The Impact Of Selected Agriculture in the Classroom Teachers On Student Agricultural Literacy

Final Report

James G. Leising, Project Director
Seburn L. Pense, Associate Director
Matthew T. Portillo, Research Associate

Department of Agricultural Education, Communications, and 4-H Youth Development
Oklahoma State University
448 Agricultural Hall
Stillwater, OK 74078

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Project Staff

James Leising, Project Director
Seburn Pense, Associate Director
Matthew Portillo, Research Associate

Department of Agricultural Education, Communications and 4-H Youth Development
Oklahoma State University
Stillwater, Oklahoma

Advisory Committee to AITC Impact Study

Monica Pastor, Arizona State AITC Director
Alan Withers, Minnesota State AITC Director
Diane Olson, Missouri State AITC Director
Margie Thompson, Montana State AITC Director
Vicki Baker, Montana State AITC Contact
Ellen Hellerich, Nebraska State AITC Director
Jennifer Hopper, New Mexico State AITC Director
Janet E. Hawkes, New York State AITC Director
Charles Cox, Oklahoma State AITC Director
Debra Spielmaker, Utah State AITC Director
Jeffrey Gilmore, Director, USDA/SERD/HEP
Kathleen Cullinan, National Program Leader

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Executive Summary

America's food and fiber systems determine the nation's general welfare and standard of living. Today, nearly ninety percent of the population is two or three generations removed from direct contact with food and fiber production (Leising and Zilbert, 1994). As a result, youth know little about agricultural production, processing, marketing, distribution, regulation or research.

In 1988, the National Research Council's Committee on Agricultural Education in Secondary Schools recommended that "all students should receive at least some systematic instruction about agriculture beginning in kindergarten or first grade and continuing through twelfth grade" (p.10).

The national Agriculture in the Classroom (AITC) program, formalized by the United States Department of Agriculture in 1981, is the largest public effort to educate people about agriculture. If the program is to reach its full potential, AITC must be consistent with research-based teaching practices that will insure all students become agriculturally literate. Therefore, baseline data were needed to ascertain what students were learning about agriculture from AITC trained teachers. It was thought by identifying where gaps in student agricultural knowledge occur, program leaders would be better able to focus efforts in instructional material development and teacher training.

Purpose

The purpose of this study was to assess the agricultural knowledge of selected public school classrooms in grades kindergarten through sixth that have received instruction from teachers trained by Agriculture in the Classroom. Also, teacher agriculture knowledge was assessed and the relationship of teacher demographic factors of education, type of agricultural literacy preparation, how agricultural knowledge was integrated into instruction, and how teachers made agricultural connections to student agriculture knowledge were examined.

Methods and Procedures

This study used a variation of the quasi-experimental pre- posttest nonequivalent-control group design (Campbell & Stanley, 1963). The treatment group was comprised of classrooms (grades kindergarten through sixth) with AITC trained teachers. The control group was comprised of classrooms (grades kindergarten through sixth) with teachers that had no exposure to AITC and was selected from schools that were demographically similar.

Four states (Arizona, Montana, Oklahoma and Utah) were involved in this study during the 2002 school year with each state including two classrooms at each of the seven grade levels in the treatment group and two classes at each grade level in the control group. A total of 52 treated classrooms (998 students) and 51 control classrooms (1,011 students) were included in the study. Student knowledge about agriculture was assessed for both the treatment and control groups using the Food and Fiber Systems Literacy Tests.

Findings and Conclusions

The agriculture literacy test results showed that AITC trained teachers make a positive difference in student acquisition of knowledge about agriculture. Students in AITC classrooms demonstrated more agricultural knowledge achievement compared to students in classrooms with no AITC training.

Students at each grade grouping taught by AITC trained teachers were most knowledgeable about agriculture in the following themes of the Food and Fiber Systems Literacy (FFSL) Curriculum Framework: Grades K-1, Theme 5 (Food, Nutrition and Health); Grades 2-3, Theme 1 (Understanding Food and Fiber Systems); Grades 4-5, Theme 3 (Science, Technology and Environment); Grade 6, Theme 2 (History, Geography and Culture). However, students who were taught by AITC trained teachers were least knowledgeable about agriculture in the following themes: K-1, Theme 2 (History, Geography and Culture); Grades 2-3, Theme 5 (Food, Nutrition and Health); Grades 4-5, Theme 5 (Food, Nutrition and Health); Grade 6, Theme 5 (Food, Nutrition and Health).

Across all grade levels, students who were taught by AITC trained teachers gained more knowledge in Theme 1 (Understanding Food and Fiber Systems) and Theme 2 (History, Geography and Culture). They gained the least knowledge in Theme 3 (Science, Technology and Environment), Theme 4 (Business and Economics) and Theme 5 (Food, Nutrition and Health).

Teachers with AITC training had more knowledge about agriculture than did teachers with no AITC training. However, all teachers were most knowledgeable in Theme 1 (Understanding Food and Fiber Systems), Theme 2 (History, Geography and Culture) and Theme 3 (Science, Technology and Environment). All teachers were least knowledgeable in Theme 4 (Business and Economics) and Theme 5 (Food, Nutrition and Health).

The National Research Council's Board on Agriculture (1988) recommended that all K-12 students receive at least some systematic instruction about agriculture. To achieve this goal, this study recommended that AITC programs studied increase student agricultural knowledge achievement by placing more focus on Theme 3 (Science, Technology and Environment), Theme 4 (Business and Economics) and Theme 5 (Food, Nutrition and Health). Kindergarten and first grade teachers should increase the focus on Theme 5 (Food, Nutrition and Health). Based on the findings, it is recommended that AITC state and national program leaders determine whether adequate in-service and instructional materials are available for teaching upper level elementary children about agriculture in themes 3, 4 and 5.

Introduction

According to the National Research Council (1988), all students should receive agricultural literacy instruction. One program designed to address this mandate was Agriculture in the Classroom (AITC), formalized by the United States Department of Agriculture (USDA) in 1981. AITC programs were set up in every state and traditionally organized through state departments of agriculture and/or education and farm organizations such as the Farm Bureau (Traxler, 1990).

Many state AITC programs have developed instructional materials for infusing agriculture into the classroom and have held teacher training workshops, but few have conducted on-going assessments to determine what agricultural knowledge students are learning. Therefore, baseline data needed to be developed to ascertain what students were learning about agriculture from AITC trained teachers.

This study sought to provide key indicators of progress being made toward the achievement of program goals by pre- and posttesting students in AITC treated and nontreated schools. Student agricultural knowledge scores were compared between the two groups, with the agricultural knowledge test scores of their teachers, and results were compared for pre- and posttest scores. The testing instruments were based upon the five thematic areas of the Food and Fiber Systems Literacy Framework (Leising, Igo, Heald, Hubert and Yamamoto, 1998). By identifying student strengths and weaknesses in the thematic areas of agriculture, it was thought 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.

Theoretical Framework

Conceptual Model

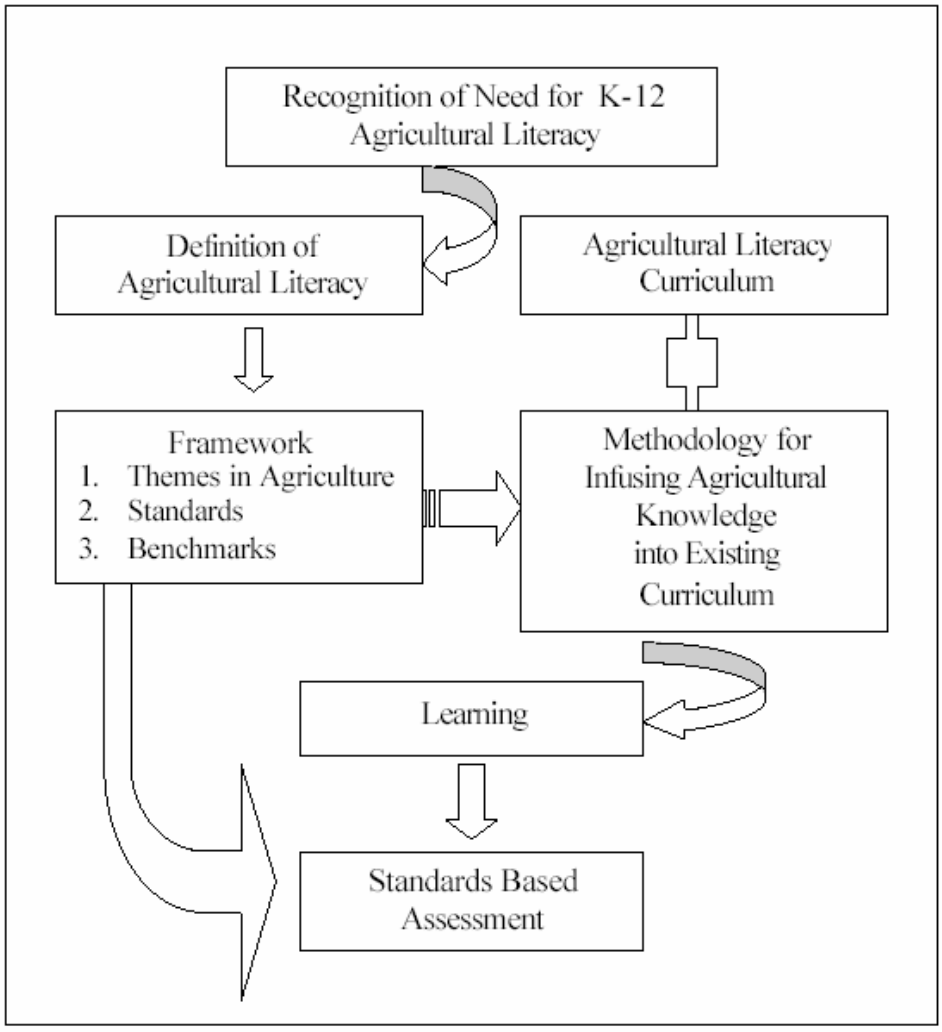
America's food and fiber systems determine the nations' general welfare and standard of living. Today, nearly ninety percent of the population is two or three generations removed from direct contact with food and fiber production (Leising and Zilbert, 1994). As a result, youth know little about agricultural production, processing, marketing, distribution, regulation or research.

