AN ASSESSMENT OF STUDENT AGRICULTURAL LITERACY KNOWLEDGE BASED ON THE FOOD AND FIBER SYSTEMS LITERACY FRAMEWORK

James G. Leising
Seburn L. Pense
Oklahoma State University
Carl Igo
Southwest Texas State University

Abstract

Over 11 years ago, agricultural literacy was nationally recognized as a need for every K –12 student (NRC, 1988), but in an already overloaded curriculum an appropriate and un-intrusive method of incorporation was needed. The Food and Fiber Systems Literacy (FFSL) Framework was designed to make connections to agricultural concepts through existing curricula. The purpose of this quasi-experimental study was to assess change in student knowledge after infusing the FFSL Framework in core academic subjects (Igo, Leising, and Frick, 1999; see also Igo & Leising, 1999). The treatment group was composed of 2 kindergarten-through-twelfth-grade schools in Montana and Oklahoma. A school in Nebraska was used as the control. Pretest and posttest mean score comparisons by grade groupings and the 5 thematic areas in the FFSL Framework resulted in significant knowledge gains in 3 of the grade groupings for the treatment group. No significant gains came from the control group. Three thematic areas yielded the most statistically significant knowledge gains in the treatment group: Understanding Agriculture; History, Culture, and Geography; and Science and Environment. The study concluded that the FFSL Framework can be used effectively to infuse instruction about agriculture in the schools studied.

Introduction

Urbanization and the ever-increasing roles of technology in people's lives continue to distance people from their agricultural roots. With nearly 20% of the labor force in America working in agricultural related industries (Petrulis, Green, Hines, Nolan and Sommer, 1987), the need for literacy about agriculture is greater than it has ever been.

In 1988, the National Research Council's Committee on Agricultural Education in Secondary Schools proposed that an agriculturally literate person would understand the Food and Fiber System in relation to its history, economic, social, and environmental significance (National Research Council, [NRC] 1988). The committee also recommended that "all students should receive at least some systematic instruction about agriculture beginning in kindergarten or first grade and continuing through twelfth grade" (NRC, 1988, p.10).

Frick, in 1990, reported one of the first conclusive agricultural literacy definitions: "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.52).

Much of the agriculture literacy research has been focused on instructional material assessment. In evaluating the Georgia Agriculture in the Classroom program, Herren and Oakley (1995) concluded the materials were effective with both urban and rural students. Swortzel (1996) reported an Ohio study assessing fourth-graders knowledge of animal agriculture. A pretest/posttest design was used and a statistically significant difference was shown between the two test scores with greater gains for students living in urban areas. Trexlar (1997) concluded the introduction of an agriculturally based science curriculum "did not alter or negatively effect student perceptions of science, agriculture, or their agri-science knowledge level" (p.19).

Nunnery (1996) noted the necessity for building a literacy framework for understanding agriculture's perspectives and viewpoints. Leising and Zilbert (1994) approached agricultural literacy from this angle. They developed a systematic curriculum framework identifying what students should know or be able to do. The Food and Fiber Systems Literacy Framework explained what an agriculturally literate high school graduate should comprehend. Using a series of standards in five thematic areas, the framework delineated the necessary components for understanding the way food and fiber systems relate to daily life. 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.

One point of contention was the most appropriate and least intrusive way to incorporate instruction into an already overloaded curriculum (Law, 1990). The Food and Fiber Systems Literacy Framework (FFSL) was designed to make connections to agricultural concepts through existing curriculum. Through case studies, Igo, Leising and Frick found that education about agriculture could be infused into core academic learning. They reported that students already had some knowledge about agriculture, but that by infusing instruction on food and fiber into the academic core curriculum knowledge about agriculture increased significantly (Igo, Leising, and Frick, 1999; see also Igo & Leising, 1999).

Experimental or quasi-experimental research designs were not used in previous studies to control for specific variables. Therefore, in the second year of the Food and Fiber Project evaluation a quasi-experimental research design was employed.

Purpose and Objectives

The purpose of this study was to assess food and fiber systems 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. For the treated and control groups of this research, the specific objectives included:

Compare differences by grade grouping (K-1, 2-3, 4-5, 6-8) for the treatment group and control group in student knowledge about agriculture before and after instruction based upon the FFSL Framework.

Compare differences by grade grouping for the treatment group and control group in student knowledge about agriculture before and after instruction based upon the five thematic areas of the FFSL Framework.

Determine if a relationship existed between the differences in student knowledge about agriculture before and after instruction based upon the FFSL Framework and the number of teacher-reported instructional connections to the Framework.

