
Total	88		413		501

Additionally, the majority of respondents indicated that they had not participated, or were unsure about their participation in agricultural literacy programs. However, a larger percentage of those who did participate in agricultural literacy programs described their school district as rural (Table 5).

Table 5

Texas State University-San Marcos Freshmen Participants From Urban, Suburban, and Rural High Schools Who Participated in Agriculture Literacy Programs

Participate in Ag literacy	Urban		Suburban		Rural		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Yes	6	4.4	13	5.0	20	18.9	39
No	115	85.2	196	75.4	67	63.2	378
Unsure	14	10.4	51	19.6	19	17.9	84
Total	135	100.0	260	100.0	106	100.0	501

Many participants indicated that they were undecided about their major area of study, and the numbers were spread fairly evenly among the type of school district attended. Of the declared majors, slightly more participants were science majors than any other, followed by the arts and education. Again, the differences between type of school district and major area of study were minor (Table 6).

Table 6

College Majors of Texas State University-San Marcos Freshmen Based on Type of High School

College Major	Urban		Suburban		Rural		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Education	29	21.5	41	15.8	12	11.3	82
Science	29	21.5	50	19.2	30	28.3	109
Arts	22	16.3	54	20.8	20	18.9	96

Table 6 - Continued

College Major	Urban		Suburban		Rural		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Law	6	4.4	13	5.0	6	5.7	25
Social Science	9	6.7	32	12.3	8	7.5	49
Undecided	40	29.6	70	26.9	30	28.3	140
Total	135	100.0	260	100.0	106	100.0	501

Findings Related to Objective Two

The overall mean score on the agricultural literacy examination achieved by the 501 Texas State University-San Marcos freshmen who participated in the study was 50.39%. Test scores were also calculated based on the five thematic areas of the Food and Fiber Systems Literacy (FFSL) framework. In order to best determine the level of agricultural knowledge, the FFSL authors divided the guide into five critical areas, or themes, and designed test questions to reflect what an agriculturally literate individual should know in each area. The five themes in the FFSL were further divided into subcategories, with specific questions for each subtopic. The five thematic areas of the FFSL include understanding agriculture (Theme 1), history, geography, and culture (Theme 2), science and the environment (Theme 3), business and economics (Theme 4), and food, nutrition and health (Theme 5). Figure 1 illustrates the five thematic areas of the FFSL and their respective standards.

Figure 1

Food and Fiber Systems Literacy Themes and Standards

Food and Fiber Systems Literacy Framework

Theme I – Understanding Food and Fiber Systems

- A. Understand the Meaning of Food and Fiber Systems/Agriculture
- B. Understand the Essential Components of Food and Fiber Systems (e.g. production, processing, marketing, distribution, research and development, natural resource management and regulation)
- C. Understand Food and Fiber Systems' Relationship to Society
- D. Understand the Local, National, and International Importance of Food and Fiber Systems
- E. Understand Food and Fiber Systems Careers

Theme II – History, Geography, and Culture

- A. Understand Food and Fiber Systems' Role in the Evolution of Civilizations
- B. Understand Food and Fiber Systems Role in Societies throughout World History
- C. Understand Food and Fiber Systems' Role in U.S. History
- D. Understand the Relationship between Food and Fiber Systems and World Culture
- E. Understand How Different Viewpoints impact Food and Fiber Systems

Theme III – Science, Technology, and Environment

- A. Understand How Ecosystems are Related to Food and Fiber Systems
- B. Understand Food and Fiber Systems' Dependence on Natural Resources
- C. Understand Management and Conservation Practices used in Food and Fiber Systems
- D. Understand Science and Technology's Role in Food and Fiber Systems

Theme IV – Business and Economics

- A. Understand Food and Fiber Systems and Economics are Related
- B. Understand Food and Fiber Systems Have an Impact on Local, National, and International Economics
- C. Understand Government's Role in Food and Fiber Systems
- D. Understand Factors Influencing International Trade of Food and Fiber Products

Theme V – Food, Nutrition, and Health

- A. Understand Food and Fiber Systems Provide Nourishment for People and Animals
 - B. Understand Food and Fiber Systems Provide Healthy-Diet Components
 - C. Understand Food and Fiber Systems Provides Food Choices
 - D. Understand Food and Fiber Systems Promotes a Safe Food Supply
-

(taken from Leising, et al., 1998, pp. 16-33)

The mean scores by theme ranged from 40.22 percent for Theme 5 (Food,

Nutrition, & Health) to 57.07% for Theme 2 (History, Geography, & Culture). Scores on the remaining themes included 55.72% for Theme 1 (Understanding Agriculture), 52.27% for Theme 3 (Science & Environment), and 45.44% for Theme 4, (Business & Economics). Table 7 summarizes the results.

Table 7

Mean Scores for Participating Texas State University-San Marcos Freshmen, Overall and by Theme

Agricultural Themes 1-5	<i>n</i>	All Participants	
		<i>M</i>	<i>SD</i>
Overall score	501	50.39	16.59
(1) Understanding Agriculture	501	55.72	19.91
(2) History, Geography & Culture	501	57.07	25.53
(3) Science & Environment	501	52.27	23.21
(4) Business & Economics	501	45.44	22.94
(5) Food, Nutrition, & Health	501	40.22	15.94

Although the FFSL authors have not determined a test score that represents an adequate level of agricultural literacy, this research project used a score of 70% on the Food and Fiber Systems Literacy student assessment for grades 9-12 to indicate that the participant was minimally literate in agriculture. Educators generally regard a score of 70% as representing adequate knowledge in colleges and universities in the United States, and as such was selected to represent the same in this study. In this sample, however, only seventy-two students, or fourteen percent of all participants, scored 70% percent or higher in overall test scores. Test scores ranged from 10% to 86%, with two

students receiving 86% (Table 8).

Table 8

Texas State University-San Marcos Freshmen Overall Test Scores Above and Below 70 Percent

Students' Overall Test Score	<i>n</i>	%
Students Scoring Below 70 %	429	85.6
Students Scoring Above 70 %	72	14.4
Total all	501	100.0

Table 9 reports the distribution of the seventy-two students scoring 70% and above.

Table 9

Distribution of Texas State University-San Marcos Freshmen Participants Overall Test Scores of 70 Percent and Above

Students' Overall Test Scores of 70 percent and higher	<i>n</i>	%
70%	19	3.8
72%	14	2.8
74%	15	3.0
76%	4	0.8
78%	10	2.0
80%	6	1.2
82%	0	0.0
84%	2	0.4
86%	2	0.4
Total scores of 70 percent and above	72	14.4

Of the 72 students achieving a score of 70% and above, nineteen scored exactly 70%, a larger number than any other score of 70% or above. The next largest groups scored 72% and 74%, with 14 students achieving a score of 72% and 15 students receiving a score of 74%. Ten participants scored 80% and above, with eight students scoring 80% and 2 students each scoring 84% and 86%.

Findings Related to Objective Three

In order to determine the level of agricultural knowledge of Texas State University-San Marcos freshmen, it was important to evaluate the test results based on a number of factors. The data were analyzed by comparing the overall mean scores, as well as individual thematic mean scores, in the Food and Fiber Systems Literacy framework with the variables of students gender, age, type of school district, type of high school, college major, and whether or not the student participated in agricultural literacy programs or in agriculture classes in school. The results are explained forthwith.

Gender and age

Of the 501 participants in the study, 194 were male and 307 were female. The mean score for all participants was 50.39%, while the mean score for male participants was 51.25%, with a low score of 14% and a high score of 86%. Female participants, on the other hand, achieved an average score of 49.85%, the lowest score being 10% and the highest score being 86%. Table 10 summarizes the results of the overall scores based on gender.

Table 10

Mean Test Scores of Texas State University-San Marcos Freshmen Participants Based on Gender

Gender	<i>n</i>	<i>M</i>	<i>SD</i>	Minimum Score	Maximum Score
Male	194	51.25	17.7	14	86
Female	307	49.85	15.8	10	86
Total	501	50.39	16.6	10	86

A t-test indicated that the difference between male and female mean scores was statistically significant at the 0.05 level, as seen in Table 11.

Table 11

Differences Between Overall Test Scores of Male and Female Texas State University-San Marcos Freshmen Participants (using T-test statistic)

	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Male	194	51.25	17.7	.372	0.016*
Female	307	49.85	15.8		

*Statistically significant at the 0.05 level

Age was also a consideration in analyzing test scores. The majority of student participants (433) were eighteen and nineteen years old, although a few (9) were below the age of eighteen, and a few more (59) were older than nineteen. The results, therefore, will refer to the traditional college freshmen, generally eighteen to nineteen years old.

Type of High School

The next comparison evaluated the effect of type of school attended and mean overall test scores. As was found by Pense and Leising, students from suburban high schools scored higher than students from either urban or rural schools (Pense & Leising,

2004). Table 12 summarizes the mean overall scores by type of high school. It was found that a statistically significant difference ($p = 0.007$) existed.

Table 12

ANOVA for Overall Scores of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Urban	135	46.80	15.95	2	5.087	0.007*
Suburban	260	52.36	16.00			
Rural	106	50.13	18.15			
Total	501	50.39	16.60			

*Statistically significant at the 0.05 level.

A Tukey's HSD) post hoc test analyzed the differences in overall scores between urban, suburban, and rural students. The results are reported in Table 13, with the significant difference being between urban and suburban participants.

Table 13

Mean Differences of Overall Scores (Tukey's HSD) of Texas State University-San Marcos Freshmen Participants Between Urban, Suburban, and Rural High Schools

Overall score	Urban	Suburban	Rural
Urban	-	-5.56*	-3.33
Suburban	5.56*	-	2.23
Rural	3.33	-2.23	-

*Statistically significant at the 0.05 level

²Mean differences are calculated as group in the row minus the group in the column

A 2003 study reported that "Many rural areas are experiencing population growths..."

