

THE AGRICULTURAL LITERACY OF URBAN/SUBURBAN AND RURAL TWELFTH GRADE STUDENTS IN FIVE ILLINOIS HIGH SCHOOLS: AN EX POST FACTO STUDY

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Abstract

This criterion group ex-post facto study sought to replicate an Oklahoma study which assessed the agricultural literacy of twelfth grade students. Seniors were selected from a random cluster sample of five Illinois high schools in two geographic locations, urban/suburban and rural. An instrument based on the Food and Fiber Systems Literacy Framework (FFSL), and used in an earlier study, was employed. Comparisons were made between students in five Urban/Suburban and Rural schools, between Agricultural Education students and General Education students, and between the five agricultural themes of the FFSL Framework. Unlike the antecedent study, rural school students scored higher in agricultural knowledge than their Urban/Suburban counterparts. Also in contrast, Agricultural Education students scored higher than General Education students in all five FFSL themes. But similar to the Oklahoma students, the low agricultural knowledge scores of students, overall, indicated that twelfth grade students who participated in the study were not agriculturally literate.

Introduction

Efforts in agricultural literacy in Illinois have been expanding, with a combined budget of \$1,557,580 in 2005 for 61 county Ag Literacy Consortia with full or part-time coordinators (Miller, 2005). Because most agricultural literacy efforts target K-8 students, and due to the fact that a previous study indicated high school seniors are not agriculturally literate (Pense & Leising, 2004), assessment of Illinois twelfth grade students was warranted. This study sought to replicate an Oklahoma study to determine whether “program completers” were agriculturally literate, and to use the Food and Fiber Systems Literacy Framework (Leising, Igo, Heald, Hubert, & Yamamoto, 1998) as a diagnostic tool to assess student strengths and weaknesses in thematic areas of agricultural literacy.

The Oklahoma study found that Agricultural Education students and General Education students did not differ in their overall mean agricultural knowledge scores, and students in rural schools obtained lower overall mean agricultural knowledge scores than did students in urban and suburban schools (Pense & Leising, 2004). Poorer achievement in Oklahoma’s rural schools seemed consistent with research indicating rural communities are in decline (Ball & Wiley, 2005, as cited in Center for Integrated Agricultural Systems, 1991; O’Hare, 1988). Further, this study sought to not only understand whether the Illinois efforts in agricultural literacy have produced positive results among high school students, but also to determine whether students in rural schools are falling behind their urban/suburban counterparts.

Theoretical/Conceptual Framework

Pense, Leising, Portillo, and Igo (2005) employed the grounded theory approach (Wiersma, 1995) to develop a conceptual model (Figure 1) used to evolve the framework employed in this study. Initially, the NRC (1988) proposed that an agriculturally literate person would be one who would understand the food and fiber system in relation to its historical, economic, social and environmental significance. An operational definition of agricultural literacy was later provided by Frick (1990), “Agricultural literacy can be defined as possessing knowledge and understanding of our food and fiber system. An individual possessing such knowledge would be able to: synthesize, analyze, and communicate basic information about agriculture” (p. 6). With this conclusive definition the grounded theory approach, advocated by Wiersma, to curriculum and the assessment of agricultural literacy led to the development of the Food and Fiber Systems Literacy (FFSL) Framework (Leising & Zilbert, 1994). The FFSL Framework was further refined in Oklahoma (Leising et al., 1998), and identified five themes in agriculture with corresponding standards, and grades K-12 benchmarks.

