An Analysis of the Spatial Effects of Population Density on the Agricultural Knowledge of College Freshmen

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Abstract

The purpose of this study was to evaluate the agricultural knowledge of college freshmen based on the spatial density of population in which they were raised. Each college freshman who responded indicated his/her location of their home as urban, suburban, or rural. Respondents then completed a multiple choice exam to test their knowledge of agriculture in five thematic areas. Overall, suburban students earned the highest scores (M = 52.4%) followed by rural students (M = 50.1%) and urban students (M = 46.8%). A statistically significant difference (p = 0.007) existed between the suburban and urban students. Suburban students also scored the highest in each of the five thematic areas of the agricultural literacy examination. Statistically significant differences were found between the suburban and urban students in Theme 1 (Understanding Agriculture) (p = 0.002) and Theme 2 (History, Geography, and Culture) (p = 0.012).

Introduction

Since undergoing a structural change in the last century, American society has moved from an industrial based entity to a more technologically advanced organization. The agriculture discipline has been extensively affected by these changes. Many citizens are choosing off-farm employment in urban settings thus losing sight of the importance of agriculture due to lack of exposure to it on a daily basis (Reidel, 2007; Bellah and Dyer, 2007; Moore, 2000; Smith et al., 2009).

Roughly 81% of the current United States population is located in an urban setting (United Nations Population Division, 2008). The remaining 19% of the population is located in rural settings, including both farming and non-farming citizens. In Texas, the total population in 2008 was 24.3 million, with roughly 21.3 million (87.8%) of the population living in urban areas (USDA–ERS, 2009). With the majority of the population living in urban areas and being so far removed from the farming or agricultural industry, it is important to consider agricultural literacy programs to educate the general population. Many people question this importance. The food and fiber system, considered one of the largest sectors in the U.S. economy, produced output valued at roughly $1.6 trillion or 12% of the nation's output (USDA-ERS, 2009). Additionally, approximately one out of every six jobs is attributed to the food and fiber system (Penson, et al., 2010).

Today, estimates of the number of people involved in farming and ranching range from 1% to 2% of our population (Terry, 2004). Put in perspective, this population provides food and fiber for the remaining 98% to 99% of Americans. Terry (2004) continues to explain that, in fact, all Americans interact with agriculture on a daily basis. The general population does not appear to realize that the food supplied on their dinner tables and the clothing on their backs all rely heavily on the state of the agricultural industry. Therefore, an extremely strong case should be made for people to understand the basic concepts of agriculture (Terry, 2004).

One hundred forty-four students in two inner-city Los Angeles schools participated in a study to evaluate their agricultural knowledge and the effectiveness of literacy activities in improving that knowledge (Mabie and Baker, 1996). The students, a combination of fifth and sixth graders, who were primarily African-American and Hispanic, were pretested about their knowledge of agriculture. They were asked to define agriculture, list three crops growing in California, and recognize common agricultural terminology, such as irrigation and drought. Mabie and Baker (1996) found that the students participating in the study appeared to know little about the food and fiber system. The researchers concluded that every child should grow up with a basic understanding of the food and fiber system and as adults they should be capable of making educated decisions on both agricultural as well as non-agricultural issues.

In a similar study conducted by Reidel (2007), the effects of an agricultural education course on the agricultural literacy of urban student enrollees were examined. Before and after the completion of the course, he investigated students' knowledge of agricultural careers, public policy in agriculture, environmental and natural resource issues, and food and fiber industry. The results indicated a lack of understanding of agriculture as compared to national standards before the completion of the course.

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Therefore, he stated a need to educate citizens to become agriculturally literate.

Smith et al. (2009) examined high school students' knowledge of agriculture based on the location of their high schools. The locations included a rural high school with an agricultural science program, a rural high school without an agricultural science program, and an urban high school without an agricultural science program. The study found that overall; students from each of these three types of high schools were not agriculturally literate. The location of the high school did not have a significant effect in the students' level of agricultural literacy. It was also noted that inaccurate representations of agriculture, such as labeling individuals related to agriculture with the traditional farming stereotype, existed among the subjects. Similarly, Birkenholz et al. (1995) examined the agricultural literacy levels of college students. The researchers found that students who had families living on farms or ranches were the most knowledgeable. Students who were living in a highly urban or suburban area tended to know the least about agriculture and its principles. Frick et al. (1995) found comparable results among adults. Those living on farms were more agriculturally literate than their rural non-farm neighbors, who, in turn, were more knowledgeable than their urban counterparts.

Today's college students are the future voters, agricultural and food policy makers, in addition to consumers of agricultural products. Awareness of the food and fiber system is thus vital in order for citizens to make informed decisions regarding agriculture and natural resources (Torres and Hopper, 2000). If these college students do not understand where their food, clothing, and shelter come from, then how can they make informed decisions about public policy?