(Nordstrom et al., 2000, p. 3). This phenomenon could possibly explain why Pense and

Leising reported that rural students demonstrated less agricultural knowledge than either urban or suburban students, and this researcher found that rural students' overall mean scores were only slightly below suburban students.

Further effects of type of high school on student scores were evaluated by examining the mean scores in each of the five thematic areas of the FFSL framework. Theme 1 (Understanding Agriculture) questions evaluate participant knowledge of basic agriculture, including agricultural systems, agriculture's relationship to society, and the importance and interaction of worldwide agricultural systems. The analysis of variance of the Theme 1 mean scores students indicated a significant difference ($p = 0.002$). Table 14 summarizes the results.

Table 14

ANOVA for Theme I (Understanding Agriculture) Scores of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Urban	135	50.72	19.97	2	6.121	0.002*
Suburban	260	57.95	19.33			
Rural	106	56.61	20.26			
Total	501	55.72	19.91			

*Statistically significant at the 0.05 level

Table 15 illustrates the significant difference lies difference between urban and suburban students.

Table 15

Mean Differences of Theme 1 Scores (Tukey's HSD) of Texas State University Freshmen Participants and Type of High School

Area	Urban	Suburban	Rural
Urban	-	-7.23*	-5.89
Suburban	7.23*	-	1.34
Rural	5.89	-1.34	-

*Statistically significant at the 0.05 level

²Mean differences are calculated as group in the row minus the group in the column

Theme 2 of the FFSL framework is concerned with history, geography, and culture. Since agriculture is critical to the survival of a society, it is important for students to understand the food and fiber systems that have supported humanity over the course of time. The mean score for Theme 2 was 57.07, and according to Table 16, a significant difference existed between the groups. Table 16 illustrates the effects of school district type on the scores for Theme 2.

Table 16

ANOVA for Theme 2 (History, Geography and Culture) Scores of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Urban	135	52.15	25.26	2	4.475	0.012*
Suburban	260	60.08	24.93			
Rural	106	55.94	26.50			
Total	501	57.07	25.53			

*Statistically significant at the 0.05 level

Similar to theme 1, the significant difference in the mean scores for Theme 2 occurred between the urban and suburban students as illustrated in Table 17.

Table 17

Mean Differences of Theme 2 Scores (Tukey's HSD) of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	Urban	Suburban	Rural
Urban	-	-7.93*	-3.80
Suburban	7.93*	-	4.13
Rural	3.80	-4.13	-

*Statistically significant at the 0.05 level

²Mean differences are calculated as group in the row minus the group in the column

In Theme 3, test questions covered topics in the areas of science, technology, and the environment. This section evaluates knowledge of agriculture and ecosystems and the relationship with and dependence on natural resources. The mean score on Theme 3 was 52.27%. Scores for urban students were the lowest on this theme, 48.21%, with little difference between the suburban and rural students. Table 18 summarizes the results.

Table 18

ANOVA for Theme 3 (Science, Technology, and Environment) Scores of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Urban	135	48.21	20.88	2	2.881	0.057
Suburban	260	53.99	23.46			
Rural	106	53.20	24.89			
Total	501	52.27	23.20			

*Statistically significant at the 0.05 level

Theme 4 addresses topics related to the business and economics of agriculture. Understanding the impact of agriculture on the economy of a society at all levels, and the role of the government on the food and fiber supply and trade is critical. Participant scores based on school district type ranged from 42.07% (urban students) to 47.26% (suburban students) and averaged 45.44%. Table 19 indicates that the difference between these scores is not significant at the 0.05 level.

Table 19

ANOVA for Theme 4 (Business and Economics) Scores of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Urban	135	42.07	21.30	2	2.289	0.102
Suburban	260	47.26	23.24			
Rural	106	45.29	23.92			
Total	501	45.44	22.94			

*Statistically significant at the 0.05 level

The final theme, Theme 5, addresses food, nutrition, and health. Topics include human and animal nourishment, healthy food choices, and the safety of the food supply. The mean score for Theme 5 was 40.22 percent with scores ranging from 38.35 percent for rural students to 41.32 percent for suburban students. As with Theme 4, the differences between these scores was not significant at the 0.05 level as seen in Table 20.

Table 20

ANOVA for Theme 5 (Food, Nutrition, and Health) Scores of Texas State University-San Marcos Freshmen Participants and Type of High School

Area	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Urban	135	39.56	17.41	2	1.470	0.231
Suburban	260	41.32	14.97			
Rural	106	38.35	16.21			
Total	501	40.22	15.94			

*Statistically significant at the 0.05 level

College major

The sample of Texas State University–San Marcos freshmen who participated in this study fairly represented the total population of student enrollment based on college major. According to the Texas State University-San Marcos Office of Institutional Research (Texas State University-San Marcos, 2007), the total student population for the 2006 academic year numbered 27,485 students. Of these students, the Office of Institutional Research reports that the largest number of Texas State University-San Marcos students were Liberal Arts students (19%), followed by students enrolled in the Colleges of Education (17%) and Fine Arts and Communications (16%). The freshmen study participants who indicated they were Education majors was 16.37%, and those who identified themselves as Arts majors was 19.16 %. Furthermore, science majors university-wide consisted of 22% of the total student population, whereas the freshmen science major study participants were 21.76% of the total participants in the study.

The mean score of the declared science majors was higher than the mean score of the students with non-science majors. The difference between the high score of 53.96%

and the lowest mean score of 47.36%, attributed to participants who identified their major as undecided. This difference was statistically significant ($p = 0.023$), as shown in Table 21.

Table 21

ANOVA for Overall Scores of Texas State University-San Marcos Freshmen Participants and College Major

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Education	82	48.59	16.06	5	2.646	0.023*
Science	109	53.96	16.81			
Arts	96	52.08	16.80			
Law	25	47.60	18.28			
Social Science	49	52.24	16.30			
Undecided	140	47.36	15.90			
Total	501	50.39	16.60			

*Statistically significant at the 0.05 level

According to Doerfert's 2003 report, little research has been done to evaluate the agricultural knowledge of college students (Doerfert, 2003). Therefore, the information reported regarding the differences in scores based on college major is purely informational. Table 22 reports that the significant difference in overall mean scores based on college major is between science majors and those freshmen who were undecided about their college major at the time of the study.

Table 22

Mean Differences of Overall Scores (Tukey's HSD) of Texas State University-San Marcos Freshmen Participants and College Majors

Overall score	Education	Science	Arts	Law	Social Science	Undecided
Education	-	-5.38	-3.50	0.99	-3.66	1.23
Science	5.38	-	1.88	6.36	1.72	6.61*
Arts	3.50	-1.88	-	4.48	-0.16	4.73
Law	0.99	-6.36	-4.48	-	-4.64	0.24
Social Science	3.66	-1.72	0.16	4.64	-	4.89
Undecided	-1.23	-6.61*	-4.73	-0.24	4.89	-

*Statistically significant at the 0.05 level

²Mean differences are calculated as group in the row minus the group in the column

The difference among the mean scores for Theme 1 (Understanding Agriculture) based on college major followed the same pattern as the overall scores. Science majors achieved the highest score (59.65%), while the undecided students had the lowest scores (53.05%). The difference between these two scores, as indicated by the analysis variance test (ANOVA), however, was not statistically significant as shown in Table 23.

Table 23

ANOVA for Theme 1 (Understanding Agriculture) Scores of Texas State University-San Marcos Freshmen Participants and College Major

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Education	82	54.80	19.41	5	1.510	0.185
Science	109	59.65	20.17			
Arts	96	56.03	18.18			

Table 23 - Continued

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Law	25	53.20	25.85			
Social Science	49	56.80	19.01			
Undecided	140	53.05	20.05			
Total	501	55.72	19.91			

*Statistically significant at the 0.05 level

Scores on Theme 2 (History, Geography, and Culture) questions ranged from 52.93% for the undecided students to 60.52% for arts majors. Science majors, however, did not lag too far behind, scoring an average of 59.91% on Theme 2 questions. The differences among the scores on Theme 2 questions was not statistically significant ($p = 0.206$) at the 0.05 level as indicated in Table 24.

Table 24

ANOVA for Theme 2 (History, Geography, and Culture) Scores of Texas State University-San Marcos Freshmen Participants and College Major

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Education	82	56.22	25.47	5	1.446	0.206
Science	109	59.91	25.59			
Arts	96	60.52	26.21			
Law	25	54.80	27.56			
Social Science	49	58.37	25.77			
Undecided	140	52.93	24.39			
Total	501	57.07	25.53			

*Statistically significant at the 0.05 level

Theme 3 (Science and Environment) scores, on the other hand, produced a significant difference ($p = 0.011$) based on college major as illustrated in Table 25. The mean score for science majors (57.51%) was the highest among study participants. Students who identified themselves as majoring in some aspect of law scored lower than any other group (46.92%), followed by the undecided students, scoring (47.51%).

Table 25

ANOVA for Theme 3 (Science, Technology, and Environment) Scores of Texas State University-San Marcos Freshmen Participants and College Major

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Education	82	51.01	22.89	5	3.008	0.011*
Science	109	57.51	22.55			
Arts	96	53.77	24.82			
Law	25	46.92	24.49			
Social Science	49	56.06	19.96			
Undecided	140	47.51	22.74			
Total	501	52.27	23.21			

*Statistically significant at the 0.05 level

Table 26 indicates that, based on Tukey's HSD, the significant difference for Theme 3 scores is between science majors and the undecided students.