Laying a foundation for a conceptual model (Figure 1), the Committee on Agricultural Education in Secondary Schools began to develop the idea of "agricultural literacy" and proposed that an agriculturally literate person would understand the food and fiber system in relation to its history, economic, social, and environmental significance (NRC, 1988). Later, Frick (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).

Nunnery (1996) later proposed the development of a literacy framework for understanding agriculture's perspectives and viewpoints. Leising and Zilbert (1994) approached agricultural literacy from the same angle and developed a systematic curriculum framework identifying what

students should know or be able to do. The Food and Fiber Systems Literacy (FFSL) Framework outlined what an agriculturally literate high school graduate should comprehend. By providing standards in five thematic areas of agriculture, the FFSL framework delineated the necessary components of a curriculum framework 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, 9-12), the framework provided a systematic means of addressing agricultural literacy.

Figure 1. Conceptual Model of the Food & Fiber Systems Literacy Framework role in the development of agricultural literacy.



This study employed the FFSL Framework standards and benchmarks as the basis for assessing student and teacher knowledge about agriculture. Figure 1 displays the conceptual model.

Agricultural Literacy Assessment

Much of the agricultural literacy research has focused on teacher perceptions and knowledge of agriculture, assessment of instructional materials, and the defining of agricultural literacy (Cox, 1994; Elliot & Frick, 1995; Frick, 1990; Harris & Birkenholtz, 1993; Pals, 1998a, b; Terry, 1990; Trexlar, 1997; Wallace, 1995; Wilhelm, 1998). In evaluating the Georgia Agriculture in the Classroom program, however, Herren and Oakley (1995) developed instruments to assess student agricultural knowledge at the second and fourth grade levels and concluded that

Agriculture in the Classroom programs were effective in teaching agricultural concepts in both rural and urban settings. 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. A standards-based assessment of student agricultural knowledge, however, was yet to be conducted.

Igo (l998) studied three schools (K-8) that used the FFSL Framework for infusing agriculture into the core curriculum. He found that it was possible to use the standards and grade-grouped benchmarks (Figures 1 & 2) to infuse instruction about agriculture and increase student knowledge of agriculture. Igo also reported strong relationships between student agricultural knowledge gains and the number of instructional connections teachers made to the FFSL Framework.

Figure 2. Standards for each of the five themes in the Food & Fiber Systems Literacy Framework.

Themes

I. Understanding Food & Fiber Systems	II. History, Geography and Culture	III. Science, Technology and Environment	IV. Business & Economics	V. Food, Nutrition, & Health
A. Understand the meaning of Food & Fiber Systems/agriculture.	A. Understand the Food & Fiber Systems' role in the evolution of civilizations.	A. Understand how ecosystems are related to Food & Fiber Systems.	A. Understand how Food & Fiber Systems and economics are related.	A. Understand how Food & Fiber Systems provide nourishment for people and animals.
B. Understand the essential components of Food & Fiber Systems (e.g., production, processing, marketing, distribution, research and development, natural resource management, and regulation).	B. Understand the Food & Fiber Systems' role in societies throughout world history.	B. Understand Food & Fiber Systems' dependence on natural resources.	B. Understand how Food & Fiber Systems have an impact on local, national, and international economies.	B. Understand how Food & Fiber Systems provide healthy diet components.
C. Understand Food and Fiber Systems' relationship to society.	C. Understand the Food & Fiber Systems' role in U.S. history.	C. Understand management and conservation practices used in Food & Fiber Systems.	C. Understand the government's role in Food & Fiber Systems.	C. Understand how Food & Fiber Systems provide food choices.
D. Understand the local, national, and international importance of Food and Fiber Systems.	D. Understand the relationship between Food and Fiber Systems and world cultures.	D. Understand science and technology's role in Food & Fiber Systems.	D. Understand factors influencing international trade of food and fiber products.	D. Understand how Food & Fiber Systems promote a safe food supply.
E. Understand Food and Fiber Systems careers.	E. Understand how different viewpoints impact Food and Fiber Systems.			

Standards

Figure 3. Example of benchmarks for a single standard in the Food and Fiber Systems Literacy Framework.

Standard	
D. Understand science and technology's role in Food and Fiber Systems.	**Benchmarks**
Students will identify tools and machines used in Food and Fiber Systems. They will give examples of tools and machines used to produce food and fiber products.	**K-1**
Students will recognize inventors and their inventions related to Food and Fiber Systems. They will describe the agricultural importance of the inventions.	**2-3**
Students will explain how technological advancements enhance Food and Fiber Systems' efficiency. They will list technologies that reduce manual labor needs in agriculture.	**4-5**
Students will identify Food and Fiber Systems careers dependent on science and technology skills. They will contrast skills needed for agricultural and non-agricultural careers.	**6-8**
Students will recognize how science and technology impact Food and Fiber Systems. They will analyze the effects of science and technology on food, clothing, shelter, and career choices.	**9-12**

Growth and Development of AITC State Programs

Prior to the study and resultant recommendations made by the NRC (1988) that students at all grade levels (K-12) receive training that would contribute to the development of their agricultural literacy, programs did exist for the purpose of educating children in the elementary grades about agriculture. AITC was one program designed to accomplish this, and was formalized by the USDA in 1981. In 1982, *The Model State Action Plan* was disseminated by the USDA on how to begin, organize and implement an AITC program. These programs were set up in every state and traditionally organized through state departments of agriculture and/or education and farm organizations such as the Farm Bureau (Traxler, 1990).

While states have not been bound by USDA goals for AITC, many states have developed their own, much like those in Illinois. Illinois's state AITC goals are to: "(a) provide for a systematic infusion of agricultural concepts into the basic subject areas of the curriculum, and (b) to provide in-service training to teachers of the basic subject areas in order to provide necessary background information for incorporation of agricultural knowledge into their respective subject areas" (Law, 1990, p. 6). Illinois has sought to accomplish these goals by providing instructional materials and curriculum guides that incorporate agricultural knowledge into basic subject areas and conduct in-service workshops for elementary/middle school teachers on how to use the materials.

Many state AITC programs have developed instructional materials for infusing agriculture into the classroom and have held teacher training workshops, but few have conducted on-going assessments to determine what agricultural knowledge students are learning. Therefore, baseline data needed to be developed to ascertain what students are learning about agriculture from AITC trained teachers.

National Progress Report on Advances in Agricultural Literacy

Warmbrod (1997) surveyed state supervisors of Agricultural Education in all 50 states, as well as faculty members who specialized in agricultural teacher education at each university with a program in agricultural education. He sought to determine the extent to which each of the 24 recommendations included in the 1988 report by the NRC's Committee on Agricultural Education in Secondary Schools were being implemented in each state (NRC, 1988). The questionnaire (Warmbrod, 1997) was sent via e-mail to 74 faculty members, obtaining responses from 50 (68%). Fifty-one state supervisors received the survey by mail, giving a response of 40 (78%). Of the 24 recommendations, six related directly to agricultural literacy and showed a mixed rate of implementation. Two recommendations received the highest rating of implementation for each state (Warmbrod, 1997):

> The focus of agricultural education must change; agricultural education must become more than vocational agriculture (p. 4) [65%]. State vocational agriculture supervisors, other education leaders, and state agriculture and education department officials should encourage use of the Ag in the Classroom instructional program for students in grades kindergarten through 12 (p. 5) [49%].

But ten years after the report was published (NRC, 1988), four of the six recommendations found most states having only made "some progress" or still in the process of "considering" the recommendations (Warmbrod, 1997). In one of the recommendations, a considerable number of the states had decided to give "no consideration" to implementing, or determined that it was "not applicable or feasible" (Warmbrod, 1997). This progress report reflects a persistent view that much of the instruction about agriculture may be incorporated into existing courses (science, social sciences, etc.) rather than taught in separate agriculture courses (p. 4). Almost one quarter of the respondents [23%] gave this recommendation the highest rating; while almost twice that number [55%] gave it the lowest.

AITC Program Evaluation by Survey of AITC State Directors

The USDA conducted an evaluation of the AITC program in 1988 at the National AITC Conference in Las Vegas by surveying each of their state directors (USDA, 1988). A series of questions regarding the major facets of the state and national programs provided data about program status and recommendations for program improvement. In addition to identifying strengths and successes of the AITC program at both the state and national levels, survey respondents called for guidelines that would direct the development and evaluation of educational materials. They also stressed the need to conduct national and state evaluations of AITC's impact on K-12 students. Respondents specified qualitative measures be created "to analyze improvement in test scores where AITC materials have been used" (p. 10). This study was a response to these recommendations and the need to know more about how AITC is impacting student knowledge.

Purposes and Objectives

The purpose of this study was to assess the agricultural knowledge of selected public school classrooms in grades kindergarten through sixth that received instruction from teachers trained by AITC. The specific objectives included:

1. Compare differences by grade grouping (K-1, 2-3, 4-5, 6) between the AITC treatment group and control group in student knowledge about agriculture, before and after instruction, based on the Food and Fiber Systems Literacy (FFSL) Framework.

2. Compare differences by grade grouping between the AITC treatment group and control group in student knowledge about agriculture, before and after instruction, using the five thematic areas of the FFSL Framework.

3. Develop a profile of student knowledge about agriculture, before and after instruction, for each grade grouping.

4. Develop a profile of AITC teachers that includes education, agricultural experience, knowledge about agriculture, place of residence, amount of agricultural literacy in-service education, instructional practices and materials used, and number of years taught.

5. Determine if a relationship existed between student knowledge about agriculture (based on the FFSL Framework) and variables, such as instructional practices and materials used in the classroom, place of residence, amount and kind of in-service education and teacher knowledge about agriculture.

Methods and Procedures

This study was a quasi-experimental nonequivalent control group design, using a pretest and posttest, described by Campbell and Stanley (l963). Treatment and control groups were selected in each participating state. The treatment group was comprised of classrooms (K-6) with AITC trained teachers. The control group was comprised of classrooms (K-6) with teachers who had no exposure to AITC. The control groups were selected from schools that were similar to the treatment groups in geographic location and size of schools in the treatment group. A pretest and posttest were given to students to measure their knowledge about agriculture. Teachers were given a test to measure their agricultural knowledge and a demographic information instrument.