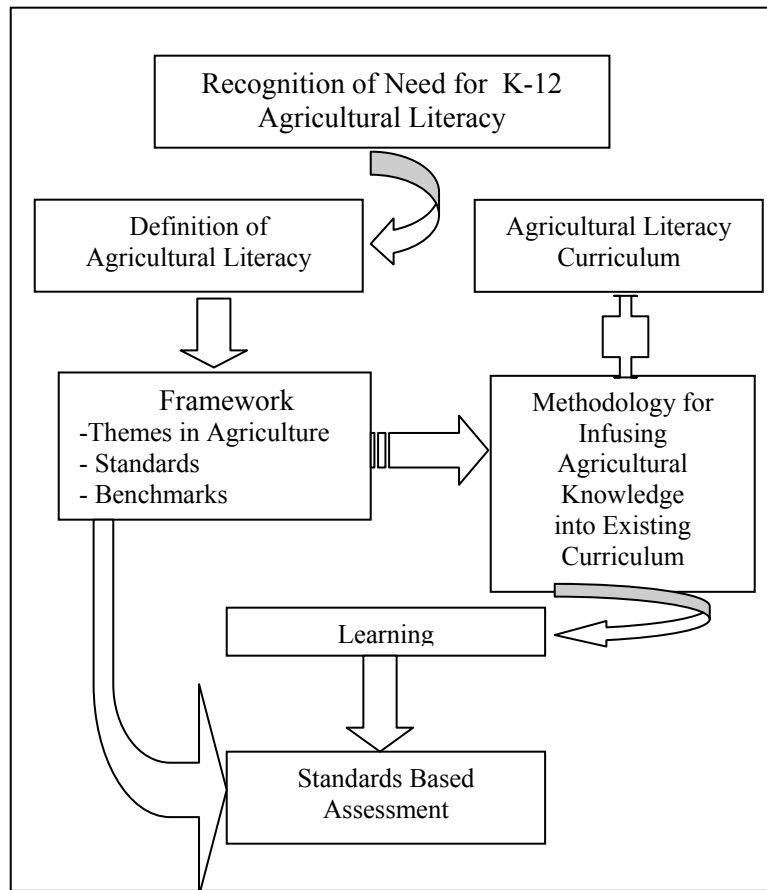


Figure 1. Conceptual model of the Food & Fiber Systems Literacy Framework role in the development of agricultural literacy curriculum and assessment. (Leising, Pense, and Portillo, 2003, p. 4).

The five themes of the FFSL Framework and agriculture’s complementary concepts (standards) addressed the multiple concepts of Caine and Caine’s Brain-Based Theory (1994). Balshweid (2002) surmised that the Brain-Based Theory and the Experiential Learning Theory of Dewey (1938) suggests interface between context and content giving students multiple opportunities for “transfer and overlap” (p. 57) of these standards. By organizing standards into grade-grouped benchmarks (K-1, 2-3, 4-5, 6-8, 9-12), the framework provided a systematic means of addressing these overlapping complementary concepts in agricultural literacy (Pense et al., 2005).

Agricultural Literacy Assessment

Igo’s study (1998) used the FFSL Framework to infuse agriculture into the core curriculum of K-8 classrooms. He concluded that it was possible to use the standards and grade-grouped benchmarks of the framework to infuse instruction about agriculture and increase student knowledge of agriculture. The study found strong relationships between student agricultural knowledge gains and the number of instructional connections teachers made to the

FFSL Framework.

A qualitative study of seven fifth-grade rural students (Meischen & Trexler, 2002) employed two frameworks to guide interviews and analysis of student understanding in the area of livestock and meat. The authors employed Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993) and the Food and Fiber Systems Literacy Framework (Leising, Igo, Heald, Hubert, & Yamamoto, 1998) to determine student understanding and the ability to converse about livestock and meat were incomplete.

Purpose and Objectives

Assessment based upon a curriculum framework had not been previously conducted to determine the agricultural literacy of students within the state of Illinois. The purpose of this study was to assess the food and fiber systems knowledge of twelfth grade students in Illinois prior to graduation. The specific objectives were:

1. Determine whether General Education students and Agricultural Education students in selected urban/suburban and rural schools were agriculturally literate in twelfth grade.
2. Determine strengths and weaknesses of agricultural knowledge for General Education students and Agricultural Education students in selected urban/suburban and rural schools using the five thematic areas of agriculture identified in the FFSL Framework.
3. Compare Agricultural Education students' and General Education students' knowledge scores about agriculture.

Methods and Procedures

The methodology for this study was a criterion group ex post facto research design. Wiersma (1995) has stated ex post facto is appropriate when the variables being studied are not manipulated, but studied in their natural context. Babbie (1986) stated that ex post facto may be employed to determine cause and effect relationships between past events. Wiersma also noted that ex post facto research designs may explain relationships and effects occurring between the variables.

Population and Sampling

The population of this study included 202 twelfth grade students purposively selected from a random cluster sample of five schools (three rural and two urban/suburban). The five schools were randomly selected from lists provided by the five district supervisors in Illinois employed by the agency, Facilitating Coordination in Agricultural Education (FCAE). Schools having strong agricultural education programs were deemed suitable for the comparison study being conducted.