Table 26

Mean Differences of Theme 3 Scores (Tukey's HSD) of Texas State University-San Marcos Freshmen Participants and College Majors

Overall score	Education	Science	Arts	Law	Social Science	Undecided
Education	-	-6.50	-2.76	4.09	-5.05	3.51
Science	6.50	-	3.74	10.59	1.45	10.01*
Arts	2.76	-3.74	-	6.85	-2.29	6.26
Law	-4.09	-10.59	-6.85	-	-9.14	-0.59
Social Science	5.05	-1.45	2.29	9.14	-	8.55
Undecided	-3.51	-10.01*	-6.26	0.59	-8.55	-

*Statistically significant at the 0.05 level

^zMean differences are calculated as group in the row minus the group in the column

Science majors, again, scored higher than any other group on questions related to Theme 4 (Business and Economics), with a mean score of 50.51%. In this theme, however, education majors earned the lowest mean score of 39.76%. Table 27 illustrates how the Theme 4 scores are broken out. Additionally, Table 27 indicates that there is a significant difference ($p = 0.023$) on Theme 4 scores at the 0.05 level.

Table 27

ANOVA for Theme 4 (Business and Economics) Scores of Texas State University-San Marcos Freshmen Participants and College Major

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Education	82	39.76	20.62	5	2.634	0.023*
Science	109	50.51	22.60			
Arts	96	47.13	22.18			

Table 27 - Continued

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Law	25	42.80	21.0			
Social Science	49	47.84	26.80			
Undecided	140	43.31	23.22			
Total	501	45.44	22.94			

*Statistically significant at the 0.05 level

The significant difference in this case, is between science majors and education students, as shown in Table 28.

Table 28

Mean Differences of Theme 4 Scores (Tukey's HSD) of Texas State University-San Marcos Freshmen Participants and College Majors

Overall score	Education	Science	Arts	Law	Social Science	Undecided
Education	-	-10.76*	-7.37	-3.04	-8.08	-3.55
Science	10.76*	-	3.39	7.71	2.68	7.21
Arts	7.37	-3.39	-	4.33	-0.71	3.82
Law	3.04	-7.71	-4.33	-	-5.04	-0.51
Social Science	8.08	-2.68	0.71	5.04	-	4.53
Undecided	3.55	-7.21	-3.82	0.51	-4.53	-

*Statistically significant at the 0.05 level

^zMean differences are calculated as group in the row minus the group in the column

Theme 5 (Food, Nutrition and Health) scores were disappointingly low, regardless of major, although arts students scored slightly higher than any other group with a mean score of 41.57%. The scores in this theme were very close based on college major.

However, education students, again, scored lower than any other group (38.30%). Table 29 depicts the scores for Theme 5 questions and indicates that the difference between Theme 5 scores based on college major was not statistically significant at the 0.05 level.

Table 29

ANOVA for Theme 5 (Food, Nutrition, and Health) Scores of Texas State University-San Marcos Freshmen Participants and College Major

College Major	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Education	82	38.30	16.59	5	0.781	0.564
Science	109	41.57	16.00			
Arts	96	41.78	16.47			
Law	25	40.00	15.12			
Social Science	49	41.08	16.72			
Undecided	140	38.96	15.04			
Total	501	40.22	15.94			

*Statistically significant at the 0.05 level

Agricultural Literacy Classes

The USDA's *Agriculture in the Classroom* (AITC) program is probably the most widely used agricultural literacy program nationwide. However, the USDA only provides information and materials, allowing state governments to determine how the programs will be administered. In Texas, AITC is run by the Texas Farm Bureau, and based on the school districts represented at AITC workshops, it appears schools in rural areas of the state may be the primary beneficiaries of the program. Various other programs may be utilized throughout the state as well, but the population sample in this

study indicated that only 39 of the 501 participants, or 8%, were aware that they had been exposed to any type of agricultural literacy program.

Although the scores of rural students were not higher based on type of high school, those who indicated participation in agricultural literacy classes during their school years did score noticeably higher when compared to those who did not participate in agricultural literacy instruction, or were unsure of their participation. Overall scores for agricultural literacy participants was 55.33%, whereas non-participants and those unsure of their participation scored 49.97% and 49.98% respectively, as summarized in Table 31. Additionally, Table 30 indicates the difference in the scores based on participation in agricultural literacy programs ($p = 0.153$) was not statistically significant at the 0.05 level.

Table 30

ANOVA for Overall Scores of Texas State University-San Marcos Freshmen Participants Who Participated in Agricultural Literacy Programs in School

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Yes	39	55.33	18.05	2	1.882	0.153
No	378	49.97	16.34			
Unsure	84	49.98	16.88			
Total	501	50.39	16.60			

*Statistically significant at the 0.05 level

Students who participated in agricultural literacy programs also scored higher on questions related to Theme 1 (Understanding Agriculture). The difference here, as with the overall scores, was not significant, as indicated in Table 31. Theme 1 scores based on

participation in agricultural literacy programs ranged from 55.14% (those who did not participate) to 59.14% (those who did participate).

Table 31

ANOVA for Theme 1 (Understanding Agriculture) Scores of Texas State University-San Marcos Freshmen Participants Who Participated in Agricultural Literacy Programs in School

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Yes	39	59.74	21.83	2	1.010	0.365
No	378	55.14	19.56			
Unsure	84	56.44	20.53			
Total	501	55.72	19.91			

*Statistically significant at the 0.05 level

Theme 2 (History, Geography, and Culture) scores followed the same pattern as Theme 1 scores, with the lowest mean score (56.51%) from those students who did not participate in any agricultural literacy programs. Agricultural literacy participants answered 62.82% of the Theme 1 questions correctly. The difference between the scores ($p = 0.339$), however, was not significant at the 0.05 level as shown in Table 32.

Table 32

ANOVA for Theme 2 (History, Geography, and Culture) Scores of Texas State University-San Marcos Freshmen Participants Who Participated in Agricultural Literacy Programs in School

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Yes	39	62.82	24.70	2	1.083	0.339
No	378	56.51	25.99			

Table 32 - Continued

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Unsure	84	56.90	23.74			
Total	501	57.07	25.53			

*Statistically significant at the 0.05 level

In the case of Theme 3 (Science, Technology, and Environment), the lowest mean score (53.17%) was from those students who were unsure about their participation in any agricultural literacy programs. As with Themes 1 and 2, as well as with the overall scores, students who were aware of their participation in agricultural literacy programs scored noticeably higher than the other groups (58.56%). However, this difference is not significant ($p = 0.173$), as illustrated in Table 33.

Table 33

ANOVA for Theme 3 (Science, Technology, and Environment) Scores of Texas State University-San Marcos Freshmen Participants Who Participated in Agricultural Literacy Programs in School

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Yes	39	58.56	22.43	2	1.759	0.173
No	378	51.42	22.76			
Unsure	84	53.17	25.25			
Total	501	52.27	23.21			

*Statistically significant at the 0.05 level

Theme 4 (Business and Economics) scores, on the other hand, did show a significant difference ($p = 0.015$) according to the analysis of variance (ANOVA). Agricultural literacy participants scored 55.67% on the Theme 4 questions, while the

non-participants and those unsure of participation scored 44.50% and 44.95% respectively. Table 34 summarizes the results.

Table 34

ANOVA for Theme 4 (Business and Economics) Scores of Texas State University-San Marcos Freshmen Participants Who Participated in Agricultural Literacy Programs in School

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Yes	39	55.67	24.20	2	4.237	0.015*
No	378	44.50	22.80			
Unsure	84	44.95	22.10			
Total	501	45.44	22.94			

*Statistically significant at the 0.05 level

According to Tukey's HSD test, there was a significant difference between those study participants who participated in agricultural literacy programs and the other two groups.

Table 35 illustrates the small difference between non-participants and those unsure of their participation.

Table 35

Mean Differences of Theme 4 Scores (Tukey's HSD) of Texas State University-San Marcos Freshmen Participants Between Participants in Agricultural Literacy Programs, Non-participants, and Unsure of Participation

Ag literacy participants	Did participate	Did not participate	Unsure
Did participate	-	11.17*	10.71*
Did not participate	-11.17*	-	-0.46
Unsure	-10.71*	0.46	-

*Statistically significant at the 0.05 level

²Mean differences are calculated as group in the row minus the group in the column

Oddly, non-participants in agricultural literacy programs scored higher on Theme 5 (Food, Nutrition, and Health) questions than either of the other two groups, although, here again, the difference was not significant ($p = 0.205$). Non-agricultural literacy program participants scored an average of 40.80% on Theme 5 questions, followed closely by agricultural literacy program participants (40.69%). Study participants unsure of their participation in agricultural literacy programs answered 37.39% of the Theme 5 questions correctly, as illustrated in Table 36.

Table 36

ANOVA for Theme 5 (Food, Nutrition and Health) Scores of Texas State University-San Marcos Freshmen Participants Who Participated in Agricultural Literacy Programs in School

Participation in Ag literacy programs	<i>n</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Yes	39	40.69	19.04	2	1.591	0.205
No	378	40.80	15.62			
Unsure	84	37.39	15.73			
Total	501	40.22	15.94			

*Statistically significant at the 0.05 level

Agriculture classes in high school

The final comparison in this study looked at how students who took agriculture classes in high school scored on the Food and Fiber Systems Literacy evaluation compared to those who did not. Study participants were asked if they had taken agriculture classes during high school, without indicating how many classes, type of classes, or how many semesters classes had been taken. However, only 88 of the 501 university freshmen indicated participation in agriculture classes while in high school. In 2004, Pense and

Leising used the same instrument in a study of Oklahoma high school seniors. They reported that agriculture students achieved higher overall mean scores, as well as higher theme scores than general education students (Pense & Leising, 2004). The overall mean score of the participants in this study who indicated that they had taken agriculture classes in high school was 54.07%, whereas the mean score of those participants who did not take agriculture classes was 40.61%. A t-test indicated the difference was not significant ($p = 0.22$). Table 37 summarizes the results.