Methods and Procedures

This study is a variation of the quasi-experimental nonequivalent control group design described by Campbell and Stanley (1963). The treatment group was composed of 21 classrooms in kindergarten through eighth grade from one school in Oklahoma and one school in Montana. A total of eight classes in Montana and 13 classes in Oklahoma composed the treatment group. Both schools were part of the Food and Fibers Systems Literacy Project. These school sites were chosen based on geographic diversity, school size and teacher willingness to infuse food and fiber systems literacy in kindergarten through eighth grade.

The control group was a school in Nebraska. The school was chosen because it was a rural school with social/economic characteristics and size similar to the treatment schools. Also, the school was willing to involve kindergarten-through-eighth-grade students and teachers in the study. A total of seven classes composed the control group.

Instrumentation

To control for existing knowledge of food and fiber systems and to determine similarity, students in the treatment and control groups were administered the same pretest at the beginning of the school year. The pretest and posttest instruments were the same. They were developed by the researchers for measuring food and fiber systems knowledge for each grade grouping in the Food and Fiber Systems Literacy Framework; K-1, 2-3, 4-5 and 6-8. Questions on each instrument were based on the grade-grouped benchmarks. The K-1 and 2-3 instruments included 16 and 21 items respectively. Both primarily used a format consisting of questions to be read by the teacher followed by a series of illustrations from which the students were to select the correct answer or answers. The K-1 instrument responses were entirely pictures, while the 2-3 instrument used picture and simple text responses. The 4-5 and 6-8 grade level instruments contained 35 and 30 text-responses respectively. The instruments had been used by the researchers in earlier studies and had reliability coefficients ranging from 0.7763 to 0.9469.

Treatment

The treatment group consisted of two schools, each with students enrolled in grades K-8 that were part of the Food and Fiber Systems Literacy Project. Teachers from these schools were prepared to infuse the Food and Fiber Systems Literacy Standards and Benchmarks into core academic subjects by participating in the l997-l998 two-phase training. Phase I training at each site involved an overview of the Project, followed by orientation to the Framework, Standards and Benchmarks and the introduction of the supporting lessons and activities. In addition, Phase I involved teachers in hands-on activities. Phase II training included time for teachers to become familiar with the Project web site, including instruction on submitting electronic reports to the Project staff. The majority of Phase II was spent in helping teachers plan instructional time throughout the academic year to address food and fiber systems concepts. In l998-l999, the teachers received an update of the project and time was spent with each teacher in planning and encouraging them to address the appropriate Standards and Benchmarks in their instruction.

Data Collection

The pretest was given to the treatment group and control group during September, l998 prior to any food and fiber systems instruction. Teachers administered the pretests in their classrooms. The instruments were collected by building principals and returned to the researcher by mail.

Infusion of Food and Fiber Systems Literacy Standards and Benchmarks for the treatment group took place during the l998-l999 academic year (September through April). The posttest was administered to the treatment and control

groups during early May, l999. Teachers administered the instrument in their classrooms. The principal collected the completed instruments and forwarded them to the researchers.

Teachers in the treatment group provided feedback regarding the connections made to the Framework throughout the project year. They indicated the theme, standards and benchmarks addressed. Teachers submitted feedback electronically or through the mail to the researchers.

Analysis of Data

After administration, the completed tests were scored and coded into a Microsoft™ Excel spreadsheet for analysis. Means and percentages were computed by grade-level grouping for the test scores from both groups. Analysis of variance procedures were performed using SAS version 6.11 to determine differences in pretest and posttest knowledge scores. The analyses included the General Linear Model's procedure and computation of Least Squares Means to delineate differences by theme area of the Food and Fiber Systems Literacy Framework. A Pearson's Product Moment Correlation was computed to assess relationships between pre- and posttest differences and the number of teacher reported instructional connections to the framework.

Results/Findings

Pretest and Posttest Grade Grouping Analysis

The pretest and posttest food and fiber knowledge levels for the treatment group and the control group are reported in Table 1. The mean test scores recorded for each grade grouping in the table indicated statistically significant differences between pretest and posttest knowledge scores, as determined by Analysis of Variance. The mean score for grade grouping 2-3 of the treated group increased by over 15 points, yielding statistical significance at the 0.05 level. The treatment group in grade groupings 4-5 and 6-8 also yielded 0.05 level significance for the differences between the pretest and posttest scores. Only the K-1grade grouping failed to show significance. The control group failed to show significant differences between the mean scores of the pretest and posttest for any of the four grade groupings.