Purpose and Objectives

The purpose of the study was to evaluate the agricultural knowledge of college freshmen based on the spatial density of population in which they were brought up. It is vitally important to learn what freshmen know about agriculture, and therefore determine the agriculture competencies that must be included in the primary, secondary, and post-secondary education of these individuals. Specific objectives of the study were to:

1. First determine the level of agricultural literacy among the freshmen students and then determine if the overall test scores differed based on the spatial density of population in which the students were brought up, and;

2. Determine if scores on the five thematic areas of an agricultural literacy assessment differed based on the spatial density of population in which the students were brought up.

Materials and Methods

The instrument used in this study was a criterion-referenced multiple-choice test titled the Food and Fiber Systems Literacy (FFSL) (Leising, et al., 2003). The agricultural literacy assessment measured agriculture content in five thematic areas: 1) understanding food and fiber systems, 2) history, geography, and culture, 3) science, technology, and environment, 4) business and economics, and 5) food, nutrition, and health.

The original pilot test was conducted and a reliability coefficient of $\alpha = 0.85$ was computed using the Kuder/Richardson-20 (Pense and Leising, 2004). Following the first test, the instrument was reviewed multiple times, adjusting questions as deemed necessary, and a second pilot test was done. The reliability coefficient was $\alpha = 0.93$. The resulting instrument was known as the Food and Fiber Systems Literacy student assessment.

The population consisted of 27,485 registered college students at a Texas university, 4,571 of whom had completed zero to twenty-nine credit hours and were considered freshmen. The ease and availability of electronic mail (e-mail) made it possible to send the survey instrument to the entire freshmen population in the sample, and offer the opportunity to all of them to voluntarily participate.

For the study's purpose, three classifications were used: urban, suburban, or rural. Respondents were asked to pick one out of three classes of spatial density of population which described most closely the area in which they were raised. Webster (1981) defined urban as "characteristic of a city." Suburban referred to "a district outside of, but adjoining a city," and rural "pertains to the country, or country life." These definitions were explained to participants in the beginning of the study.

The data was entered into an SPSS 17.0 data file and was analyzed using descriptive statistics and analysis of variance (ANOVA). Descriptive statistics included mean, standard deviation, aggregate mean, and frequencies. An analysis of variance was used to analyze differences in overall agricultural literacy scores and thematic scores for students from urban, suburban, and rural areas.

Results and Discussion

In order to gain a full understanding of the participants in the study, it was important to examine the demographics of the responding sample. The male (n=194) and female (n=307) respondents came from a mixture of locations (urban, suburban, rural), although the majority of participants described growing up in a suburban area (n=260, 51.9%). The remaining participants indicated that they grew up in an urban (n=135, 26.9%) and rural (n=106, 21.2%) setting, respectively (Table 1).

Overall agricultural literacy test scores (M = 50.4%) were compared using the spatial density of

Table 1. Gender Distribution of College Freshmen Participants Based on Home Location

	Male		Female		
Geographical Location	*n*	%	*n*	%	Total
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

population groupings to determine if any statistically significant differences were present. Interestingly, students from suburban areas (M = 52.4%) scored higher than students from either urban (M = 46.8%) or rural areas (M = 50.1%) (Table 2). It was found that a statistically significant difference (p = 0.007) existed between the three groups. A post hoc test (Tukey a) further analyzed the data finding that the difference occurred between urban (M = 46.8%) and suburban (M = 52.4%) students' scores.

Further spatial effects of population density on students' agricultural literacy scores were evaluated by examining the mean literacy scores in each of the five thematic areas of the FFSL framework. Theme 1 (Understanding Agriculture) evaluated participants' knowledge of basic agriculture, including agricultural systems, agriculture's relationship to society, and the importance and interaction of worldwide agricultural systems. Overall, all three groups of students did fairly poor (M = 55.7%) on questions related to Theme 1. As shown in Table 3, a comparison of the urban (M = 50.7%) suburban (M = 57.9%), and rural (M = 56.6%) students' scores on Theme 1 indicated a statistically significant difference (p = 0.002) between the urban and suburban groups.

Theme 2 of the FFSL framework was 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. Overall, scores on Theme 2 were a little higher (M =57.1%) than those on Theme 1. As shown in Table 3, scores of all three groups of students were compared and a statistically significant difference (p = 0.012) was evident. Suburban students (M = 60.1%) scored the highest on this particular theme. Rural students (M = 55.9%) came in second followed by urban students (M = 52.2%) Similar to Theme 1, a statistically significant difference existed between the urban and suburban students.