Table 37

Comparison of Overall Scores of Texas State University-San Marcos Freshmen Participants and Enrollment in High School Agriculture Classes using T-test Statistic

Took agriculture Classes in high school	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Yes	88	54.07	17.81	2.30	0.22
No	413	49.61	16.24		

*Statistically significant at the 0.05 level

Participants who took at least one agriculture class in high school achieved a higher overall mean score as well as in each of the five thematic areas of the instrument. Based on a t-test, Theme 1 (Understanding Agriculture) scores were not statistically significant ($p = 0.052$), but were very close at the 0.05 level. Table 38 illustrates the mean scores of the study participants.

Table 38

Comparison for Theme 1 (Understanding Agriculture) Scores of Texas State University-San Marcos Freshmen Participants and Enrollment in High School Agriculture Classes using T-test Statistic

Took agriculture Classes in high school	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Yes	88	59.45	20.17	1.944	0.052
No	413	54.92	19.79		

*Statistically significant at the 0.05 level

The mean score for Theme 2 (History, Geography and Culture) was also not significant ($p = 0.082$). Students who took agriculture classes achieved a mean score of 61.36%, while students not enrolled in agriculture classes achieved a score of 56.15% as shown in Table 39.

Table 39

Comparison for Theme 2 (History, Geography and Culture) Scores of Texas State University-San Marcos Freshmen Participants and Enrollment in High School Agriculture Classes using T-test Statistic

Took agriculture Classes in high school	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Yes	88	61.36	25.33	1.743	0.082
No	413	56.15	25.51		

*Statistically significant at the 0.05 level

Theme 3 (Science, Technology and Environment) scores on the other hand, were statistically significant at the 0.05 level ($p = 0.009$). A mean score of 58.10% was achieved by the students who had been enrolled in high school agriculture classes as

compared to a mean score of 51.02% for those not enrolled in any high school agriculture classes. Table 40 illustrates the results.

Table 40

Comparison for Theme 3 (Science, Technology and Environment) Scores of Texas State University Freshmen Participants and Enrollment in High School Agriculture Classes using T-test Statistic

Took agriculture Classes in high school	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Yes	88	58.10	24.70	2.614	0.009*
No	413	51.02	22.71		

*Statistically significant at the 0.05 level

The Theme 4 (Business and Economics) mean score for students who had taken agriculture classes in high school was 48.70% as opposed to the mean score of 44.75% achieved by students who had no agriculture classes in high school. According to the t-test statistic, this difference was not significant ($p = 0.142$) as shown in Table 41.

Table 41

Comparison for Theme 4 (Business and Economics) Scores of Texas State University-San Marcos Freshmen Participants and Enrollment in High School Agriculture Classes using T-test Statistic

Took agriculture Classes in high school	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Yes	88	48.70	24.79	1.470	0.142
No	413	44.75	22.50		

*Statistically significant at the 0.05 level

Mean scores for high school agriculture students (41.44 %) and non-agriculture students (39.96%) were closer on Theme 5 (Food, Nutrition and Health) questions than

on any other theme, or the overall test scores and was not statistically significant ($p = 0.428$). The results of the t-test are shown in Table 42.

Table 42

Comparison for Theme 5 (Food, Nutrition and Health) Scores of Texas State University-San Marcos Freshmen Participants and Enrollment in High School Agriculture Classes using T-test Statistic

Took agriculture Classes in high school	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Yes	88	41.44	16.50	0.793	0.428
No	413	39.96	15.83		

*Statistically significant at the 0.05 level

Summary of Results

Five hundred-one freshmen at Texas State University-San Marcos responded to an online request to participate in a survey to determine their level of agricultural literacy. The survey consisted of the Food and Fiber Systems Literacy (FFSL) student assessment for grades 9-12 (see Appendix C), as well as demographic questions related to student age, gender, college major, type of high school, and participation in agricultural literacy programs and agriculture classes in school. The results indicated that the majority of respondents graduated from Texas high schools, and that most classified their high schools as suburban (Table 2). Most respondents were 18 to 19 years old and nearly two-thirds (307) were female (Table 1). Additionally, more than two-thirds (378) of the participants indicated that they had not participated in any agricultural literacy programs (Table 5), while slightly more than one-fourth (88) stated that they had been enrolled in agriculture classes during high school (Table 4). Lastly, more respondents were undecided about their college major (140). There were more science majors than any of

the other declared majors among the participants (109) followed by arts majors (96), education majors (82), social science majors (49), and law students (25) (Table 6).

Students participating in the study achieved an overall mean score of 50.39% on the FFSL student assessment. The FFSL framework consists of five themes: Theme 1 – Understanding Agriculture, Theme 2 – History, Geography, and Culture, Theme 3 – Science, Technology, and Environment, Theme 4 – Business and Economics, and Theme 5 – Food, Nutrition, and Health. Theme scores for all participants ranged from 40.22% (Theme 5 – Food, Nutrition, and Health) to 57.07 (Theme 2 – History, Geography and Culture). The remaining theme scores were 45.44% (Theme 4 – Business and Economics), 52.27% (Theme 3 – Science and Environment), and 55.72% (Theme 1 – Understanding Agriculture) (Table 7).

Overall test scores ranged from 10% to 86%. Seventy-two student participants scored 70% and above, with nineteen students scoring exactly 70%. Since 70% is generally considered a satisfactory grade in colleges and universities in the United States, that was the score selected to represent minimal literacy in agriculture. In this case, only 14% of the respondents were able to achieve a score of 70% or higher (Table 9).

Mean test scores, overall and by theme, were compared in order to evaluate the effect a variety of factors may have had on the final score. The mean overall score of male participants was significantly higher than female participants (Table 11). School type (urban, suburban, rural) also affected the overall scores, with suburban students scoring higher than the other groups in overall mean scores (Table 12). A Tukey's HSD test among these groups indicated a significant difference between suburban and rural students (Table 13). When broken down by theme, suburban students scored higher than

the other groups on all themes, although the difference was significant only on Theme 1 (Understanding Agriculture) (Table 14 and Table 15), and Theme 2 (History, Geography, and Culture) (Table 16 and Table 17). In both cases, the significant difference occurred between the suburban and urban students.

The college major of participants was another factor used in comparing mean test scores. Science majors answered a higher percentage of test questions correctly than any of the other majors (53.96%) in the overall test score. The lowest overall score, 47.36%, based on college major was achieved by the undecided group (Table 21). The difference between these two scores was significant based on a Tukey's HSD test (Table 22). Science majors scored higher than any other group in all five thematic areas except on Theme 2 (History, Geography, and Culture), where arts majors surpassed them by a small margin. Only in Theme 3 (Science, Technology, and Environment) and Theme 4 (Business and Economics), however, did a significant difference occur. A Tukey's HSD revealed that the significant difference was between science majors and undecided students on Theme 3, and between science and education majors on Theme 4 (Table 26 and Table 28).

Although only a small number of respondents indicated they had participated in agricultural literacy programs in school, those that did participate scored higher than those who did not. Furthermore, those who were unsure of their participation achieved a higher score than those who did not participate on the overall test score and on every theme except Theme 5 (Food and Nutrition). The highest mean score on Theme 5 was achieved by those students who did not participate, though only slightly (Table 36). The mean scores based on participation in agricultural literacy programs was only significant

on Theme 4 (Business and Economics) according to the analysis of variance (ANOVA), and a Tukey's HSD test revealed that the difference was between those who did participate in agricultural literacy programs and those who were unsure (Table 35).

Finally, the study looked at how enrollment in agriculture classes during high school affected test scores. Those students who indicated they were enrolled in agriculture classes during high school achieved a higher mean score overall and on each of the five themes. However, based on a t-test, the only theme where the difference was significant was on Theme 3 (Science, Technology, and Environment) (Table 40).

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of the study was to determine the level of agricultural knowledge of Texas State University-San Marcos freshmen. As a result, the information gathered will also assess if agricultural literacy programs need to be expanded in Texas public schools.

Specific objectives of the study were:

1. Determine the demographics of Texas State University-San Marcos freshmen.
2. Determine if Texas State University-San Marcos freshmen could achieve a score of at least 70% on the Food and Fiber Systems Literacy student assessment for grades 9-12.
3. Determine if test scores differ among gender, type of high school (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and agriculture classes in high school. The evaluation was based on the five thematic areas of the Food and Fiber Systems Literacy framework.

Summary of the Literature Review

Agriculture is the basis of a society. It “determines a nation’s general welfare and standard of living” (Leising et al., 1998, p. 618). Yet, in twenty-first century America, a large percentage of the population is two to three generations removed from direct contact with production agriculture, creating a population that knows little about the

production, processing, marketing, distribution, regulation, and research that make up its food and fiber supply (Leising et al., 1998, p. 618). This apparent lack of agricultural literacy among the general population, is therefore, a growing concern (Mabie & Baker, 1996, p. 1).

Recognizing this, the National Research Council (NRC) in 1988 recommended that American students in grades K-12 should receive some systematic instruction in agriculture. This statement by the NRC became the impetus for a variety of agricultural literacy programs and studies since its publication.

As a result, many individuals and organizations have promoted numerous programs and a variety of methods in the effort to increase agricultural knowledge in both youth and adults. The Cooperative Extension Service is one organization that has been instrumental in the areas of program development and research across the country. In Ohio, Mechling (1997) utilized quizzes derived from Ohio agricultural publications to stimulate discussion about agricultural issues with an audience. Los Angeles fifth and sixth graders participated in a study in 1993 to evaluate agricultural knowledge and the effectiveness of experiential activities in improving that knowledge. This study determined that the students “appeared to know little about the food and fiber system.” (Mabie & Baker, 1996, p.2). Bellah, Dyer and Casey suggest that “agricultural literacy must be viewed as lifelong learning and regularly partner with both campus educators and industry.” (Bellah et al., 2004, p. 24). Furthermore, the education system must make a conscious effort to address agricultural literacy, and redesign vocational agriculture.