An external project advisory committee of state AITC coordinators and USDA AITC staff recommended states for participation in the study. Ten states demonstrating strong AITC programs were nominated and invited to participate in the study. However, due to limited state AITC program budgets and project requirements, only four states agreed to participate: Arizona, Montana, Oklahoma and Utah.

The study called for two classrooms at each of the seven grade levels to be included in each treatment and control group. A total of 52 treatment classrooms and 51 control classrooms completed the student pretests in the fall of 2001. All of the pretest classes in the treatment group and 48 of the control group completed the posttest instrument in spring of 2002. A total of 2,009 students completed the pretest instruments in the four participating states. A total of 1,734 students completed the posttest instrument. Ninety teachers completed the test instrument on agricultural knowledge and the demographic information instrument.

Instrumentation

Student Knowledge

Student knowledge about agriculture was assessed for both the treatment and control groups using the Food and Fiber Systems Literacy (FFSL) Tests. The tests focused on the following five thematic areas: Theme 1 (Understanding Food and Fiber Systems); Theme 2 (History, Geography and Culture); Theme 3 (Science, Technology and Environment); Theme 4 (Business and Economics); and Theme 5 (Food, Nutrition and Health). Four instruments developed by Leising and Igo (l999) for assessing food and fiber systems knowledge were used in the pretest

and posttest assessment. These grade levels were kindergarten through first, second through third, fourth through fifth, and sixth through eighth. Questions on each instrument were based on the FFSL grade-grouped benchmarks. The kindergarten through first grade and second through third grade 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 kindergarten through first grade instrument responses were entirely pictures, while the second through third grade instrument used pictures and simple text responses. The fourth through fifth grade and sixth through eighth grade level instruments contained 35 and 30 text items respectively.

The instruments were pilot-tested with groups of students not included in the study. Researchers had used these instruments in earlier studies. The internal consistency was established using Guttman's Split-Halves reliability coefficients. The reliability coefficient for the kindergarten through first grade instrument was 0.7763 and the reliability coefficient for the second through third grade instrument was 0.9469. The fourth through fifth grade instrument yielded a coefficient of 0.7892, and the sixth through eighth grade instrument yielded a reliability coefficient of 0.7879.

Teacher Knowledge

A teacher survey instrument was developed and consisted of two parts. For Part 1, a 50-item test instrument was developed to assess the agricultural knowledge of teachers based on the themes, standards and benchmarks of the FFSL Framework. For Part 2, a demographic instrument was developed to collect data about gender, ethnicity, experience in agriculture, academic preparation, experience in teaching, amount of agricultural literacy in-service training received, place of residence, and instructional practices and materials used.

Two pilot tests were conducted on groups of teachers not participating in the study at the Oklahoma 2001 AITC Summer Institutes. Instrument review and item revision following the first pilot test resulted in a final reliability coefficient of 0.74 using the Kuder-Richardson 20 (KR-20) Method.

Treatment and Control Groups

The treatment group consisted of a total of 52 classrooms in four states. Each states' treatment group was comprised of two teachers/classrooms trained by AITC for each of the seven grade levels (K-6) to be studied. The 52 teachers/classrooms were purposely selected by each states' AITC coordinator based on the criteria that teachers received agricultural literacy training through specialized workshops or institutes and were infusing agriculture into their curriculum.

The control group consisted of teachers/classrooms in the same four states from which the treated group was selected. Criteria for selecting the two teachers/classrooms for each of the seven grade levels in the control group included similar geographic location, size of schools in the treatment group, and no training or use of AITC materials in the classroom or school.

Data Collection

Student pretest data were collected from 52 treated teachers/classrooms and 51 control teachers/classrooms in September/October, 2001. Student posttest data were collected from 52 treated teachers/classrooms, but only 48 control teachers/classrooms in March/April, 2002. Teacher data were collected only once from both treatment and control groups in September/October, 2001. Project staff collaborated with AITC coordinators in the four states to select the teachers/classrooms for inclusion in the study. Project staff prepared directions/procedures for collecting the data from each site and trained the AITC coordinators in methods for administering the instruments to teachers and students. Completed instruments were collected by the AITC Coordinators from teachers and students and returned to the researchers by mail.

Data Analysis

Upon completion of the pretest administration, tests were scored and coded into a Microsoft™ Excel spreadsheet for analysis. Test site teachers were instructed to posttest only those students who had been pretested. Test mortality accounted for 88 fewer students tested at the Arizona sites, eight fewer students tested at the Montana sites, 54 fewer students tested at the Oklahoma sites, and 93 fewer students tested at the Utah sites. The posttest data were coded in the same manner following the administration and retrieval of those instruments, and SAS version 8.2 and SPSS version 8.0 were used to perform all statistical procedures, analyzing data for both pretest and posttest groups in conjunction with the purpose and objectives of the study.

Objectives 1-3. Analysis of variance procedures were performed using SAS version 8.2. Specifically, the MIXED procedure was used to fit a mixed linear model to the data. CLASSIFICATION variables were state, treatment, and classroom. The MODEL statement included gain scores as the dependent variable, pretest scores as a covariate, and treatment as the fixed effect. Satterthwaite degrees of freedom were calculated for this unbalanced design. RANDOM effects included state and room (state by treatment). LSMEANS statement calculated the difference between the treatment and control groups.

Objective 4. The data from the test and demographic instruments were quantitative and entered into Statistical Package for Social Science (SPSS) for Windows, version 8.0 for analysis. Data were analyzed using descriptive statistics to describe and summarize observations. In addition, the researchers summarized solicited comments to three open-ended questions concerning benefits of AITC training and types of outdoor activities used to teach agriculture.

Teacher characteristics for the treatment and control groups were described using frequency distributions and percentages. Agricultural knowledge differences between treatment and control groups were described using measures of central tendency and variability. Glass' delta was also calculated as an effect size to determine agricultural knowledge improvement. Conventions for Glass' delta were based on Cohen's *d* (1988): small, less than 0.49; medium, 0.50-0.79; large, greater than 0.80.

Objective 5. Pearson's Product Moment Correlations were calculated between mean scores of teachers and students by grade and treatment. Conventions used to describe these relationships were: .20 or lower, "very low"; .20 to .40, "low"; .40 to .60, "moderate"; .60 to .80, "strong"; .80 or higher, "very large" (Bartz, 1994). Resources and materials used to teach about agriculture were described using frequency distributions and percentages.

Major Findings

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

Data in Table 1 summarized grade groupings for AITC treatment and control groups by pretest and posttest mean scores. Data indicated a kindergarten through first grade pretest mean score of 53.64 for the treatment group and 51.36 for the control group with standard deviations of 12.44 and 13.00 respectively. Data also indicated a kindergarten through first grade posttest mean score of 67.31 for the treatment group and 58.26 for the control group with standard deviations of 9.78 and 12.73 respectively. In addition, the differences between kindergarten through first grade posttest and pretest mean scores were 13.67 for the treatment group and 6.90 for the control group.

Data indicated a second through third grade pretest mean score of 73.08 for the treatment group and 74.39 for the control group with standard deviations of 13.25 and 12.84 respectively. Data also indicated a second through third grade posttest mean score of 84.55 for the treatment group and 78.77 for the control group with standard deviations of 15.03 and 15.90 respectively. In addition, the differences between second through third grade posttest and pretest mean scores were 11.47 for the treatment group and 4.38 for the control group.

Data indicated a fourth through fifth grade pretest mean score of 54.84 for the treatment group and 51.50 for the control group with standard deviations of 12.16 and 13.44 respectively. Data also indicated a fourth through fifth grade posttest mean score of 68.00 for the treatment group and 56.86 for the control group with standard deviations of 15.47 and 13.82 respectively. In addition, the differences between fourth through fifth grade posttest and pretest mean scores were 13.16 for the treatment group and 5.36 for the control group.

Data indicated a sixth grade pretest mean score of 48.16 for the treatment group and 47.23 for the control group with standard deviations of 11.47 and 11.74 respectively. Data also indicated a sixth grade posttest mean score of 66.59 for the treatment group and 50.98 for the control group with standard deviations of 21.78 and 11.32 respectively. In addition, the differences between sixth grade posttest and pretest mean scores were 18.43 for the treatment group and 3.75 for the control group.

Table 1

Summary of Grade Groupings for AITC Treatment and Control by Pretest and Posttest Mean Scores

Grade Grouping	Treatment				Control			
	n	*M*	*SD*	Percent Correct	*n*	*M*	*SD*	Percent Correct
K-1								
Pretest	264	53.64	12.44	67.90	246	51.36	13.00	65.01
Posttest	248	67.31	9.78	85.21	178	58.26	12.73	73.75
Difference		13.67				6.90		
2-3								
Pretest	311	73.08	13.25	63.84	290	74.39	12.84	64.68
Posttest	284	84.55	15.03	73.81	226	78.77	15.90	68.49
Difference		11.47				4.38		
4-5								
Pretest	295	54.84	12.16	50.78	321	51.50	13.44	47.19
Posttest	277	68.00	15.47	62.96	283	56.86	13.82	52.65
Difference		13.16				5.36		
6								
Pretest	128	48.16	11.47	47.21	149	47.23	11.74	46.30
Posttest	107	66.59	21.78	65.28	129	50.98	11.32	49.98
Difference		18.43				3.75		

Note: *n* represented number of students tested. Difference was calculated as posttest minus pretest.

In addition, a mean gain score was calculated as the difference between the mean posttest and pretest scores. In order to determine if a difference existed between students' agricultural knowledge by AITC trained teachers and non-AITC trained teachers, an analysis of variance procedure was used. Since the classroom was the experimental unit in this unbalanced design, students' mean pretest scores for each classroom were determined and held constant as a covariate to estimate a difference in mean gain scores. Therefore, data in Table 2 compared the difference of mean gain scores between AITC treatment and control groups for grade groupings (K-1, 2-3, 4-5, 6).

Data for kindergarten through first grade indicated a 7.20 estimated mean difference in gain scores with a 1.68 standard deviation. With an alpha level of .05, data indicated this difference in mean gain scores was statistically significant between the AITC treatment and control groups for kindergarten through first grade, t (20.7) = 4.30, p = .0003. Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group for kindergarten through first grade. In addition, the confidence interval for this estimate ranged from 3.72 to 10.69.