Theme 3 test questions covered topics in the areas of science, technology, and the environment. This section evaluated the knowledge of agriculture and ecosystems and their relationship with natural resources. Theme 3 overall mean score (M = 52.3%) was fairly consistent with the previous two themes. Scores for urban students

Table 2. Analysis of Variance of Overall Agricultural Literacy Test Scores by Home Location

Area	*n*	*M*	*SD*	df	F	*p*
Urban	135	46.8	15.9	2	5.087	0.007*
Suburban	260	52.4	16.0			
Rural	106	50.1	18.2			
Total	501	50.4	16.6			

Note: * $p < .05$

Table 3. Analysis of Variance of Theme Literacy Scores by Home Location

Area	*n*	*M*	*SD*	df	F	*p*
Theme 1 (Understanding Agriculture)						
Urban	135	50.7	19.9	2	6.121	0.002*
Suburban	260	57.9	19.3			
Rural	106	56.6	20.3			
Total	501	55.7	19.9			
Theme 2 (History, Geography, and Culture)						
Urban	135	52.2	25.3	2	4.475	0.012*
Suburban	260	60.1	24.9			
Rural	106	55.9	26.5			
Total	501	57.1	25.5			
Theme 3 (Science, Technology, and Environment)						
Urban	135	48.2	20.9	2	2.881	0.057
Suburban	260	53.9	23.5			
Rural	106	53.2	24.9			
Total	501	52.3	23.2			
Theme 4 (Business and Economics)						
Urban	135	42.1	21.3	2	2.289	0.102
Suburban	260	47.3	23.2			
Rural	106	45.3	23.9			
Total	501	45.4	22.9			
Theme 5 (Food, Nutrition, and Health)						
Urban	135	39.6	17.4	2	1.470	0.231
Suburban	260	41.3	14.9			
Rural	106	38.4	16.2			
Total	501	40.2	15.9			

Note: * $p < .05$

(M = 48.2%) were the lowest on this theme with little difference between the suburban (M = 53.9%) and rural (M = 53.2%) students (Table 3). This particular theme showed no significance differences (p = 0.057) between urban, suburban, and rural students' literacy scores.

Theme 4 addressed 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. Theme 4 overall mean score (M = 45.4%) was lower in relation to the first three themes. Urban students (M = 42.1%) scored the lowest of the three groups of students compared to the scores suburban students (M = 47.3%) and rural students (M = 45.3%). An analysis of variance indicated that the difference between the scores was not statistically significant ($p < 0.05$) (Table 3).

The final theme, Theme 5, addressed food, nutrition, and health. Topics include human and animal nourishment, healthy food choices, and the safety of the food supply. The overall mean score for Theme 5 (M = 40.2%) was the lowest of the 5 themes. This theme was fairly unique in that the rural students (M = 38.4%) scored the lowest of the three groups of students followed by urban (M = 39.6%) and suburban students (M = 41.3%). As shown in Table 3, the differences between student groups on Theme 5 scores were not statistically significant ($p < 0.05$).

Summary

Overall agricultural literacy scores, as well as thematic area literacy scores of students from urban, suburban, and rural population areas were examined. The results revealed that significant differences ($p < .05$) existed between the student groups for the overall literacy scores, as well as for Theme 1 (Understanding Agriculture) and Theme 2 (History, Geography, and Culture) (Tables 2 and 3).

Students who indicated growing up in a suburban area scored higher than either urban or rural students on the overall agricultural literacy examination, as well as in each thematic area. These results did not concur with other research studies which found that college students and adults living or working on farms were the most knowledgeable about agriculture (Birkenholz et al., 1994; Frick et al., 1995).

At first glance these results might be unexpected. One might expect rural students to excel on a test about agriculture. However, rural populations are changing 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 from farming and ranching backgrounds might tend to be more specialized in their knowledge, being less aware of aspects of agriculture outside their realm. Similarly, agricultural literacy programs in rural schools might not be as prevalent as in suburban and urban schools due to a number of factors including funding, personnel, location, and the misconception that students are already familiar with the material. General practitioners tend to make inferences about the agricultural literacy of rural students, believing that since the rural students live among farming and ranching they understand the concepts. Agricultural educators should not take for granted the correlation between geographical locations and students' agricultural literacy. Agricultural awareness and literacy programs should be implemented at the elementary level and continue through post-secondary education in all geographical locations. This will create a greater awareness of agriculture and allow future generations to make sound decisions and judgments related to our food and fiber systems. Additionally, universities and departments of agriculture would be wise to consider the results of this study and begin discussions of what the profession can do to battle agricultural illiteracy. Are citizens agricultural illiterate due to location solely, or is it based on other issues, such as curriculum needs, teacher training, standardized testing mandates, etc.? Universities and agriculture departments should consider offering a general agriculture course in the core curriculum for the university. The general agriculture course(s) could fulfill several core curriculum areas, including a natural science, a social science, or an international perspective. Such an implementation could increase student enrollment in colleges and departments of agriculture by sparking students' interest and could increase student credit hours.

Since the results of this study cannot be generalized beyond this particular population, it is recommended that this study be replicated at other institutions in Texas and nationwide in order to determine if results would be similar. Additional studies should include sophomore, junior, and senior college students to determine if similarities or differences exist. Comparisons of agricultural literacy efforts at urban, suburban, and rural schools should be performed as well. Agricultural educators must continue to examine agricultural literacy competencies in order to fulfill the recommendations of the National Research Council's report (1988) which states that future generations should be able to make agriculturally-related public policy decisions, make educated consumer decisions, and create an environment of respect. Unfortunately, society is not quite there yet.

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