Agricultural literacy can be differentiated from agricultural education by identifying the purpose of each. Literacy in agriculture is providing education about

agriculture and its connection to every day life, while agricultural education provides career training in agriculture. Two programs, *Agriculture in the Classroom* (AITC), sponsored by the United States Department of Agriculture (USDA), and *A Guide to Food and Fiber Systems Literacy* (FFSL), developed at Oklahoma State University, stand out in providing helpful materials and guidelines to promote literacy in agriculture nationwide.

Agriculture in the Classroom (AITC) was established in 1981 and is the “largest public effort to educate people about agriculture” (AITC, Final Report, 2004, p.1). The concept for AITC began when the USDA invited representatives from various agricultural, educational, and governmental businesses and organizations to discuss agricultural literacy. A task force was developed, which then recommended that the agency assist each state in the organization of agricultural literacy programs. USDA provided opportunities for each individual state to administer its own AITC programs, which based the programs on the needs and interest of the state farm organizations and governments. As a result, the level of commitment to AITC varies widely from state to state.

The Guide to Food and Fiber Systems Literacy (FFSL) “summarizes what America’s youth should know about Food and Fiber Systems to be agriculturally literate by the time they graduate from high school” (Leising et al., 1998, p. 4). Development of the FFSL began in 1994 at the University of California, Davis in collaboration with several California agricultural organizations and the Milton S. Hershey School in Pennsylvania. In 1995, the W.K. Kellogg Foundation provided a grant funding further development at Oklahoma State University concluding in 1997-1998 with field testing

the program in schools (Leising et al., 1998, p. 5).

The FFSL framework consists of five themes and standards that summarize the extent of agricultural knowledge deemed essential for Americans. The five themes are Understanding Agriculture (Theme 1), History, Geography, and Culture (Theme 2), Science, Technology, and Environment (Theme 3), Business and Economics (Theme 4), and Food, Nutrition, and Health (Theme 5). Benchmarks for each grade level are included in the guide, as well as example lessons. “Breaking the standards into grade-grouped benchmarks, K-1, 2-3, 4-5, 6-8, the Framework provided a systematic means of addressing agricultural literacy” (Igo, Leising & Frick, 1999, p.50).

The Texas Department of Agriculture (TDA) indicates that agricultural education is a high priority for the agency, and provides resources for teachers and schools. Department initiatives include providing programs, research, workshops, urban school grants, and internships (TDA, November 6, 2004). According to the TDA website, “The focus is on educating people on the science behind agriculture and how it affects their everyday lives” (TDA, November 6, 2004).

In Texas, the *Agriculture in the Classroom* (AITC) program is administered through the Texas Farm Bureau, the Texas division of the American Farm Bureau. The Texas Farm Bureau (TFB) is a membership directed organization, “one of the largest groups of farmers, ranchers, and rural families in the world” (TFB, November 6, 2004). In addition to administering the AITC programs, the TFB represents its membership by addressing issues such as economic improvements to increase farm income and improving the image of agriculture to the public.

Each summer TFB sponsors the *Summer Agricultural Institute*, a workshop for

elementary school teachers to learn how to integrate agriculture into the classroom.

Participants attend seminars and field trips designed to inform educators of the importance of agriculture in their own lives, as well as those of their students. The TFB AITC effort also includes a resource guide for teachers, which includes lesson plans for grades 1-6, as well as videos and a newsletter. In 2003, forty-five teachers from across the state attended on or two one-week sessions, many sponsored by county Farm Bureau scholarships (TFB, November 6, 2004).

Methodology

Instrumentation

The instrument used in this study was a criterion-referenced multiple choice test designed by James G. Leising, Seburn L. Pense, and Mathew T. Potillo for a study associated with Oklahoma State University in 2001. The purpose of the test was to evaluate knowledge of the food and fiber system, according to the standards and benchmarks in the Guide to the Food and Fiber Systems Literacy (FFSL). Test content was validated by three methods, the first of which consisted of referencing the test questions to the five thematic areas of the FFSL. Secondly, test questions were written by three credentialed agricultural education teachers and three agricultural education graduate students. Finally, a panel of secondary school teachers validated the questions based on the FFSL benchmarks, grade appropriate language, and content appropriate for the designated grade-levels. The instrument was pilot tested twice, at two different small, rural high schools. The reliability coefficient after the first pilot test was $\alpha = 0.85$ using the Kuder/Richardson-20 (KR-20). Following the second pilot test, the reliability coefficient was calculated at $\alpha = 0.93$.

The issue of at what level an individual is considered agriculturally literate was discussed with Dr. James Leising, one of the original test designers. According to Dr. Leising, “the real value of the test is that it does give insight into the areas of agricultural knowledge that the student has and areas that need to be improved in the curriculum” Leising, (personal communication, 2004). However, since teachers generally consider a score of 70% representative of acceptable knowledge, the same will be used in this study.

Sample Population

The population sample for this study consisted of college freshmen, enrolled at Texas State University-San Marcos. Registered freshmen, those students who had completed zero to twenty-nine hours at the university, were invited to participate in the study via an online test. Electronic mail (email) addresses for all Texas State University-San Marcos freshmen were provided to Dr. Douglas Morrish, supervising professor, by the university registrar in response to a request by this researcher. Following receipt of the email addresses, the invitation to participate was initiated.

Students who opted to respond did so voluntarily, and after comparing the demographic makeup of the respondents to the non-respondents, it was noted that the participants accurately represented the freshmen students population at the Texas State University-San Marcos. This observation was based on gender, percentage of undecided majors, and age.

Data Collection and Analysis

The test was administered through an online test system provided for use by the Episcopal Theological Seminary of the Southwest in Austin, Texas. James Thomas administered the survey using PHPSurveyor, version 1.0. Dr. James G. Leising of

Oklahoma State University, one of the original test designers, provided an electronic version of the instrument which was loaded into the survey program for distribution to 4,571 Texas State University-San Marcos freshmen.

On September 11, 2006, the initial mailing was distributed, consisting of an introduction from the researcher, an explanation of the survey, and an invitation to participate, followed by a link to the online test (see Appendix B). Once the link was opened, the participant was provided with additional information about the survey, including a statement regarding the approval from the Institutional Review Board and a contact number at the university for questions about the legitimacy of the survey. A follow-up email was sent one week later, followed by second distribution on October 12, 2006 and a follow-up email on October 25. The survey was closed on October 31, 2006, having generated 501 responses, which represented a response rate of 11%.

Data was analyzed using descriptive statistics and analysis of variance (ANOVA). Descriptive statistics included mean, standard deviation, aggregate mean, and frequencies, and were compared using the variables of gender, type of high school attended (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school. The ANOVA compared overall agricultural literacy test scores as well as in each of the five thematic areas with type of high school attended (urban, suburban, rural), college major, participation in agricultural literacy programs in school, and enrollment in agriculture classes in high school.

Conclusions

The primary conclusion drawn from this study was that Texas State University-

San Marcos college freshmen who completed the survey in general know little about the systems that provide their life sustaining food and fiber. This conclusion, based on the results of the Food and Fiber Systems Literacy student assessment for grades 9-12, was not surprising, but was also somewhat disheartening. Further evaluation, however, indicated that some students are better acquainted with certain aspects of agriculture than others. The results are discussed forthwith.

Objective One

The first objective of this study was to determine the demographics of Texas State University-San Marcos freshmen. The sample consisted of 501 university freshmen, 194 of which were male, and 307 of which were female (Table 1). The proportion of male to female respondents is representative of the total freshmen population, according to data received from the Texas State University-San Marcos registrars office. The majority of those students who participated in the study indicated that they graduated from a high school described as suburban, most of which were in Texas (Table 2). Additionally, the overwhelming majority of participants indicated they did not take any agriculture classes in high school, although, of those that did enroll in agriculture classes, most were from rural high schools (Table 4). Many suburban high schools in Texas do offer some agriculture courses, but the fact that more rural students indicated they had enrolled in some agriculture classes was expected, since, in general, more rural students are exposed to a lifestyle that includes agriculture.

The number of students who indicated they had participated in agricultural literacy programs was minimal. Only 39 students were sure of their participation in such programs, but many more (378) indicated they had not participated, and a few (84) were

unsure of their participation. Considering that most study participants were from suburban high schools, this is not surprising, since teacher participation in agricultural literacy programs, such as *Agriculture in the Classroom* (AITC), seems to occur more frequently in rural counties. According to Tad Duncan, Texas Farm Bureau Education Director, the more urban and suburban counties in the central Texas area have not been well represented at AITC workshops (T. Duncan, personal correspondence, October 29, 2004). However, the possibility exists that many of those students who indicated they had not participated or were unsure of their participation in agricultural literacy programs may in actuality have been exposed to agricultural education, but did not understand the terminology. Of the 106 rural high school participants, 20 students (18.9%) indicated they had definitely participated in agricultural literacy programs, a much higher percentage than from urban or suburban schools. Most of the rural students (63.2%), however, indicated they had not participated, which is in line with the urban and suburban students (Table 5).

Nearly three-fourths of the of study respondents had declared their major area of study at Texas State University-San Marcos, while the remaining twenty-eight percent indicated they were undecided. Participants who had declared their college major, stated they were majoring in education, science, arts, law, or social science (Table 6). The figures in Table 6 are fairly representative of the university student population, according to the Office of Institutional Research at Texas State University-San Marcos (Texas State University-San Marcos, 2005).