Data for second through third grade indicated a 6.11 estimated mean difference in gain scores with a 2.67 standard deviation. With an alpha level of .05, data indicated this difference in mean gain scores was statistically significant between the AITC treatment and control groups for second through third grade, t (24.9) = 2.29, p = .0307. Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group for second through third grade. In addition, the confidence interval for this estimate ranged from 0.62 to 11.61.

Data for fourth through fifth grade indicated a 9.24 estimated mean difference in gain scores with a 2.89 standard deviation. With an alpha level of .05, data indicated this difference in mean gain scores was statistically significant between the AITC treatment and control groups for fourth through fifth grade, t (24.4) = 3.19, p = .0038. Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group for fourth through fifth grade. In addition, the confidence interval for this estimate ranged from 3.28 to 15.21.

Data for sixth grade indicated a 16.03 estimated mean difference in gain scores with a 6.79 standard deviation. With an alpha level of .05, data indicated this difference in mean gain scores was statistically significant between the AITC treatment and control groups for sixth grade, t (7.45) = 2.36, p = .0483. Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group for sixth grade. In addition, the confidence interval for this estimate ranged from 0.16 to 31.90.

Table 2

Comparison of Mean Gain Scores between AITC Treatment and Control for Grade Grouping K-6

Grade Grouping	Estimate	*SD*	*df*	*t*	*p*	*CI*
K-1						
Difference	7.20	1.68	20.7	4.30*	0.0003	(3.72, 10.69)
2-3						
Difference	6.11	2.67	24.9	2.29*	0.0307	(0.62, 11.61)
4-5						
Difference	9.24	2.89	24.4	3.19*	0.0038	(3.28, 15.21)
6						
Difference	16.03	6.79	7.45	2.36*	0.0483	(0.16, 31.90)

Note: Gain scores were calculated by posttest minus pretest. Mean pretest scores were used as a covariate in a mixed linear model design. Degrees of freedom were Satterthwaite *p < .05, two-tailed. Values enclosed in parentheses represented the lower and upper bound confidence interval.

Objective 2: Compare differences by grade grouping between the AITC treatment group and control group in student knowledge about agriculture, before and after instruction, using the five thematic areas of the FFSL Framework.

The kindergarten through first grade mean posttest scores by treatment and theme indicated the treatment group answered 85.21 percent of the questions correctly and the control group answered 73.75 percent of the questions correctly. The treatment and control groups were most knowledgeable about Theme 5 (Food, Nutrition and Health) followed by Theme 3 (Science, Technology and Environment) and Theme 4 (Business and Economics). The treatment and control groups were least knowledgeable about Theme 2 (History, Geography and Culture) followed by Theme 1 (Understanding Food and Fiber Systems).

Table 3

Summary of K-6 Mean Pretest and Posttest Scores by AITC Treatment and Control for Themes

		Pretest				Posttest		
Group	*n*	*M*	*SD*	Percent Correct	*n*	*M*	*SD*	Percent Correct
K-1 Treatment	264				248			
Theme 1		14.16	4.23	67.41		17.38	3.77	82.76
Theme 2		11.20	5.10	56.02		16.27	4.21	81.37
Theme 3		9.58	2.38	73.72		11.35	1.81	87.28
Theme 4		6.54	1.94	72.69		7.46	1.67	82.93
Theme 5		12.24	3.14	76.47		14.63	2.03	91.46
K-1 Control	246				178			
Theme 1		12.98	4.49	61.79		14.85	3.83	70.71
Theme 2		11.41	5.15	57.03		13.26	5.23	66.32
Theme 3		9.08	2.55	69.82		10.08	2.44	77.53
Theme 4		6.41	1.74	71.27		6.98	1.93	77.53
Theme 5		1149	3.28	71.80		13.10	2.79	81.85
2-3 Treatment	311				284			
Theme 1		21.10	4.95	70.32		25.06	3.75	83.52
Theme 2		9.69	3.33	57.01		12.68	3.54	74.59
Theme 3		15.83	4.27	63.33		18.04	4.22	72.17
Theme 4		12.78	3.75	60.85		14.33	3.91	68.23
Theme 5		13.68	3.78	62.19		14.52	4.45	66.02
2-3 Control	290				226			
Theme 1		21.50	4.90	71.68		23.51	4.06	78.38
Theme 2		9.68	3.01	56.92		10.70	3.14	62.94
Theme 3		16.47	3.56	65.88		17.31	4.07	69.24
Theme 4		12.91	3.25	61.49		13.30	4.35	63.32
Theme 5		13.82	3.02	62.84		13.95	4.78	63.40
4-5 Treatment	295				277			
Theme 1		17.41	4.32	60.02		20.87	4.18	71.97
Theme 2		10.23	4.74	42.64		15.11	5.63	62.97
Theme 3		11.55	4.11	64.18		13.10	4.27	72.80
Theme 4		9.28	3.78	48.85		11.61	4.13	61.12
Theme 5		6.37	4.00	35.37		7.30	4.03	40.53
4-5 Control	321				283			
Theme 1		16.82	4.32	58.01		18.47	4.61	63.69
Theme 2		8.94	4.62	37.27		10.42	5.26	43.43
Theme 3		10.09	4.11	56.04		11.74	4.04	65.21
Theme 4		8.92	3.89	46.96		9.66	3.81	50.86
Theme 5		6.18	4.50	34.35		6.70	4.71	37.24
6 Treatment	128				107			
Theme 1		11.70	3.69	44.98		16.58	7.33	63.77
Theme 2		12.10	4.49	55.01		17.36	6.62	78.93
Theme 3		6.34	4.04	39.60		10.64	4.93	66.47
Theme 4		10.05	3.65	50.23		14.19	4.89	70.93
Theme 5		7.98	3.31	44.31		9.97	3.51	55.40
6 Control	149				129			
Theme 1		11.24	3.47	43.24		11.33	3.24	43.59
Theme 2		11.81	4.90	53.69		12.67	4.55	57.61
Theme 3		6.36	3.73	39.77		7.95	4.21	49.71
Theme 4		9.58	3.96	47.92		10.98	4.10	54.88
Theme 5		8.23	3.49	45.71		8.05	3.43	44.70

The second through third grade mean posttest scores by treatment and theme indicated the treatment group answered 73.81 percent of the questions correctly and the control group answered 68.49 percent of the questions correctly. The treatment group was most knowledgeable about Theme 1 (Understanding Food and Fiber Systems) followed by Theme 2 (History, Geography and Culture) and Theme 3 (Science, Technology and Environment). The treatment group was least knowledgeable about Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics). The control group was most knowledgeable about Theme 1 (Understanding Food and Fiber Systems) followed by Theme 3 (Science, Technology and Environment) and Theme 5 (Food, Nutrition and Health). The control group was least knowledgeable about Theme 2 (History, Geography and Culture) followed by Theme 4 (Business and Economics).

The fourth through fifth grade mean posttest scores by treatment and theme indicated the treatment group answered 62.96 percent of the questions correctly and the control group answered 52.65 percent of the questions correctly. The treatment group was most knowledgeable about Theme 3 (Science, Technology and Environment) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 2 (History, Geography and Culture). The treatment group was least knowledgeable about Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics). The control group was most knowledgeable about Theme 3 (Science, Technology and Environment) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 4 (Business and Economics). The control group was least knowledgeable about Theme 5 (Food, Nutrition and Health) followed by Theme 2 (History, Geography and Culture).

Sixth grade mean posttest scores by treatment and theme indicated the treatment group answered 65.28 percent of the questions correctly and the control group answered 49.98 percent of the questions correctly. The treatment group was most knowledgeable about Theme 2 (History, Geography and Culture) followed by Theme 4 (Business and Economics) and Theme 3 (Science, Technology and Environment). The treatment group was least knowledgeable about Theme 5 (Food, Nutrition and Health) followed by Theme 1 (Understanding Food and Fiber Systems). The control group was most knowledgeable about Theme 2 (History, Geography and Culture) followed by Theme 4 (Business and Economics) and Theme 3 (Science, Technology and Environment). The control group was least knowledgeable about Theme 1 (Understanding Food and Fiber Systems) followed by Theme 5 (Food, Nutrition and Health).

Students' mean and percent correct scores by thematic area of the FFSL Framework allowed the researchers to determine a level of agricultural knowledge demonstrated by students of AITC trained teachers and non-AITC trained teachers. However, this did not allow the researchers to determine students' acquisition of agricultural knowledge. To describe students' acquisition of agricultural knowledge, the difference between the mean posttest and pretest scores was calculated as a gain score, Table 4.

Table 4

Comparison of Mean Gain Scores between AITC Treatment and Control by Themes

Group	*n*	*M*	*SD*
K-1 Treatment/Control	*T, C*	*T, C*	*T, C*
Overall Gain	248, 178	13.72, 8.65	10.59, 10.78
Theme 1 (Understanding Food and Fiber Systems)		3.22, 2.43	4.02, 3.72
Theme 2 (History, Geography and Culture)		5.08, 2.51	4.37, 4.67
Theme 3 (Science, Technology and Environment)		1.74, 1.14	2.12, 2.49
Theme 4 (Business and Economics)		0.92, 0.82	1.80, 1.80
Theme 5 (Food, Nutrition and Health)		2.47, 1.73	2.47, 2.75
2-3 Treatment/Control			
Overall Gain	284, 226	11.16, 4.41	12.39, 13.48
Theme 1 (Understanding Food and Fiber Systems)		3.88, 1.98	3.89, 3.69
Theme 2 (History, Geography and Culture)		3.04, 1.02	3.28, 2.75
Theme 3 (Science, Technology and Environment)		2.08, 0.75	3.41, 3.79
Theme 4 (Business and Economics)		1.51, 0.36	3.68, 4.15
Theme 5 (Food, Nutrition and Health)		0.72, 0.30	3.85, 4.67
4-5 Treatment/Control			
Overall Gain	277, 283	13.08, 5.16	15.75, 11.87
Theme 1 (Understanding Food and Fiber Systems)		3.41, 1.34	4.15, 3.97
Theme 2 (History, Geography and Culture)		4.89, 1.33	6.13, 4.80
Theme 3 (Science, Technology and Environment)		1.52, 1.39	4.24, 4.01
Theme 4 (Business and Economics)		2.32, 0.68	4.20, 3.66
Theme 5 (Food, Nutrition and Health)		0.94, 0.56	4.18, 4.81
6 Treatment/Control			
Overall Gain	107, 129	18.75, 3.65	20.28, 10.99
Theme 1 (Understanding Food and Fiber Systems)		4.86, 0.08	7.72, 3.31
Theme 2 (History, Geography and Culture)		5.29, 0.83	6.66, 4.53
Theme 3 (Science, Technology and Environment)		4.24, 1.59	3.91, 4.12
Theme 4 (Business and Economics)		4.17, 1.36	3.99, 4.00
Theme 5 (Food, Nutrition and Health)		2.00, -0.18	3.84, 3.34

The kindergarten through first grade posttest and pretest mean score differences by treatment and theme indicated increases of 13.72 and 8.65 for the treatment and control groups with standard deviations of 10.59 and 10.78 respectively. The treatment and control groups' largest knowledge increases were in Theme 2 (History, Geography and Culture) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 5 (Food, Nutrition and Health). The treatment and control groups' smallest increases were in Theme 4 (Business and Economics) followed by Theme 3 (Science, Technology and Environment).