In order to compare students in two groups, a target population of 50 or more students was determined for each group. The groups to be studied included those majoring in agricultural studies (defined as students who had taken three or more semesters of agricultural coursework) and those in general education studies (students who had not taken any agricultural classes). Most authors suggest that a sample include 30 or more students in each group for experimental research, however a larger number is desirable in a descriptive study employing a purposive sample (Ary, Jacobs, & Razavieh, 1990). To obtain an adequate number of Agricultural Education students, FCAE district supervisors were asked to include only schools with strong agricultural education programs. This resulted in two urban/suburban schools and three rural schools randomly selected from the generated list.

Random sampling of subjects was not feasible given the limitations of testing intact groups and the large numbers of classes in each school. The final sample of 202 was included in the study, of which 53 met the definition for Agricultural Education students while 144 were General Education majors. Although the population was homogenous in age, the purposive sampling (Wiersma, 1995), determined by school administrators, allowed a cross-section of students according to geographic location, gender, ethnicity and academic ability. The term 'judgment sample,' rather than 'purposive sample,' is employed by Worthen, Sanders, and Fitzpatrick (1997) and is said to be effective in describing a subgroup and permitting a better understanding of the program as a whole.

Due to the difficulty of admittance to test sites in urban public schools, and because urban and suburban schools scored similarly in the Oklahoma study (Pense & Leising, 2004), the two school types were grouped as one.

Instrumentation

The instrument, designed by Pense and Leising (2004), was based on the grade group 9-12 benchmarks of the FFSL Framework. Instruments based on the FFSL Framework, which were used in previous studies to measure student knowledge about agriculture in grades K-8, provided guidance for the instrument development process:

1. The researcher employed three methods to generate and validate the test questions used to assess agricultural knowledge:
 - a. Each item was referenced to one of five thematic areas of agriculture in the FFSL Framework. Each item was also referenced to the grade level grouping 9-12 standards and benchmarks of the Framework. Furthermore, by employing a method of criterion referencing, a "representative sample of items was established from a well defined domain of behavior to ensure validity" (Center for the Study of Evaluation, 1979, p. 10).
 - b. A panel of three credentialed Agricultural Education teachers and three graduate students in Agricultural Education, all of whom had no contact with any of the test sites, agreed to serve on the test development panel to write question items. Adkins-Wood (1960) underscores the need for item writers to possess several important qualities to increase content validity, including a thorough knowledge of the subject matter, an intimate

understanding of specific teaching objectives, and a facility in the clear and economical use of language.

- c. The questions were validated by a panel of secondary school teachers of various disciplines to ensure that: 1) each item addressed its corresponding FFSL benchmark content 2) the content was grade-level appropriate, and 3) each item was language appropriate. According to the Microsoft Word™ spelling and grammar check, readability ranged from sixth to twelfth grade reading levels.

2. The instrument underwent considerable revision:

- a. It was written in a format that would be consistent with a criterion-referenced knowledge achievement test.
- b. Multiple-choice items were employed as they are most widely used for measuring knowledge, comprehension and application outcomes (Gronlund, 1998).
- c. The test was also scrutinized to ensure that each item was written according to rules established for multiple-choice items (Gronlund, 1998).

Pilot Testing: Item Revision and Reliability

Two pilot tests were conducted with twelfth grade students in two rural Oklahoma high schools (Pense & Leising, 2004). The first was conducted on May 15, 2001 with an intact English IV class yielding a reliability coefficient of 0.846 using the Kuder/Richardson-20 (KR-20) Method. The instrument was then reviewed and questions revised based upon both input from students and indices indicating difficulty and discrimination from an item analysis (Wiersma & Jurs, 1990). The second pilot test was conducted on September 4, 2001 in a U.S. Government class and yielded a reliability coefficient of .933.

A computed estimate of the reliability is deemed by some as indicative of a criterion referenced test's adequacy, yet clear disagreement exists in the literature. Wiersma and Jurs (1990) cite eight factors through which reliability of an instrument may be enhanced. Each of the following factors were addressed during instrument development: homogeneous items, discriminating items, enough items, high-quality copying and format, clear directions to the student, a controlled setting, motivating introduction, and clear directions to the scorer (Pense & Leising, 2004).

Data Collection

Data was collected during the fall semester of the 2004-2005 school year. By testing in the fall, access to the data collection sites was less restrictive due to spring testing requirements set by No Child Left Behind (Illinois State Board of Education, 2005). According to J. G. Leising (personal communication, October 13, 2004) students scored ten percentage points higher in the pilot test conducted in the fall than those students tested in the spring during the Oklahoma study. Incentives of soft drinks and candy were also employed in this replication

study to reward students for their participation and in an attempt to encourage best effort (Dillman, 2000).