Objective Two

Objective two sought to discover if Texas State University-San Marcos freshmen

would be able to achieve an overall score of at least 70% on the Food and Fiber Systems Literacy (FFSL) student assessment for grades 9-12. The results showed that the mean overall score for all participants was 50.39% (Table 7). Sadly, only 14% of participants, or seventy-two students, achieved an overall score of 70% or above. The scores ranged from 10% to 86%, with two students receiving an overall score of 86% (Table 8).

Mean scores for all participants based on the five thematic areas of the FFSL (Figure 1) ranged from 40.22% (Theme 5 – Food, Nutrition, and Health) to 57.07% (Theme 2 – History, Geography, and Culture) (Table 7). The mean score of 40.22% on Theme 5 (Food, Nutrition, and Health), nearly ten points lower than the overall mean score, was discouraging, especially since the topics related to this theme are generally included in school curricula, and appear frequently in the news media. It is difficult to imagine that 18-19 year old college freshmen could be unaware of the general health and nutrition topics covered by Theme 5 questions. On the other end of the spectrum, however, the mean score for Theme 2 (History, Geography, and Culture) of 57.07% was somewhat encouraging in the sense that history is a required subject throughout high school. Students, especially college students, should have an basic understanding of history in general, and might logically apply that understanding to the historical and geographical questions relating to agriculture.

The second highest mean theme score of 55.72% was on Theme 1 (Understanding Agriculture) questions. This result indicates that there might be a general understanding that agriculture plays a role in everyday life among the respondents. Mean scores for the remaining two themes, Theme 3 (Science, Technology, and Environment) and Theme 4 (Business and Economics), were 52.27% and 45.44% respectively. The fact that Theme

3 (Science, Technology, and Environment) scores were higher than Theme 4 (Business and Economics) could be relative to the notion that more science majors responded than students in majors related to business and economics.

Objective Three

A number of variables were considered when comparing overall and theme scores for objective three which was to determine how or if the variables would effect the outcome. The variables of gender, type of high school (urban, suburban, rural), college major, participation in agricultural literacy programs, and enrollment in agriculture classes in high school were considered. Conclusions based on these variables follow.

Gender and Age

The study respondents consisted of 104 males and 307 females, the majority of whom (433) were eighteen to nineteen years old, the typical age for college freshmen. The overall mean test score for males was 52.25%, whereas the overall mean score for females was 49.85% (Table 10). Using a t-test statistic ($p = 0.016$), it was determined that the difference between these two scores was significant at the 0.05 level. Although, the difference in mean scores based on gender was significant, further comparisons would reveal more useful information.

Type of High School

Participants were asked how they would describe the high school from which they graduated: urban, suburban, or rural. There were 135 students who identified their high school as urban, 260 who described their high school as suburban, and 106 who attended rural schools. Overall mean scores based on type of type of high school ranged from 46.80% for urban students to 52.36% for suburban students. Rural students scored an

average of 50.13% (Table 12). An analysis of variance (ANOVA) indicated a significant difference between these scores ($p = 0.007$), and a Tukey's HSD test revealed that the difference was between the urban and suburban students.

An ANOVA based on the five themes revealed that the difference in mean score for Theme 1 (Understanding Agriculture) and Theme 2 (History, Geography, and Culture) were also statistically significant at the 0.05 level, where $p = 0.002$ for Theme 1 scores (Table 14) and $p = 0.012$ for Theme 2 scores (Table 16). Using a Tukey's HSD test, it was revealed that the significant difference in both themes was between the urban and suburban students (Table 15 and Table 17). In both cases, suburban students scored the highest of the three groups (57.95% on Theme 1 and 60.08% on Theme 2), and urban students received the lowest mean score (50.72% on Theme 1 and 52.15% on Theme 2). Mean scores on Theme 3 (Science, Technology, and Environment) and Theme 4 (Business and Economics) followed the same pattern as Themes 1 and 2 with suburban students achieving the highest mean score of the three groups, and urban students achieving the lowest score (Table 18 and Table 20). On the other hand, Theme 5 (Food, Nutrition, and Health) scores were very close between groups, with suburban students scoring the highest (41.32%), followed by urban students (39.56%) and rural students (38.35%) as seen in Table 20.

Students who classified their high schools as suburban scored higher than either urban or rural students overall. In addition, suburban students scored the highest in each of the thematic areas. At first glance these results might be unexpected. One might have expected rural students to excel on a test about agriculture. Rural populations are changing, however, due to the fact that more and more families choose to live "in the

country,” causing farm families to be less dominant in rural areas. Additionally, rural students who are from farming and ranching backgrounds might tend to be more specialized in their knowledge, being less aware of aspects of agriculture outside their realm. However, the mean scores of rural and suburban students were extremely close overall and on all themes except Theme 2 (History, Geography, and Culture), and Theme 5 (Food, Nutrition, and Health).

College Major

College major choices in this study consisted of education, science, arts, law, social science, or undecided. Declared science majors scored higher than any of the other groups overall and on most themes with the exception of Theme 2 (History, Geography, and Culture) and Theme 5 (Food, Nutrition, and Health). Arts majors scored slightly higher than science majors in those two themes. Since Theme 2 questions address topics of interest to arts students such as the historical and sociological interactions between food and fiber systems and world cultures, it is perhaps not surprising that arts majors, particularly liberal arts majors, would score well on this section. The lowest scores among the groups were achieved by students who were undecided about their major area of study overall and on every theme except Theme 4 (Business and Economics), and Theme 5 (Food, Nutrition, and Health). Oddly, the lowest score on Theme 4 (Business and Economics) was achieved by law majors, while education majors received the lowest score on Theme 5 (Food, Nutrition, and Health).

An analysis of variance (ANOVA) revealed a significant difference on the overall score ($p = 0.023$) and on Theme 3 (Science, Technology, and Environment) ($p = 0.011$) and Theme 4 (Business and Economics) ($p = 0,023$). The significant difference on the

overall test score and on Theme 3 (Science, Technology, and Environment), according to a Tukey's HSD test, was between the science majors and those who were undecided about their major area of study. A Tukey's HSD test indicated the significant difference on Theme 4 (Business and Economics) scores was between science and education majors.

Agricultural Literacy Programs

Only a small number of participants (39) indicated they had definitely participated in an agricultural literacy program in school. The majority of students (378) indicated they had not participated, while eighty-four participants were unsure of their participation. The overall mean score for agricultural literacy program participants was 55.33%, which was higher, though not significantly higher ($p = 0.153$), than those who did not participate or were unsure of their participation (Table 30). The mean score for agricultural literacy program participants was higher in all five thematic areas of the test, although the theme where a significant difference occurred was in Theme 4 (Business and Economics) where $p = 0.015$. The significant difference on Theme 4 (Business and Economics), according to Tukey's HSD, occurred between those who participated in agricultural literacy programs and the other two groups, since the mean score for the other groups differed by only 0.45 points (Table 34 and Table 35).

The implications of this information are significant. It was encouraging to note that existing agricultural literacy programs appear to be at least somewhat effective. However, it was discouraging that so few students appeared to be exposed to them. The fact that the only significant difference in mean scores occurred on Theme 4 (Business and Economics) questions was interesting as well, although no real explanation for this

difference was obvious.

Enrollment in Agriculture Classes

The effect of enrollment in high school agriculture classes proved interesting. Although only a small number of participants (88) indicated they had been enrolled in agriculture classes during high school, the results indicated that those that did have some agricultural education scored noticeably higher than those who did not. The overall mean score for high school agriculture students was 54.07%, whereas the overall mean score for non-agriculture students was 40.61% (Table 37). Furthermore, students who were enrolled in agriculture classes in high school scored higher in all five thematic areas of the test than those who were not enrolled in agriculture classes. However, a t-test indicated that the differences in scores was not significant, with the exception of Theme 3 (Science, Technology, and Environment) where $p = 0.009$.

Recently, agricultural educators have been lobbying to allow agriculture students to receive high school science credit for their agriculture classes. Since the only theme score where a significant difference occurred between agriculture students and non-agriculture students was in the theme with questions about science, technology, and the environment, perhaps agricultural educators have a valid point. The fact remains, however, that although agriculture students scored significantly higher than non-agriculture students, the mean score on Theme 5 (Science, Technology, and Environment) questions, the mean score for agriculture students was only 58.10% (Table 40).

Implications

Issues related to the food supply and land development in the United States have

been the topic of news stories as well as a motion picture in 2007. Pet food contamination resulted from improperly handled ingredients in China. *Fast Food Nation*, a motion picture based on the book of the same name, was released. The labeling and safety of genetically modified foods continues to be a hot topic, and the organic and natural food movements continue to grow. Food safety, and issues related to the transportation of food and food products, as well as the processing of those products are ongoing concerns. How the use of farm chemicals before, during, and after crop production and harvesting affect the land and consumers have continued to be newsworthy topics, in addition to the humane treatment of livestock before and during slaughter, and the medical treatment of that livestock. Water availability and usage for crop production and human consumption, including commercial and residential landscapes, and the development of farm and ranchlands for other uses are also critical issues that affect the quality of life in America, particularly regarding the food and fiber supply.

With so many food supply issues facing the American population, how can Americans be expected to make informed decisions about these issues without the dissemination of some very basic agricultural information? American students are expected to understand business practices and economic issues by enrolling in an economics class. They are required to take science classes so they are capable of making informed decisions regarding global warming and stem cell research. Students study history and math in order to understand historical trends in business and the stock market. Why not agriculture? Why is the topic of how and where life sustaining food and fiber comes from and the practices of producing it not considered important enough for

inclusion in the American education system?