The second through third grade posttest and pretest mean score differences by treatment and theme indicated increases of 11.16 and 4.41 for the treatment and control groups with standard

deviations of 12.39 and 13.48 respectively. The treatment and control groups' largest increases were in Theme 1 (Understanding Food and Fiber Systems) followed by Theme 2 (History, Geography and Culture) and Theme 3 (Science, Technology and Environment). The treatment and control groups' smallest increases were in Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics).

The fourth through fifth grade posttest and pretest mean score differences by treatment and theme indicated increases of 13.08 and 5.16 for the treatment and control groups with standard deviations of 15.75 and 11.87 respectively. The treatment group's largest increases were in Theme 2 (History, Geography and Culture) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 4 (Business and Economics). The treatment group's smallest increases were in Theme 5 (Food, Nutrition and Health) followed by Theme 3 (Science, Technology and Environment). The control group's largest increases were in Theme 3 (Science, Technology and Environment) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 2 (History, Geography and Culture). The control group's smallest increases were in Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics).

The sixth grade posttest and pretest mean score differences by treatment and theme indicated increases of 18.75 and 3.65 for the treatment and control groups with standard deviations of 20.28 and 10.99 respectively. The treatment group's largest increases were in Theme 2 (History, Geography and Culture) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 3 (Science, Technology and Environment). The treatment group's smallest increases were in Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics). The control group's largest increases were in Theme 3 (Science, Technology and Environment) followed by Theme 4 (Business and Economics) and Theme 2 (History, Geography and Culture). The control group's smallest gain was in Theme 1 (Understanding Food and Fiber Systems). No gain in knowledge was realized for Theme 5 (Food, Nutrition and Health).

Objective 3: Develop a profile of student knowledge about agriculture, before and after instruction, for each grade grouping.

Students in all the treatment groups had a higher overall gain in agricultural knowledge than did students in all the control groups. Moreover, there was a statistically significant difference between student gain scores in the AITC treatment groups and control groups. However, the areas in which they were most knowledgeable varied with the grade groupings, Table 5.

Table 5

A Profile of Student Knowledge about Agriculture, Before and After Instruction, for Each Grade Grouping by Theme (most knowledgeable to least knowledgeable)

K-1	2-3	4-5	6
T, C (treatment, control)	T, C	T, C	T, C
5, 5	1, 1	3, 3	2, 2
3, 3	2, 3	1, 1	4, 4
4, 4	3, 5	2, 4	3, 3
2, 2	4, 2	5, 5	5, 1
1, 1	5, 4	4, 2	1, 5

Note: Theme 1 (Understanding Food and Fiber Systems); Theme 2 (History, Geography and Culture); Theme 3 (Science, Technology and Environment); Theme 4 (Business and Economics); Theme 5 (Food, Nutrition and Health)

The K-1 treatment and control groups were most knowledgeable about agricultural topics involving Theme 5 (Food Nutrition and Health) followed by Theme 3 (Science, Technology and Environment) and Theme 4 (Business and Economics). The treatment and control groups were least knowledgeable about agricultural topics involving Theme 2 (History, Geography and Culture) followed by Theme 1 (Understanding Food and Fiber Systems). Moreover, there was a statistically significant difference between student gain scores in the AITC treatment group and control group (See Table 2). Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group (see Table 4).

The 2-3 treatment group was most knowledgeable about agricultural topics involving Theme 1 (Understanding Food and Fiber Systems) followed by Theme 2 (History, Geography and Culture) and Theme 3 (Science, Technology and Environment). The treatment group was least knowledgeable about agricultural topics involving Theme 4 (Business and Economics) and Theme 5 (Food, Nutrition and Health). The control group was most knowledgeable about agricultural topics involving Theme 1 (Understanding Food and Fiber Systems) followed by Theme 3 (Science, Technology and Environment) and Theme 5 (Food, Nutrition and Health). The control group was least knowledgeable about agricultural topics involving Theme 2 (History, Geography and Culture) followed by Theme 4 (Business and Economics). Moreover, there was a statistically significant difference between student gain scores in the AITC treatment group and control group (see Table 2). Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group (see Table 4).

The 4-5 treatment group was most knowledgeable about agricultural topics involving Theme 3 (Science, Technology and Environment) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 2 (History, Geography and Culture). The treatment group was least knowledgeable about agricultural topics involving Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics). The control group was most knowledgeable about agricultural topics involving Theme 3 (Science, Technology and Environment) followed by Theme 1 (Understanding Food and Fiber Systems) and Theme 4 (Business and Economics). The control group was least knowledgeable about agricultural topics involving Theme 5 (Food, Nutrition and Health) followed by Theme 2 (History, Geography and Culture). Moreover, there

was a statistically significant difference between student gain scores in the AITC treatment group and control group (see Table 2). Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group (see Table 4).

The grade 6 treatment group was most knowledgeable about agricultural topics involving Theme 2 (History, Geography and Culture) followed by Theme 4 (Business and Economics) and Theme 3 (Science, Technology and Environment). The treatment group was least knowledgeable about agricultural topics involving Theme 5 (Food, Nutrition and Health) followed by Theme 1 (Understanding Food and Fiber Systems). The control group was most knowledgeable about agricultural topics involving Theme 2 (History, Geography and Culture) followed by Theme 4 (Business and Economics) and Theme 3 (Science, Technology and Environment). The control group was least knowledgeable about agricultural topics involving Theme 1 (Understanding Food and Fiber Systems) followed by Theme 5 (Food, Nutrition and Health). Moreover, there was a statistically significant difference between student gain scores in the AITC treatment group and control group (see Table 2). Students in the treatment group had a higher overall gain in agricultural knowledge than did students in the control group (see Table 4).

Objective 4: Develop a profile of AITC teachers that includes education, agricultural experience, knowledge about agriculture, place of residence, amount of agricultural literacy in-service education, instructional practices and materials used, and number of years taught.

Data in Table 6 describes teachers' mean scores of treatment and control groups by theme. Data indicated the treatment group answered 73.68 percent of the questions correctly and the control group answered 65.43 percent of the questions correctly with standard deviations of 11.89 and 16.07 respectively. The treatment and control groups were most knowledgeable about Theme 2 (History, Geography and Culture) followed by Theme 3 (Science, Technology and Environment) and Theme 1 (Understanding Food and Fiber Systems). The treatment group was least knowledgeable about Theme 4 (Business and Economics) followed by Theme 5 (Food, Nutrition and Health). The control group was least knowledgeable about Theme 5 (Food, Nutrition and Health) followed by Theme 4 (Business and Economics).

Table 6

Summary of Teachers' Mean Scores of Treatment and Control Groups by Theme

Training	*n*	*M*	*SD*
Treatment/Control	T/C	T/C	T/C
Total	44, 46	73.68, 65.43	11.89, 16.07
Theme 1 (Understanding Food and Fiber Systems)		72.73, 64.82	16.75, 17.73
Theme 2 (History, Geography and Culture)		84.77, 76.52	15.32, 19.00
Theme 3 (Science, Technology and Environment)		79.55, 66.80	15.08, 22.86
Theme 4 (Business and Economics)		64.29, 59.63	18.10, 18.64
Theme 5 (Food, Nutrition and Health)		64.70, 58.30	16.07, 22.07

Note: Mean scores are reported as percent scores.

Data in Table 7 summarize the magnitude of AITC training on teachers' mean scores by theme. For Theme 1 (Understanding Food and Fiber Systems), a small effect size of 0.45 indicated that

the mean of the treatment group was at the 67.5th percentile of the control group. For Theme 2 (History, Geography and Culture), a small effect size of 0.43 indicated that the mean of the treatment group was at the 66.5th percentile of the control group. For Theme 3 (Science, Technology and Environment), a medium effect size of 0.56 indicated that the mean of the treatment group was at the 71.5th percentile of the control group. For Theme 4 (Business and Economics), a small effect size of 0.25 indicated that the mean of the treatment group was at the 60th percentile of the control group. For Theme 5 (Food, Nutrition and Health), a small effect size of 0.29 indicated that the mean of the treatment group was at the 61.5th percentile of the control group. For the aggregate agricultural knowledge score, a medium effect size of 0.51 indicated that the mean of the treatment group was at the 69.5th percentile of the control group.

Table 7

Summary of the Magnitude of the Treatment on Teachers' Mean Scores by Theme

	Treatment			Effect	Percentile
Theme	M_T	M_C	SD_C	Size	Standing
Theme 1 (Understanding Food and Fiber Systems)	72.73	64.82	17.73	0.45	67.5
Theme 2 (History, Geography and Culture)	84.77	76.52	19.00	0.43	66.5
Theme 3 (Science, Technology and Environment)	79.55	66.80	22.86	0.56	71.5
Theme 4 (Business and Economics)	64.29	59.63	18.64	0.25	60.0
Theme 5 (Food, Nutrition and Health)	64.70	58.30	22.07	0.29	61.5
Overall Average	73.68	65.43	16.07	0.51	69.5

Note: Means are reported as percent scores.