Other data collection procedures were the same as used in the Oklahoma study (Pense & Leising, 2004). Testing was administered at each project site by the same researcher. Each instrument was numbered in an effort to keep scores separate and school identity clear. Researchers did not identify individual students with their corresponding test numbers to ensure anonymity. Before testing, students were given an introduction to the study and test instructions were read to all participants. Answers were recorded by students on a general purpose NCS[®] answer sheet.

School administrators provided profile data on each school participating in the research study. Demographic information of each school was based on documents submitted by schools for state and federal funding. Qualitative observations were also made by the researcher. Demographic information for each individual student was obtained through a ten item questionnaire attached at the end of the testing instrument.

Students required 25 to 50 minutes to complete the test questions on the instrument. Those exams completed in less than ten minutes were not included in the sample as they were not deemed to be “honest expressions” of the students’ knowledge. By so doing, skewed results were less likely to occur.

Data were entered into an SPSS-12.0 version data file. In cases where marks on the students’ answer sheets were not readable by the scanning machine, corrections were entered by hand to assure completeness and accuracy of the data. Descriptive statistics were used to report frequencies, percentages, means and standard deviations.

Results and Findings

With an overall mean percent score of 52.15%, Agricultural Education students scored nearly 10 percentage points higher than General Education students. Both Agricultural Education and General Education students in rural settings had higher mean percents than their urban/suburban counterparts (Table 1).

Students from Urban/Suburban schools scored over 17 percentage points lower than students from rural schools on the agricultural knowledge test. Urban/suburban students had a total mean percent score of 35.87 while their rural counterparts had a total mean percent score of 53.35 (Table 1).

A summary of the five thematic areas (Table 2) showed larger mean percent scores in all five themes for rural students. Rural students scored at least 10.36 percentage points higher in each of the thematic areas. Overall, Agricultural Education students (Table 3) scored higher in all five thematic areas, scoring at least 6.28 percentage points higher than General Education students in each of the five thematic areas.

Table 1

Summary of Selected Illinois 12th Grade Agricultural Education Students' and General Education Students' Mean Percent Scores by Geographic Location of School and Student High School Major

Student H.S. Major	Urban/Suburban			Rural			Student H.S. Major Totals		
	<i>n</i>	<i>M %</i>	<i>SD</i>	<i>n</i>	<i>M %</i>	<i>SD</i>	<i>n</i>	<i>M %</i>	<i>SD</i>
Ag. Education	14	35.86	17.50	40	57.50	15.37	53	52.15	18.53
Gen. Education	<u>80</u>	<u>35.88</u>	<u>12.82</u>	<u>64</u>	<u>50.75</u>	<u>12.57</u>	144	42.49	14.67
School Type Totals	94	35.87	13.50	104	53.35	14.03			

Table 2

Summary of Selected Illinois 12th Grade Students' Thematic Mean % Agricultural Knowledge Scores According to School Type

Agricultural Themes	Urban/Suburban			Rural		
	N	Mean %	S.D.	N	Mean %	S.D.
(1) Understanding Agriculture	94	38.36	16.39	108	51.00	16.15
(2) Hist., Geography & Culture	94	38.70	20.85	108	62.90	23.32
(3) Science & Environment	92	34.09	20.11	107	55.82	22.07
(4) Business & Economics	93	29.00	20.14	108	48.86	19.64
(5) Food, Nutrition & Health	94	34.73	15.60	108	45.09	15.76

The mean percent scores for the five thematic areas according to geographic locations of students' schools and students' high school majors were then examined. Urban/suburban students scored much lower in Thematic Area 1 than rural students, with a mean percent difference of 12.64 (Table 2). Thematic Area 2 had a mean percent difference of 24.20 (Table 2), with urban students scoring lower. Thematic Area 3 had a mean percent difference of 21.73 (Table 2), with urban students again scoring lower than the rural students. Thematic Area 4 had a

mean percent difference of 19.86 (Table 2), with urban students scoring, once again, less than their rural counterparts. Thematic Area 5 had a mean percent difference of 10.36 (Table 2), with urban students scoring lower than rural students.