The results of this study clearly indicate that college freshmen at Texas State University-San Marcos do not have a good cognitive grasp of the concepts relating to their food and fiber supply. However, since the conclusions of this study were based on the results of a multiple choice test, the question of other methods of disseminating and evaluating agricultural knowledge was considered. According to Wiggins and McTighe, "...understanding is not a single concept but a family of interrelated abilities – six different facets – and an education for understanding develops them all" (Wiggins & McTighe, 2001, p.3). Wiggins and McTighe suggest the use of performance evaluation in education, stating that "performance is the key to assessing understanding" (Wiggins & McTighe, 2001, p.vi). A possible performance assessment for understanding agriculture would be for students to research the ingredients for a particular food or food product, determining how each ingredient was produced, where it came from, and how it got here.

In conclusion, this researcher suggests that agricultural literacy should be considered a critical aspect to general education throughout the public school system. Without a basic understanding of the various aspects of agriculture as stated above, individuals will be ill equipped to deal with the issues that arise regarding their food and fiber supply.

Conclusions

1. The overall results from this study indicated that Texas State University-San Marcos freshmen were not agriculturally literate, that is, having an understanding about agriculture, based on the cognitive evaluation of the Food and Fiber

Systems Literacy student assessment for grades 9-12 and a score of 70%.

2. The overwhelming majority of participants (86%) were unable to achieve a score of 70% or higher on the Food and Fiber Systems Literacy student assessment for grades 9-12 regardless of gender, type of high school, college major, participation in agricultural literacy programs, or enrollment in agriculture classes in high school.
3. Those students who responded to the survey were an accurate representation of all freshmen at Texas State University-San Marcos based on age, gender, and college major.
4. Results from this study indicated that students who participated in agricultural literacy programs in school achieved a higher score than those who did not participate or were unsure of their participation.
5. Results from this study indicated that declared science majors tended to score higher than other majors on the Food and Fiber Systems Literacy student assessment for grades 9-12.
6. Results from this study indicated that participants who were enrolled in agriculture classes in high school achieved higher scores on the Food and Fiber Systems Literacy student assessment for grades 9-12 than those who were not enrolled in agriculture classes. A significant difference in scores occurred on the questions related to science, technology, and the environment (Theme 3 – Science, Technology, and Environment).
7. Results from this study indicated that since agriculture students scored significantly higher on Theme 3 (Science, Technology, and Environment)

questions, there is an implication that the state should research information about students receiving science credit for agriculture classes, per the ruling that requires high school students to acquire 4 science credits prior to graduation...

8. Results from this study indicated that Texas Educators should consider the importance of agricultural literacy and incorporate agriculture into existing curricula.
9. Results from this study indicated that more summer workshops should be conducted for the purpose of educating teachers about integrating agriculture into existing curriculum.
10. Results from this study indicated that students might acquire and retain more agricultural knowledge if agricultural literacy programs were extended into high school.

Recommendations for Additional Research

1. It is recommended that this study be replicated at other institutions in Texas, or across all Texas universities, in order to determine if results would be similar.
2. It is recommended that this study be replicated and include sophomore, junior, and senior college students, comparing the results.
3. It is recommended that research be done to examine the effects of offering science credit for agriculture classes.
4. It is recommended that this study be replicated nationally in order to determine if consistencies exist with the current study.
5. It is recommended that research be done to evaluate the agricultural knowledge of public school teachers, and/or the general adult population.

APPENDIX A

PERMISSION TO USE INSTRUMENT

This appendix contains a copy of the email from Dr. James Leising granting permission to use the Food and Fiber Systems Literacy student assessment for grades 9-12 as the instrument in this study.

From: James Leising <leising@okstate.edu>
To: "SUE KEITH" <skeith7263@msn.com>
Subject: Re: ag literacy research
Date: Tue, 9 Nov 2004 08:28:20 -0600

Sue:

Seb Pense, Matt Portillo and I developed an instrument for grades 9-12 a couple of years ago. This exam. is keyed to the standards and benchmarks for that grade grouping. It may better meet your needs for the audience being tested (See attached documents). If you choose to use this test, I am only granting permission for you to use it and it is not to be shared.

The development of this instrument, including reliability, is described in a recent journal article in the Journal of Agricultural Education, Vo. 45, #3, 2004, titled, An assessment of food and fiber systems knowledge in selected Oklahoma high schools by Pense and Leising.

Jim Leising

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"SUE KEITH" <skeith7263@msn.com>
11/08/2004 08:22 PM

To: leising@okstate.edu
cc: (bcc: James Leising/ext/dasnr/Okstate)
Subject: ag literacy research

Dr. Leising,

I've been in communication, via email, with Carl Igo regarding a research project I'm looking into about the level of agricultural literacy in Texas college students. I believe he has mentioned this to you. He has provided me with a copy of the pre-tests used in the study of Food and Fiber Systems Literacy, and suggested we look into seeing if Texas college

students know as much as the FFSL suggests 6-8th graders should know. He also mentioned that you have been working on programs for grades 9-12. I think I would like to use the 6-8th grade pre-test as my instrument, unless you have compiled one for older students that I might use. I have discovered one potential problem with using the 6-8th grade test on college age students, however, and I would appreciate your thoughts. I went through the test last night with my 22 year old daughter, who just graduated from the University of Texas. As we were looking at some of the questions, she tended to read more into the simple question than a 6-8th grader would. For example, in the T/F questions, she indicated that I needed to define agriculture before she could determine whether the statement was really true or false. Similar situations occurred throughout the test. I will freely admit that she may have just been being difficult, but I wondered if there might be a difference in the way older students interpret questions geared for 6-8th graders that might affect the results. If that's the case, I'm not sure where to turn.

In any event, I wanted to find out what would be required in order for me to use the 6-8th grade pre-test as my instrument. Please let me know. Thank you for your help.

Sue Keith
skeith7263@msn.com

APPENDIX B

EMAILED REQUEST FOR PARTICIPATION

This appendix includes the email sent to students requesting participation in the study.

Dear Sheila R,

You are invited to participate in a confidential research study about your knowledge of agriculture. Since agriculture is the basis of any society, it is crucial that members of the society have an understanding of where their food and fiber comes from. This study is being conducted as a graduate research project, and the confidential results will be submitted to research publications as well as being presented to professional agricultural educators. The survey consists of 63 questions and should take about 30 or so minutes of your time. Your honest input is very important and your willingness to participate is much appreciated.

This research study has been reviewed and approved by the Institutional Review Board-Human Subjects in Research, Texas State University. For research related problems or questions, please contact the Institutional Review Board (Texas State University) at 512-245-2314.

If you have any questions concerning the survey or this study, please contact Sue Keith at sk1133@txstate.edu.

Click on the link below to enter the survey. Thank you for your help.
<http://survey.etss.edu/phpsurveyor/index.php?sid=8&token=0373923977>.

Sincerely,

James Thomas (mclvin@etss.edu)
Survey Administrator

APPENDIX C

FOOD AND FIBER SYSTEMS LITERACY STUDENT ASSESSMENT FOR GRADES 9-12

This appendix includes the Food and Fiber Systems Literacy student assessment for grades 9-12 instrument used in this study.

Part I – Student Assessment Key & Themes**Theme**

- 1B 1. Which of the following *does not* influence farmer/producer decisions about what type of product to grow and how it is processed?
- Consumer preferences
 - Government regulations
 - Historical events**
 - Specific commodity prices overseas
- 1E 2. A genetically modified corn plant has been developed with natural resistance to pests. What type of agricultural business will be most directly affected by this new technological advancement?
- Agricultural chemical company**
 - Feed and milling company
 - Tractor and equipment dealership
 - Veterinary supply store
- 5B 3. What nutrient develops and repairs body organs and tissues?
- Carbohydrates
 - Minerals
 - Proteins**
 - Vitamins
- 1C 4. Which of the following occupations is *least related* to the industry of agriculture?
- Fashion designer**
 - Park ranger
 - Landscape designer
 - Meat inspector
- 5D 5. Which one of the following government agencies regulates food handling, preparation and storage?
- Environmental Protection Agency (EPA)
 - Food and Drug Administration (FDA)
 - Natural Resource Conservation Service (NRCS)
 - United States Department of Agriculture (USDA)**
- 5C 6. What does consumer product testing not determine?
- Customer health related to products
 - Customer preferences
 - Durability of products
 - Shopping patterns within a retail outlet**

- 3A 7. Planting trees on a farm field border will help protect the environment in what way?
- Increase the amount of top soil
 - Reduce the need for fertilizers
 - Reduce water use
 - Reduce wind erosion**
- 2A 8. What role did agriculture *not play* in the growth and development of America?
- Communications**
 - Food & textile industry
 - Immigration policy
 - Trade
- 2E 9. What will energy shortages/surpluses experienced in the United States impact?
- Banana production
 - Cross cultural relations
 - Food prices**
 - Food safety
- 1B 10. What is an essential part of the Food and Fiber System?
- Consumer Demand
 - Consumer Supply
 - Natural resources**
 - Value-added products
- 1A 11. Why is America able to sustain a high standard of living?
- Agricultural Industry**
 - International Trade
 - Micro-computer industry
 - Stock Market
- 5C 12. What technology was recently introduced in the Meat Industry to increase shelf life?
- Curing
 - Dehydration
 - Freezing
 - Irradiation**
- 3A 13. What supports plant growth and represents the living reservoir that buffers the flow of water, nutrients, and energy through an ecosystem?
- Air
 - Soil**
 - Sunlight
 - Worms