Data in Table 8 describes the standard error of measurement of teacher agricultural knowledge and the resulting interval estimate. For Theme 1 (Understanding Food and Fiber Systems), the proportion of 11 questions answered correctly was 68.69 percent. An estimate of the error that may be involved with this theme was 0.15. Therefore, it was estimated that teachers could correctly answer between 53.69 to 83.69 percent of the items in Theme 1 correctly. For Theme 2 (History, Geography and Culture), the proportion of 10 questions answered correctly was 80.56 percent. An estimate of the error that may be involved with this theme was 0.13. Therefore, it was estimated that teachers could correctly answer between 67.56 to 93.56 percent of the items in Theme 2 correctly. For Theme 3 (Science, Technology and Environment), the proportion of 11 questions answered correctly was 73.03 percent. An estimate of the error that may be involved with this theme was 0.14. Therefore, it was estimated that teachers could correctly answer between 59.03 to 87.03 percent of the items in Theme 3 correctly. For Theme 4 (Business and Economics), the proportion of seven questions answered correctly was 61.9 percent. An estimate of the error that may be involved with this theme was 0.2. Therefore, it was estimated that teachers could correctly answer between 41.9 to 81.9 percent of the items in Theme 4 correctly. For Theme 5 (Food, Nutrition and Health), the proportion of 11 questions

answered correctly was 61.41 percent. An estimate of the error that may be involved with this theme was 0.15. Therefore, it was estimated that teachers could correctly answer between 46.41 to 76.41 percent of the items in Theme 5 correctly. The overall proportion of 50 questions answered correctly was 69.47 percent. An estimate of the error that may be involved with this score was 0.07. Therefore, it was estimated that teachers could correctly answer between 62.47 to 76.47 percent of all items correctly.

Table 8

Distribution of Teacher Agricultural Knowledge Scores by Standard Error of Measurement and Interval Estimate

Theme	Percent Correctly Answered	Number of Test Items	*SEM*	Interval Estimate
Theme 1	68.69	11	0.15	53.69-83.69
Theme 2	80.56	10	0.13	67.56-93.56
Theme 3	73.03	11	0.14	59.03-87.03
Theme 4	61.90	7	0.20	41.90-81.90
Theme 5	61.41	10	0.15	46.41-76.41
Overall Average Score	69.47	50	0.07	62.47-76.47

Data in Table 9 summarizes teacher demographics of the treatment and control groups. Predominately, teachers of the treatment and control group were Caucasian females with no agricultural background or experience. Treatment and control teachers graduated with an elementary education major, held an elementary teacher certification, and had at least one agriculture course in college. In addition, both treatment and control teachers were experienced teachers who most frequently worked in either small rural or urban schools.

Table 9

Summary of Teacher Demographics of Treatment and Control Groups

Demographic	Treatment	*P*	Control	*P*
Gender	Female	88.4	Female	88.6
Ethnicity	Caucasian	97.4	Caucasian	100.0
Grew Up on a Farm	No	86.0	No	79.5
4-H Member	No	62.8	No	77.3
FFA Member	No	100.0	No	100.0
Ag Courses Taken in H.S.	No	100.0	No	97.7
Level of Education	Bachelor's	69.8	Bachelor's	70.5
Undergraduate Major	Elem. Ed.	50.0	Elem. Ed.	52.4
Teaching Certification	Elementary	68.9	Elementary	69.5
Ag Course Taken in College	1-3 Hours	87.1	1-3 Hours	92.9
Residence	Suburban	64.3	Urban	36.4
Work Experience in Ag	No	69.8	No	68.2
Teaching Experience	19-24	26.2	13-18	27.3
Type of School	Rural	40.0	Urban	26.8
Size of School	201-500	48.6	201-500	58.6

Note: *P* represents percent.

Data in Table 10 describes the frequency and proportion of treatment teachers by the type of resources they used to teach about agriculture. Data indicated treatment teachers used the following: 33 (22.8%) used books; four (2.8%) used CD ROM; 31 (21.4%) used activities; 16 (11%) used agricultural professionals; 27 (18.6%) used videos; two (1.4%) used newsletters; one (0.6%) used a commodity group information sheet; five (3.4%) used state agricultural facts sheets; 20 (13.8%) used lesson plans; and six (4.1%) used other resources. These other resources were from Food, Land and People (FLP), Agriculture in the Classroom (AITC), agricultural field trips, projects and the National FFA Organization.

Table 10

Distribution of Treatment Teachers by Types of Resources Used To Teach Agriculture, Including Non-Web and Web Resources

Type of Resource Used to Teach Agriculture	Treatment Teachers *f* (*P*)
Non-Web	
Books	33 (22.8)
Activities	31 (21.4)
Video	27 (18.6)
Lesson Plans	20 (13.8)
Ag Professionals	16 (11.0)
Other	6 (4.1)
State Ag Fact Sheets	5 (3.4)
CD ROM	4 (2.8)
Newsletter	2 (1.4)
Commodity Group Info Sheets	1 (0.6)
Web	
State AITC	3 (42.9)
National AITC	2 (28.6)
Ag Comm Sites	1 (14.3)
Other	1 (14.3)
On-line Library	--

Note: Teachers listed all that applied.

In addition the data in Table 10 describes the frequency and proportion of treatment teachers by web resources they used to teach about agriculture. One teacher used a plant science Web site about seeds.

Data in Table 11 describes treatment teachers' responses to how they and their students benefited from integrating agriculture into core academic subjects (e.g., math, history, & language arts). Teachers indicated an increased awareness of agriculture and an ease of teaching. Teachers also indicated they were able to teach science-related activities, increase their knowledge of history, and use real-life examples, which allowed students to make better-informed decisions.

Table 11

Distribution of Treatment Teachers' Responses to How They and Their Students Benefited from Integrating Agriculture into Core Academic Subjects

Benefits	Teacher Response (*f*)
Teacher	
Knowledge of history, Teach science related activities	3
Teaching becomes easier, Increased awareness	4
Real-life examples to use	2
Students will make better future decisions, Allows more material to be covered	1
Student	
Awareness of product origins	13
Real-life examples	5
Learn more about history	3
More subject area emphasis, Hands-on activities	1

Data in Table 11 also describes treatment teachers' responses to how their students benefited from the integration of agriculture into core academic subjects. They indicated students became more aware about the origins of agricultural products and about history through real-life examples and hands-on activities.

Data in Table 12 described treatment teachers' responses to what outdoor student-learning activities they used to teach about food, agriculture, and the environment. Teachers overwhelmingly reported that they used school gardens and recycling projects (e.g., newspaper & aluminum). Teachers also reported they planted trees, went on field trips, used environment and weather, plant and animal activities, and participated in Ag Week and Earth Day activities.

Table 12

Distribution of Teacher Responses to Types of Outdoor Student Learning Activities They Used to Teach about Food, Agriculture and the Environment

Outdoor Student Learning Activities	Teacher Responses (*f*)
Recycling (newspaper & aluminum)	15
Gardens	12
Planting seeds	7
Field trips, Planting trees	5
Environmental Activities	2
Weather Activities, Participated in Ag Week, Participated in Earth Day, Animal Activities, Hands-on Activities	1

Profile of Teachers

Teachers in the treatment and control groups were most knowledgeable about agricultural topics involving Theme 2 (History, Geography and Culture) followed by Theme 3 (Science, Technology and Environment) and Theme 1 (Understanding Food and Fiber Systems). The treatment and control groups were least knowledgeable about Theme 4 (Business and Economics) and Theme 5 (Food, Nutrition and Health). Predominately, teachers of the treatment and control groups were Caucasian females with no agricultural background or work experience in the agricultural sector. Treatment and control teachers took at least one agricultural course during college and held a bachelor's degree in elementary education and an elementary teaching certificate. In addition, both treatment and control groups were experienced classroom teachers. These treatment teachers mainly used books, activities, and videos as resources for teaching about agriculture and participated in school gardens and recycling projects as outdoor activities to teach about agriculture.

Objective 5: Determine if a relationship existed between student knowledge about agriculture (based on the FFSL Framework) and variables, such as instructional practices and materials used in the classroom, place of residences, amount and kind of in-service education and teacher knowledge about agriculture.

Data in Table 13 describes the relationship of agricultural knowledge between mean scores of teachers and mean gain scores of students by AITC treatment group for grade groupings K-1, 2-3, 4-5, 6. A moderately negative correlation (-0.44) of agricultural knowledge was present between mean scores of teachers and mean gain scores of students by AITC treatment group in grades kindergarten through first. A very low positive correlation (0.14) of agricultural knowledge was present between mean scores of teachers and student gain scores by AITC treatment group in grades second through third. No correlation (0.02) was present between mean scores of teachers and student gain scores by AITC treatment group in grades fourth through fifth. A very low positive correlation (0.19) of agricultural knowledge was present between mean scores of teachers and student gain scores by AITC treatment group in grade six.

Table 13

Pearson's Product Moment Correlations Between Agricultural Knowledge Mean Scores of Teachers and Agricultural Knowledge Mean Gain Scores of Students by AITC Treatment Groups for Grade Groupings K-6

Grade Grouping	*n*	*M*	*SD*	*r*	**p*	Relationship
K-1						
Teacher	11	37.27	6.51	-0.44	0.1808	Moderate
Student Gain	14	13.68	6.77			
2-3						
Teacher	13	36.00	5.55	*0.14*	0.6596	Very Low
Student Gain	17	10.97	8.92			
4-5						
Teacher	14	36.14	7.04	*0.02*	0.9403	Very Low
Student Gain	15	13.35	11.91			
6						
Teacher	6	39.50	2.07	*0.19*	0.7128	Very Low
Student Gain	6	19.53	19.90			

Note: *n* represents the number of classrooms per group. Mean scores of teachers represents mean raw scores. Student gain scores were calculated as posttest scores minus pretest scores.
*$p < .05$.

Conclusions

The conclusions are not to be generalized beyond the population within this research study. Examination and analysis of the major findings for each objective led to the following conclusions:

1. All students possessed some knowledge about agriculture prior to receiving classroom instruction from an Agriculture in the Classroom (AITC) trained teacher.

2. AITC training of teachers made a positive difference in student acquisition of knowledge about agriculture.

3. Students taught by AITC trained teachers gained more knowledge about agriculture than students taught by untrained teachers.