Table 3

Summary of Selected Illinois 12th Grade Students' Thematic Mean % Agricultural Knowledge Scores According to Student Major

Agricultural Themes	Ag Ed Students			Gen Ed Students		
	N	Mean %	S.D.	N	Mean %	S.D.
(1) Understanding Agriculture	56	49.64	19.69	146	43.36	16.18
(2) Hist., Geography & Culture	56	60.20	25.97	146	48.40	24.24
(3) Science & Environment	55	54.18	25.60	144	42.55	22.10
(4) Business & Economics	56	44.43	22.90	145	36.57	21.66
(5) Food, Nutrition & Health	56	46.09	16.06	146	38.00	16.15

Overall, Agricultural Education students scored higher than General Education students in all of the thematic areas (Table 3). Thematic Area 1 had a mean percent difference of 6.28 (Table 3), with General Education students' scoring lower than Agricultural Education students. Thematic Area 2 had a mean percent difference of 11.80 (Table 3), with General Education students' scores lower than those of Agricultural Education students. Thematic Area 3 had a mean percent difference of 11.63 (Table 3), with General Education students scoring lower than Agricultural Education students. Thematic Area 4 had a mean percent difference of 7.86 (Table 3), with General Education students' scores lower than those of Agricultural Education students. Thematic Area 5 had a mean percent difference of 8.09 (Table 3), with General Education students' scores lower than those of Agricultural Education students.

Conclusions

The conclusions in this study should not to be generalized beyond the 202 selected 12th grade students in the five Illinois high schools that participated in the study. The major findings presented in the study support the following conclusions:

1. Both Agricultural Education students and General Education students, regardless of their school type, possessed some agricultural knowledge.
2. Agricultural Education students obtained higher scores than General Education students in

their level of overall knowledge about agriculture.

3. Students enrolled in urban/suburban schools scored much lower in agricultural knowledge than students in rural schools for all five thematic areas of the Food and Fiber Systems Framework; urban/suburban school students were especially weak in Theme 4: Business & Economics.

4. Overall, 12th grade students in the five Illinois high schools that participated in this study demonstrated a lack of agricultural literacy, as defined by the FFSL Framework.

5. Agricultural literacy was considerably lower in the urban/suburban schools than in the rural schools included in this study.

6. Agricultural Education students obtained their highest score in Theme 2: History, Geography & Culture; followed by Theme 3: Science & Environment. Agricultural Education students scored lowest in Theme 4: Business & Economics (15.77% lower than Theme 2). Their second to lowest score was in Theme 5: Food, Nutrition & Health.

Recommendations

The following recommendations were made based upon the major findings of the study:

1. As in the Oklahoma study (Pense & Leising, 2004), overall low agricultural knowledge scores indicated that students participating in the study were not agriculturally literate. These findings suggest materials and curriculum should be developed in order to integrate applicable agricultural concepts for every discipline taught at the schools studied.
2. Agricultural educators in the five schools studied should make every effort to ensure that gaps in agricultural knowledge be eliminated by teaching those thematic areas where scores were low.
3. The Agricultural Education programs of the five Illinois high schools in this study should place more emphasis on developing curriculum for Theme 4: Business & Economics; and for Theme 5: Food, Nutrition and Health.
4. A methodology and delivery plan should be developed to help infuse the Food and Fiber System Literacy (FFSL) Framework into the curriculum of the five high schools in this study.
5. Replication of this study using the FFSL Framework is recommended in other states to better understand the strengths and weaknesses of student acquisition of knowledge in agriculture according to student major, school type, and thematic areas of agriculture.

Implications

Based on conclusions from this study and the findings of similar research (Pense &

Leising, 2004), Agricultural Education curricula across the nation may be too narrow in scope. A need exists to review Agricultural Education curricula and programs, improve upon them using the established criteria in the FFSL Framework (themes, standards and benchmarks), and thereby improve student agricultural literacy at the secondary level.

Agricultural educators, industry leaders, and extension educators should also help to expand the agricultural knowledge of educators in other disciplines, such as those teaching the science curriculum. Science teachers agreed students learn more through an integrated curriculum (Warnick, Thompson, & Gummer, 2004). This could contribute to an increased agricultural literacy among K-12 students, and given time, the entire population as well.

Agricultural literacy has been studied for nearly 20 years. During this time, programs have been developed to promote agriculture; most of these literacy efforts have targeted grades K-8. These programs could be explored and scrutinized to ensure that students entering secondary schools are agriculturally literate.

This study replicated the research conducted in Oklahoma. Ongoing discussion and research with a focus on twelfth grade students should be continued to determine if students have an understanding of agriculture. A larger population should be explored, including schools that do not currently have agricultural education programs.

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