It must be noted that the control group obtained higher mean scores in the pretest for every grade grouping than did the treatment group. In two grade groupings, K-1 and 2-3, the control group also scored higher than the treatment group for the posttest. It must also be noted, however, that in spite of having higher agricultural knowledge pretest mean scores than the treatment group, the control group failed to obtain significant increases in its posttest food and fiber knowledge scores, while the treatment group showed significant differences between the pretest and posttest mean scores in three of the four grade groupings.

Table 1.
F-Value Comparison of Food and Fiber Knowledge Pretest and Posttest Differences for the Treatment Group and Control Group

	Treatment				Control			
Grade	Pretest Mean	Posttest Mean	F-value	p	Pretest Mean	Posttest Mean	F-value	p
K-1	41.89	51.10	4.73	0.0606	43.38	47.43	0.45	0.5197
2-3	78.72	94.13	17.28	0.0014*	84.82	98.06	4.33	0.0611
4-5	24.36	28.21	17.51	0.0032*	25.17	26.16	0.50	0.4946
6-8	22.42	28.31	15.57	0.0064*	23.88	26.0	0.36	0.5567

*$p<0.05$

Thematic Area Analysis

The Food and Fiber Systems Literacy Framework was organized around five thematic areas: Understanding Agriculture; History, Culture, and Geography; Science and Environment; Business and Economics; and Food, Nutrition and Health. Table 2 provides the F-value comparison of the pretest and posttest score differences by grade groupings within theme areas for the treatment group and control group. Three thematic areas yielded the most statistically significant differences in the treatment group: Understanding Agriculture; History, Culture, and Geography; and Science and Environment. In each of the three thematic areas statistical significance appeared within the 2-3, 4-5, and the 6-8 grade groupings. The treatment group also registered statistically significant differences for two grade groupings in the Business and Economics theme (2-3 and 4-5); and for two grade groupings in the Food, Nutrition, and Health theme (K-1 and 2-3).

Table 2.
F-Value Comparison of Composite Pretest and Posttest Differences Within Theme Areas For Treatment and Control Groups

Themes and Grade Groupings	Treatment F-value	p	Control F-value	p
Understanding Agriculture				
K-1	2.46	0.1546	0.01	0.9204
2-3	5.68	0.0354*	0.15	0.7076
4-5	13.12	0.0108*	0.61	0.4547
6-8	18.10	0.0082*	0.01	0.9346
History, Culture, and Geography				
K-1	2.79	0.1328	0.22	0.6482
2-3	13.54	0.0033*	2.36	0.1535
4-5	12.29	0.0068*	0.28	0.6088
6-8	10.09	0.0186*	0.86	0.3653
Science and Environment				
K-1	1.38	0.2723	0.17	0.6898
2-3	10.09	0.0083*	8.19	0.0155*
4-5	6.02	0.0147*	0.81	0.3675
6-8	34.52	0.0183*	0.18	0.6729
Business and Economics				
K-1	0.59	0.4675	0.88	0.3750
2-3	24.75	0.0003*	16.35	0.0020*
4-5	5.28	0.0468*	0.05	0.8216
6-8	0.62	0.4583	0.24	0.6323
Food, Nutrition, and Health				
K-1	19.71	0.0020*	7.41	0.0232*
2-3	16.25	0.0018*	0.10	0.7567
4-5	0.72	0.3954	0.36	0.5512
6-8	5.78	0.0734	0.02	0.8808

*$p<0.05$

The control group showed no statistical differences between the pretest and posttest scores for any of the grade groupings in the first two thematic groups: Understanding Agriculture; and History, Culture, and Geography. The control group did, however, show a statistical difference in a single grade grouping for each of the last three thematic areas: Science and Environment (grade group 2-3); Business and Economics (grade group 2-3); and Food, Nutrition, and Health (grade group K-1).

Relationship Between Student Knowledge and Teacher Connections

Pearson's Product Moment Correlation Coefficient was computed using SAS to assess whether a relationship existed between the difference in pretest and posttest knowledge scores and the number of instructional connections that teachers made to food and fiber systems. Those instructional connections were based upon feedback provided by the teachers within the treatment group as a part of the Food and Fiber Systems Literacy Project. Table 3 summarizes the result of the analysis. Unlike the previous year of this study, the sites in the treatment group failed to show a statistically significant correlation between the test score differences and the number of instructional connections made by teachers.

Table 3.
Correlation Of Differences in Pretest and Posttest Scores to Instructional Connections at the Treatment Site

Site	n	Reported Connections	Pearson r	P
Treatment Group	21	143.8	0.1637	0.3154

*$p<0.05$

Conclusions

The conclusions are based on the findings and were not to be generalized beyond the population of this study.

Students had some knowledge of food and fiber systems prior to the study. The Nebraska control group possessed more knowledge at the beginning of the study compared to the Oklahoma and Montana treatment group.