4. Students who were taught by AITC trained teachers were most knowledgeable about agriculture in the following thematic areas of the Food and Fiber Systems Literacy (FFSL) Framework:

K-1 Theme 5 - Food, Nutrition and Health
2-3 Theme 1 - Understanding Food and Fiber Systems
4-5 Theme 3 - Science, Technology and Environment
6 Theme 2 - History, Geography and Culture

5. Students who were taught by AITC trained teachers were least knowledgeable about agriculture in the following thematic areas of the FFSL Framework: grades K-1—Theme 2 - History, Geography and Culture, and grades 2-3, 4-5, and 6—Theme 5 - Food, Nutrition and Health

6. Students who were taught by AITC trained teachers gained more knowledge in the following two thematic areas of the FFSL Framework:

   Theme 1 - Understanding Food and Fiber Systems
   Theme 2 - History, Geography and Culture

7. Students who were taught by AITC trained teachers gained the least knowledge in the following three thematic areas of the FFSL Framework:

   Theme 3 - Science, Technology and Environment
   Theme 4 - Business and Economics
   Theme 5 - Food, Nutrition and Health

8. Teachers with AITC training had more knowledge about agriculture than did teachers without AITC training. However, all teachers were most knowledgeable in the following thematic areas of the FFSL Framework:

   Theme 1 - Understanding Food and Fiber Systems
   Theme 2 - History, Geography and Culture
   Theme 3 - Science, Technology and Environment

9. All teachers were least knowledgeable in the following thematic areas of the FFSL Framework:

   Theme 4 - Business and Economics
   Theme 5 - Food, Nutrition and Health

10. The typical elementary teacher who participated in the study can be described as a Caucasian female who did not grow up on a farm or participate in a 4-H youth program, FFA, or high school agricultural education, took at least one agriculture course in college and had no work experience in agriculture. The teacher typically had a bachelor's degree in elementary education with elementary teaching certification. Furthermore, it was concluded that the typical teacher had approximately 15 years of teaching experience.

11. AITC trained teachers integrated agriculture into their curriculums by using books, student activities and videos as resources for teaching about agriculture. Outdoor activities cited most frequently by AITC trained teachers were school gardens and recycling projects.

Implications and Recommendations

Many of the findings and conclusions of this study have implications for recommendations that state AITC program coordinators should consider. In addition, these recommendations may provide national AITC program leaders with ideas for future consideration.

Agriculture in the Classroom across the United States has focused the majority of teacher training and instructional material development on students in lower elementary grades. Long term efforts by states to develop instructional materials and infuse agriculture into the elementary curriculum appeared to have had a positive impact because students in AITC teacher trained classrooms attained higher levels of knowledge about agriculture compared to students in classrooms where teachers received no training. It is recommended that AITC state and national program leaders develop strategies for conducting more teacher in-service and instructional materials for infusing agriculture into upper level elementary grades to enhance achievement about agriculture.

Ag in the Classroom does not have a unified national curriculum framework or standards to guide the teaching of agriculture in schools. The Food and Fiber Systems Literacy Curriculum Framework was used as a basis in this study to assess student knowledge. This study revealed that students in grades K-6 are learning about agriculture even though no national curriculum standards have been developed. Therefore, this study may suggest that a national curriculum is not needed. However, results of this study may also imply that states do agree more then disagree on the core knowledge about agriculture that should be included in the curriculum. If this is true, a national curriculum containing standards and grade level benchmarks could find acceptance among the states. Some of the benefits that would evolve from adopting a national curriculum framework would include improved communications to education leaders, students, parents and the public about what Ag in the Classroom is teaching and the progress that students are making in becoming agriculturally literate. Also, a unified agricultural literacy curriculum framework would be helpful in unifying preservice teacher preparation and providing overall direction for teacher in-service about agriculture. In addition, the future development of instructional materials for students and teachers across states would reduce duplication and increase sharing and use.

Continuous evaluation of the contributions AITC programs make to student learning in agriculture and basic core academic areas needs to be encouraged. This study provided a first step in understanding how AITC is impacting student acquisition of knowledge about agriculture in selected classrooms in four states. Additional studies are needed by state AITC programs to provide information that can provide a basis for determining future direction for teaching and learning about agriculture and instructional material development for teachers and students. It is recommended that under the leadership of the National AITC Program Office, states be

encouraged to collaborate on evaluation projects and data gathering that will be meaningful to state and national decision makers.

It was observed that AITC state programs use a wide-range of approaches and practices to educate teachers and students about agriculture. Further research is needed to identify "best practices" leading to improved teaching and learning about agriculture and academic core areas for students and teachers.

Agriculture today is integrated into a social and economic system that is far more specialized, complex and interdependent than ever before. The well-known gap between producers and consumers is one result, but it is only part of the larger problem of agricultural literacy.

Today's role for education about food, agriculture and the environment is to make possible not only better public understanding of agriculture, but better public policies; to educate not only technologists for the food system, but professionals serving both agriculture and the public interest.

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Appendix

Summary Data for the States of Arizona, Montana, Oklahoma, and Utah

Table 14

Summary of Arizona K-6 Mean Pretest and Posttest Overall and Theme Scores by AITC Treatment and Control Groups

	Pretest				Posttest			
Group	*n*	*M*	*SD*	Percent Correct	*n*	*M*	*SD*	Percent Correct
K-1 Treatment								
Total	64	53.05	11.85	67.15	57	63.37	11.34	80.21
Theme 1		14.13	3.99	67.26		15.88	4.01	75.61
Theme 2		11.22	4.96	56.09		15.16	4.50	75.79
Theme 3		8.77	2.16	67.43		11.02	1.94	84.75
Theme 4		6.70	1.53	74.48		7.58	1.59	84.21
Theme 5		12.23	2.83	76.46		13.74	2.13	85.86
K-1 Control								
Total	78	41.81	10.81	52.92	68	49.38	13.84	62.51
Theme 1		10.56	4.47	50.31		12.53	3.87	59.66
Theme 2		7.79	3.93	38.97		10.56	5.87	52.79
Theme 3		7.49	2.75	57.59		8.99	2.77	69.12
Theme 4		5.72	1.86	63.53		6.00	2.16	66.67
Theme 5		10.24	3.20	64.02		11.31	3.16	70.68
2-3 Treatment								
Total	111	65.60	11.39	57.86	92	71.57	13.47	63.11
Theme 1		19.00	4.95	63.33		22.91	4.36	76.38
Theme 2		9.51	3.97	55.96		12.14	4.39	71.42
Theme 3		14.03	4.38	56.11		14.32	3.96	57.26
Theme 4		11.47	4.04	54.61		11.58	4.06	68.17
Theme 5		11.59	3.58	52.70		10.87	4.45	49.41
2-3 Control								
Total	85	67.78	11.92	58.94	69	64.20	15.09	55.83
Theme 1		18.78	4.88	62.59		20.23	4.51	67.44
Theme 2		8.76	2.78	51.56		8.77	2.75	51.58
Theme 3		14.99	3.41	59.95		15.30	4.40	61.22
Theme 4		12.29	3.06	58.54		9.68	3.47	46.10
Theme 5		12.95	2.73	58.88		10.22	4.88	46.44
4-5 Treatment								
Total	71	53.94	11.43	49.95	64	59.98	13.55	58.89
Theme 1		16.39	4.23	56.53		18.59	4.17	64.55

Theme 2		11.27	4.67	46.95		12.78	5.30	62.00
Theme 3		10.79	4.21	59.94		11.50	4.29	64.67
Theme 4		8.76	3.37	46.11		9.95	3.57	54.53
Theme 5		6.73	3.80	37.40		7.16	4.08	44.44
4-5 Control								
Total	89	43.12	12.55	39.93	69	49.04	10.40	45.41
Theme 1		14.46	4.23	49.86		15.36	3.83	52.97
Theme 2		6.63	4.26	27.62		8.45	4.94	35.21
Theme 3		9.27	4.03	51.50		10.62	3.77	59.02
Theme 4		7.71	3.74	40.57		8.01	3.28	42.18
Theme 5		5.06	4.40	28.09		6.59	4.56	36.63
6 Treatment								
Total	24	43.29	10.67	42.44	24	49.38	9.63	48.41
Theme 1		12.21	3.37	46.96		10.83	3.13	41.67
Theme 2		10.83	5.46	45.45		23.46	5.18	55.11
Theme 3		4.38	2.45	25.00		6.25	3.38	39.06
Theme 4		7.75	2.49	35.00		10.00	3.99	50.00
Theme 5		8.13	3.92	44.44		8.42	3.49	46.76
6 Control								
Total	47	42.13	12.26	41.30	38	45.66	10.31	53.26
Theme 1		11.51	3.65	44.27		11.39	3.17	43.67
Theme 2		10.09	5.06	45.84		12.50	3.62	61.00
Theme 3		4.74	3.31	29.65		6.21	3.79	56.85
Theme 4		8.36	4.21	41.81		8.82	4.15	57.26
Theme 5		7.43	3.14	41.25		6.74	2.85	50.00

Table 15

Summary of Montana K-6 Mean Pretest and Posttest Overall and Theme Scores by AITC Treatment and Control Groups

		Pretest				Posttest		
Group	*n*	*M*	*SD*	Percent Correct	*n*	*M*	*SD*	Percent Correct
K-1 Treatment								
Total	69	51.52	13.78	65.22	70	71.41	9.22	90.40
Theme 1		14.06	4.81	66.94		19.51	2.63	92.93
Theme 2		10.91	5.16	54.57		17.60	3.82	88.00
Theme 3		9.67	2.70	74.36		11.07	1.96	85.16
Theme 4		6.42	2.56	71.34		7.76	1.81	86.19
Theme 5		10.74	4.11	67.12		14.7	1.88	91.88