- 3B 14. What renewable natural resources are necessary for agricultural production?
- Air, water, fertilizer, and sunlight
 - Soil, air, sunlight, and water**
 - Soil, air, water, and fertilizer
 - Water, sunlight, organic matter, and air
- 4A 15. What was the effect on United States' beef exports to the United Kingdom when England detected Mad Cow Disease in their beef herds?
- No change in United Kingdom's demand for United States' beef
 - United Kingdom's demand decreased for United States' beef
 - United Kingdom's demand for United States' beef increased**
 - United States' demand for beef decreased
- 3D 16. What technological innovation has the potential to increase plant resistance to disease and insects, and decrease food and fiber production costs?
- Cloning
 - Genetic engineering**
 - Hydroponics
 - Integrated Pest Management
- 1B 17. What components does Agriculture include?
- Farming, distribution and research of food, clothing and shelter
 - Production and regulation of food, clothing and shelter
 - Production, processing and selling of food, clothing and shelter
 - Production, processing, marketing and distribution of food and fiber**
- 5D 18. What is the primary cause of food safety problems in the United States?
- Confusing regulations
 - Improper food handling and preparation**
 - Improper food processing
 - Improper use of antibiotics in animals
- 2C 19. How has new technology in agriculture impacted America?
- Increased food prices and increased number of available food products
 - Increased the number of people employed in farming and ranching, and decreased labor required
 - Reduced access to new equipment for most farmers, and decreased cost of production
 - Reduced required physical labor and increased production**
- 4B 20. In what way are wheat farmers most likely to increase their profits?
- Organize a marketing cooperative to export more of their wheat to developing countries
 - Plant more acres of soybeans on the best land available

- c. **Use vertical integration to process their raw wheat into flour, frozen dough and other food products**
 - d. Use genetic engineering to develop new improved wheat varieties
- 1D 21. What has the *least influence* on production practices of farmers in the United States?
- a. Machinery costs to producers
 - b. New York Stock Exchange**
 - c. Price of the commodity to the processor
 - d. Consumer preferences
- 4D 22. Which of the following action or procedures placed on an agricultural commodity *will inhibit* international trade?
- a. Letter of Credit
 - b. North America Free Trade Agreement
 - c. Product labeling
 - d. Tariff**
- 4C 23. If hoof and mouth disease were discovered in the United States, what populations would be at risk of infection?
- a. Humans and cattle
 - b. Poultry and cattle
 - c. Cattle and horses
 - d. Cattle and swine**
- 3D 24. What was significant about the cotton gin, plow, and mechanical reaper?
- a. Increased crop yields per acre
 - b. Increased the status of farmers
 - c. Increased the work load of farmers
 - d. Freed up laborers to do other jobs**
- 3B 25. Why is planting grass an important practice in sustaining the ecological system?
- a. Contributes to rapid water run-off
 - b. Increases microorganisms in the soil
 - c. Increases nutrients in the soil
 - d. Prevents wind and water erosion**
- 5A 26. Until recently, what components were commonly added in the feed rations of cattle and sheep?
- a. Animal by-products**
 - b. Human waste
 - c. Vegetable by-products
 - d. Wood by-products

- 2E 27. The major world producer of dates in 1992 was Iraq, while the state of California was the second largest producer. What was the impact of the gulf war on the date industry?
- Demand decreased and price increased
 - Demand increased and price increased
 - Supply decreased and price increased**
 - Supply increased and price increased
- 1C 28. How does the percentage of the population working directly in farming and production agriculture in the United States compare to other countries in the world?
- Population is declining compared to less developed countries of the world.**
 - Population is greater than in less developed countries of the world.
 - Population is greater than other developed countries of the world.
 - Population is increasing due to population growth & the increasing demand for food.
- 5B 29. What are the benefits of eating a balanced diet?
- Increases physical fitness
 - Increases the number of hours of sleep required
 - Lowers food costs
 - Prevents nutritional diseases**
- 1E 30. Which agricultural sector has *the least* number of workers?
- Distribution
 - Processing
 - Production**
 - Transportation
- 3B 31. What is the most important energy source in the production, processing and distribution of food products?
- Ethanol
 - Fossil fuels**
 - Hydroelectric energy
 - Solar energy
- 2B 32. What impact did the American Revolutionary War have on the price of cotton in England?
- The cost of men's cotton pants decreased.
 - The cost of men and women's cotton clothing stayed the same.
 - The cost of men's cotton shirts increased.**
 - The cost of women's cotton blouses decreased.
- 4C 33. The outbreak of a contagious animal disease in Taiwan would likely bring what type of response from the United States Government?
- United States would increase the tariff on meat imports from Taiwan.

- b. **United States would stop imports of meat and meat by-products from Taiwan.**
 - c. United States would quarantine sick animals in Taiwan.
 - d. United States would require vaccination of animals in the United States against the disease.
- 1C 34. How do plants and animals meet society's needs in ways other than food, clothing, and shelter?
- a. Fuels and Electronics
 - b. Medicines and Plastics
 - c. **Medicines and Recreation**
 - d. Plastics and Recreation
- 3C 35. How have the United States' agricultural technology and conservation impacted other countries?
- a. **Improved seed varieties and introduced efficient farm machinery**
 - b. Improved seed varieties and introduced organic fertilizers
 - c. Improved seed varieties and encouraged manual harvesting
 - d. Improved seed varieties and encouraged synthetic rubber
- 2B 36. Predict the price of coffee in the United States if the supply of coffee in Brazil decreased.
- a. The drought in Brazil would not affect coffee prices in the United States.
 - b. The price of coffee in the United States would decrease.
 - c. **The price of coffee in the United States would increase.**
 - d. The price of coffee in the United States would stay the same.
- 3D 37. Why were past predictions that agriculture would not be able to meet the world's demand for food inaccurate?
- a. Average farm size increased
 - b. Cost of food significantly increased
 - c. **New technology introduced**
 - d. World population growth slowed
- 1D 38. When other countries adopted new technologies for growing wheat, what was the effect on wheat growers in the United States?
- a. United States wheat growers gained a production advantage in the world wheat market.
 - b. United States wheat growers gained a processing advantage in the world wheat market.
 - c. **United States wheat growers lost the production advantage in the world wheat market.**
 - d. United States wheat growers lost the processing advantage in the world wheat market.

- 4D 39. How did the North American Free Trade Agreement (NAFTA) impact United States' trade with other countries?
- Decreased trade with Mexico and Canada
 - Increased trade with Canada and Mexico**
 - Slowed trade with Canada but accelerated trade with Mexico
 - Slowed trade with Mexico but accelerated trade with Canada
- 2D 40. In Columbus' first voyage to America, his intent was to obtain what commodities?
- Corn and potatoes
 - Iron ore
 - Silver and gold
 - Sugar and spices**
- 5A 41. Of the following answers, which one *is not* a purpose of a food additive?
- Improve appearance
 - Improve flavor
 - Improve nutrition
 - Reduce production costs**
- 4C 42. What governmental agency regulates fertilizers, pesticides, and herbicides?
- United States Department of Agriculture (USDA)
 - Environmental Protection Agency (EPA)**
 - Food and Drug Administration (FDA)
 - Health and Human Services (HHS)
- 3A 43. How has the conversion of wetland to farmland affected waterfowl populations?
- Waterfowl populations have decreased**
 - Waterfowl populations have increased
 - Waterfowl populations have not been studied
 - Waterfowl populations have stayed the same
- 2A 44. What factors made it possible for early Americans to establish settlements rather than assume the wandering lifestyle of hunters/gathers?
- Ability to produce food**
 - Abundance of wildlife
 - Fur trading
 - Trade with Native Americans
- 3C 45. What term describes the control and management of resources for present and future use?
- Conservation**
 - Preservation
 - Reclamation
 - Restoration

- 2A 46. What factor contributed to the western expansion of the United States?
- Available capital
 - Available labor
 - Available land**
 - Available water
- 5D 47. Why is homogenization used in milk processing?
- To extend shelf life
 - To reduce milk fat content
 - To reduce milk fat to smaller particles**
 - To separate milk solids and liquids
- 2D 48. What is the oldest and most essential industry in the world?
- Construction
 - Food/Fiber production**
 - Manufacturing
 - Mining
- 5B 49. What is a major source of protein for humans?
- Corn and spinach
 - Beans and spinach
 - Rice and beans**
 - Rice and corn
- 5B 50. Which of the following food combinations best describes a balanced meal using the four basic food groups?
- Broccoli, biscuits, peaches, & lamb
 - Eggs, milk, pancakes, & orange juice**
 - Milk, granola, grapefruit, & bread
 - Steak, toast, butter, & eggs

Part II - Student Information:

51. What is your gender?
- Male
 - Female
52. What is your age?
- under 17
 - 17
 - 18
 - 19
 - 20
 - 21
 - over 21

53. If you are not a college freshman, please identify your college classification.
- A. Sophomore
 - B. Junior
 - C. Senior
 - D. Graduate
54. Where did you attend high school?
- A. In Texas
 - B. Outside of Texas (name of state _____)
55. In what school district did you attend school? Name the district where you spent the majority of your school years.
- A. In Texas _____
 - B. Outside Texas _____
56. In what county is this school district located?
- A. In Texas _____
 - B. Outside Texas _____
57. Identify the types of jobs you have held. Circle all that apply.
- A. Food service
 - B. Retail
 - C. Farm labor
 - D. Office work
 - E. Sales
 - F. Other _____
58. Which of the following most closely represents the population of the city where you attended high school.
- A. less than 1,000
 - B. 1,000 – 10,000
 - C. 10,000 – 50,000
 - D. 50,000 – 100,000
 - E. greater than 100,000
59. Would you classify your high school as
- A. Urban
 - B. Suburban
 - C. Rural
60. Did you take any agriculture classes during high school?
- A. Yes
 - B. No

61. What is your college major?
- A. Education
 - B. Science
 - C. Arts
 - D. Law
 - E. Social Sciences
 - F. Undecided
62. Did you participate in any agricultural literacy programs in grades K-12?
- A. Yes
 - B. No
 - C. Unsure

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VITA

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