The Oklahoma/Montana treatment group increased student knowledge about agriculture by infusing instruction based upon the Food and Fiber Systems Literacy Framework Standards and Benchmarks.

Student knowledge increased most frequently within three themes: Understanding Agriculture; History, Culture and Geography; Science and Environment. This conclusion was also reached in the first year of the project.

No relationship existed between the number of connections teachers made to the Food and Fiber Systems Literacy Framework and increases in student knowledge. However, in the first year of this study, a significant relationship existed between student knowledge and the number of teacher connections to the Framework.

Recommendations

Based upon the conclusions and major findings of this research, the following recommendations were made:

Further research is needed to understand why no significant increase in pre- and posttest knowledge score differences in the K-1 grade grouping occurred for the themes, Understanding Agriculture; History, Culture and Geography; Science and Environment; and Business and Economics.

Additional research is needed to understand how teacher behavior in the classroom impacts acquisition of agricultural knowledge by students. Conflicting findings in this paper regarding the relationship between student knowledge and the number of teacher reported connections to the Food and Fiber Systems Literacy Framework provides a basis for further study.

Food and Fiber Systems Literacy Standards and Benchmarks and evaluation instruments should be made available to educators and practitioners. Through implementation, it will become clearer if this systematic approach to agricultural literacy will be workable in school districts.

There is a need to field-test the Food and Fiber Systems Literacy Standards and Benchmarks for grades 9-12 in whole-school settings. Field-testing will help to develop an understanding of how to implement food and fiber literacy across disciplines and through departments.

Implications

The Food and Fiber Systems Literacy Framework can be used effectively to guide instruction about agriculture in grades K-8. The opportunity exists for further dialogue about agricultural literacy and the use of standards and benchmarks to assess student progress. Discussions among agricultural literacy professionals, agriculture industry leaders, agriculture educators, curriculum specialists, and local and state education leaders must focus on reaching consensus about the definition and scope of agricultural literacy instruction. The Food and Fiber Systems Literacy Framework provides a model and starting point for discussion.

This study used the whole-school setting to implement food and fiber systems literacy instruction. The project learned that by involving an entire school a synergy among teachers, administrators, students and parents was created. This synergy may lead to greater overall student achievement and increase the sustainability of agricultural literacy in the school curriculum.

References

Campbell, D.T. & Stanley, J.C. (1963). *Experimental and quasi-experimental designs for research.* Chicago: Rand/McNally.

Frick, M.J. (1990). *A definition and the concepts of agricultural literacy: A national study.* Unpublished doctoral dissertation, Iowa State University, Ames.

Herren, R.V. & Oakley, P. (1995). An evaluation of Georgia Agriculture in the Classroom program. *Journal of Agricultural Education, 36* (4), 26-31.

Igo, C.G. & Leising, J.G. (1999). Assessing agricultural literacy: a case study approach. *Proceedings of the 49th Annual AAAE Southern Agricultural Education Research Meeting, USA, 49,* 165-176.

o, C.G., Leising, J.G. and Frick, M.J. (1999). A case study assessment of standards and benchmarks for implementing food and fiber systems literacy. *Proceedings of the 18th Annual Western Region, 18,* 218-229.

Law, D.A. (1990). Implementing agricultural literacy programs. *Agricultural Education Magazine, 62* (9), 5-6, 22.

Leising, J.G. & Zilbert, E.E. (1994). Validation of the California agriculture literacy framework. *Proceedings of the National Agricultural Education Research Meeting, USA, 21,* 112-119.

National Research Council, Board on Agriculture, Committee on Agricultural Education in Secondary Schools. (1988). *Understanding agriculture: New directions for agricultural education.* Washington, D.C.: National Academy Press.

Nunnery, S. (1996). Systematic educational efforts teaching about agriculture and the effect on fourth-grade students knowledge of animal agriculture in Ohio. *Proceedings of the National Agricultural Education Research Meeting, USA, 23*, 163-172.

Petrulis,M.,Green, B.L., Hines, F., Nolan, R., and Sommer, J. (1987). How is farm financial stress affecting rural America? *Agricultural Economic Report No. 568*. Washington, D.C.: Economic Research Service, USDA.

Swortzel, K.A. (1996). Systematic educational efforts teaching about agriculture and the effect on fourth-grade students knowledge of animal agriculture in Ohio. *Proceedings of the National Agricultural Education Research Meeting, USA, 23*, 163-172.

Trexlar, C. (1997). The cheeseburger came from where?: Elementary school student's understanding of how food is affected by biology and climate. *Proceedings of the National Agriculture Research Meeting*, USA, 24, 23-33.