K-1 Control								
Total	58	58.60	10.10	74.18	58	64.38	8.56	81.49
Theme 1		15.21	3.10	72.41		16.22	3.27	77.26
Theme 2		13.14	4.80	65.69		15.14	4.14	75.69
Theme 3		10.26	2.02	78.91		11.34	1.68	87.27
Theme 4		6.52	1.64	72.41		7.67	1.51	85.25
Theme 5		13.48	1.99	84.27		14.00	1.77	87.50
2-3 Treatment								
Total	65	81.73	9.51	71.07	68	99.63	7.98	86.64
Theme 1		22.73	3.89	75.76		27.35	2.11	91.18
Theme 2		10.42	2.75	61.32		15.24	2.53	89.62
Theme 3		18.14	3.06	72.55		21.62	2.09	86.47
Theme 4		14.85	2.59	70.71		17.93	1.62	85.36
Theme 5		15.59	2.65	70.87		17.50	2.27	79.55
2-3 Control								
Total	63	80.65	11.13	70.13	66	85.17	10.25	74.06
Theme 1		23.22	3.99	77.41		24.51	2.86	81.72
Theme 2		10.68	3.23	62.84		12.18	3.03	71.66
Theme 3		17.56	3.31	70.22		18.53	3.40	74.12
Theme 4		14.60	2.90	69.54		15.17	4.01	72.22
Theme 5		14.59	2.25	66.31		14.77	3.55	67.15
4-5 Treatment								
Total	51	59.59	11.42	55.17	51	82.11	11.18	76.03
Theme 1		19.90	4.15	68.63		23.70	2.82	81.74
Theme 2		10.10	4.03	42.08		18.35	5.40	76.47
Theme 3		12.33	3.34	68.52		16.20	2.84	89.98
Theme 4		10.75	4.44	56.55		15.45	3.72	81.32
Theme 5		6.51	3.81	36.17		8.41	3.25	46.73
4-5 Control								
Total	65	56.78	10.29	52.58	62	59.85	13.35	55.42
Theme 1		19.55	3.60	67.43		19.58	4.00	67.52
Theme 2		9.97	4.39	41.54		11.52	4.91	47.98
Theme 3		11.51	4.60	63.93		11.95	4.01	66.40
Theme 4		9.51	3.75	50.04		10.00	3.21	52.63
Theme 5		6.25	4.01	34.70		6.81	4.74	37.81
6 Treatment								
Total	36	52.17	9.39	51.14	34	95.24	2.62	93.37
Theme 1		11.31	3.62	43.48		25.71	0.87	98.87
Theme 2		13.39	4.47	60.86		21.79	0.77	99.06
Theme 3		8.50	3.97	53.13		15.79	0.73	98.71
Theme 4		11.86	3.67	59.31		19.38	1.04	96.91

Theme 5		7.11	3.06	39.51		12.56	1.76	66.67
6 Control								
Total	36	49.72	11.44	48.75	31	54.32	9.66	53.26
Theme 1		9.97	3.12	38.35		11.35	2.58	43.67
Theme 2		12.94	4.91	58.84		13.42	4.13	61.00
Theme 3		8.03	3.49	50.17		9.10	3.98	56.85
Theme 4		10.08	3.86	50.42		11.45	3.24	57.26
Theme 5		8.69	3.38	48.30		9.00	4.11	50.00

Table 16

Summary of Oklahoma K-6 Mean Pretest and Posttest Overall and Theme Scores by AITC Treatment and Control Groups

	Pretest				Posttest			
Group	*n*	*M*	*SD*	Percent Correct	*n*	*M*	*SD*	Percent Correct
K-1 Treatment								
Total	67	56.66	10.86	71.72	62	68.43	6.86	86.63
Theme 1		14.82	4.09	70.58		17.40	3.20	82.87
Theme 2		12.25	5.11	61.27		16.79	3.70	83.95
Theme 3		9.87	2.34	75.89		11.76	1.39	90.45
Theme 4		6.27	1.37	69.65		6.77	1.73	75.27
Theme 5		13.45	1.81	84.05		15.71	1.69	98.19
K-1 Control								
Total	69	50.30	10.18	63.68	52	63.06	7.63	79.82
Theme 1		12.03	3.68	57.28		16.35	2.79	77.84
Theme 2		11.94	4.14	59.71		14.71	3.83	73.56
Theme 3		9.43	2.07	72.58		10.10	2.01	77.66
Theme 4		6.38	1.32	70.85		7.48	1.49	83.12
Theme 5		10.52	3.27	65.76		14.42	1.83	90.14
2-3 Treatment								
Total	62	75.48	12.75	65.64	59	83.97	9.84	73.01
Theme 1		21.85	4.96	72.85		24.81	2.93	82.71
Theme 2		9.50	3.06	55.88		11.39	2.43	67.00
Theme 3		16.98	3.98	67.94		18.85	2.86	75.39
Theme 4		12.87	3.56	61.29		14.03	3.07	66.83
Theme 5		14.27	4.14	64.88		14.88	3.75	67.64
2-3 Control								
Total	83	76.65	12.84	66.65	61	88.57	7.82	77.02
Theme 1		23.11	4.88	77.03		25.74	2.24	58.79
Theme 2		10.07	2.94	59.25		11.69	2.42	68.76
Theme 3		16.94	3.27	67.76		18.79	2.38	75.15

Theme 4		12.58	3.46	59.90		15.34	2.74	73.07
Theme 5		13.95	3.64	63.42		17.02	3.29	77.35
4-5 Treatment								
Total	75	54.53	13.15	50.49	67	59.07	13.55	54.70
Theme 1		16.55	4.21	57.06		18.84	3.84	64.95
Theme 2		10.60	4.81	44.17		12.22	4.55	50.93
Theme 3		11.29	4.40	62.74		11.18	4.21	62.11
Theme 4		9.88	3.70	52.00		9.79	4.11	51.53
Theme 5		6.21	4.66	34.52		7.04	4.24	39.14
4-5 Control								
Total	85	58.61	12.64	54.27	74	63.18	15.10	58.50
Theme 1		18.80	3.61	64.83		20.78	4.69	71.67
Theme 2		11.52	4.61	47.99		12.55	5.37	52.31
Theme 3		10.44	4.02	57.97		12.30	4.45	68.32
Theme 4		10.68	3.86	56.22		11.22	3.95	59.03
Theme 5		7.18	4.22	39.87		6.86	4.61	38.14
6 Treatment								
Total	49	48.43	12.23	47.48	33	51.15	9.11	50.15
Theme 1		12.04	3.98	46.31		10.58	3.81	40.68
Theme 2		11.80	4.25	53.62		10.21	3.57	46.42
Theme 3		6.27	4.31	39.16		8.72	3.82	54.55
Theme 4		10.08	3.40	50.41		12.67	3.86	63.33
Theme 5		8.24	3.35	45.80		8.97	3.28	49.83
6 Control								
Total	40	49.23	10.97	48.26	37	52.51	12.54	51.48
Theme 1		11.53	3.61	44.33		11.32	3.88	43.56
Theme 2		12.48	4.21	56.70		12.08	5.77	54.91
Theme 3		6.10	3.89	38.13		7.41	4.13	46.28
Theme 4		10.55	3.67	52.75		12.35	4.15	61.76
Theme 5		8.58	3.71	47.64		9.35	3.06	51.95

Table 17

Summary of Utah K-6 Mean Pretest and Posttest Overall and Theme Scores by AITC Treatment and Control Groups (Note: Hyphens represent missing data.)

	Pretest				Posttest			
Group	*n*	*M*	*SD*	Percent Correct	*n*	*M*	*SD*	Percent Correct
K-1 Treatment								
Total	64	53.36	12.72	67.54	59	65.08	9.52	82.39
Theme 1		13.59	3.96	64.73		1.27	4.13	77.48

Theme 2		10.41	5.08	52.03		15.24	4.40	76.19
Theme 3		10.02	2.08	77.04		11.56	1.83	88.92
Theme 4		6.80	2.03	75.52		7.73	1.28	85.88
Theme 5		12.59	2.71	78.67		14.29	1.94	89.30
K-1 Control								
Total	41	61.07	11.66	77.31	--	--	--	--
Theme 1		16.00	4.35	76.19		--	--	--
Theme 2		14.93	5.28	74.63		--	--	--
Theme 3		9.83	2.10	75.61		--	--	--
Theme 4		7.66	1.57	85.09		--	--	--
Theme 5		12.66	3.25	79.12		--	--	--
2-3 Treatment								
Total	72	74.61	13.37	64.88	65	87.68	9.62	76.24
Theme 1		22.18	4.62	73.94		25.91	3.13	86.36
Theme 2		9.46	2.90	55.64		11.94	2.53	70.23
Theme 3		15.51	4.05	62.06		18.85	3.12	75.38
Theme 4		12.82	3.55	61.04		14.72	2.86	70.11
Theme 5		14.64	3.16	66.55		16.26	3.07	73.92
2-3 Control								
Total	59	74.03	11.67	64.38	30	78.23	16.28	68.03
Theme 1		21.34	4.07	714.13		24.33	3.51	81.11
Theme 2		9.36	2.84	55.03		9.87	3.05	58.04
Theme 3		16.78	3.81	67.12		16.23	5.19	64.93
Theme 4		12.47	3.03	59.40		13.33	4.40	63.49
Theme 5		14.08	2.93	64.02		14.47	3.96	65.76
4-5 Treatment								
Total	98	53.26	11.82	49.31	95	72.11	12.58	66.76
Theme 1		17.50	4.09	60.34		22.32	3.48	76.95
Theme 2		9.28	4.95	38.65		16.98	5.05	70.75
Theme 3		11.90	4.12	66.10		13.88	3.76	77.13
Theme 4		8.44	3.50	44.41		11.96	3.13	62.94
Theme 5		6.14	3.71	34.13		6.97	4.18	38.71
4-5 Control								
Total	82	49.05	11.59	45.42	78	55.40	11.99	51.29
Theme 1		16.04	4.07	55.30		18.14	4.03	62.56
Theme 2		8.56	4.04	35.67		9.28	4.81	38.68
Theme 3		10.27	3.94	57.05		12.03	3.78	66.81
Theme 4		8.16	3.29	42.94		9.38	3.96	49.39
Theme 5		6.02	4.91	33.47		6.56	4.97	36.47
6 Treatment								

Total	19	46.00	12.00	45.10	16	63.38	12.24	62.13
Theme 1		10.89	3.51	41.90		18.19	2.81	69.95
Theme 2		12.05	3.37	54.78		13.56	2.80	61.65
Theme 3		4.89	3.26	30.59		10.19	4.78	63.67
Theme 4		9.42	3.88	47.11		12.56	3.63	62.81
Theme 5		8.74	2.66	48.54		8.88	4.00	49.31
6 Control								
Total	26	49.92	9.30	48.94	37	52.51	12.54	51.79
Theme 1		12.08	2.65	46.45		11.32	3.88	43.14
Theme 2		12.35	4.93	56.12		12.08	5.77	58.70
Theme 3		7.38	3.36	46.15		7.41	4.13	63.59
Theme 4		9.62	3.77	48.08		12.35	4.15	58.48
Theme 5		8.50	3.88	47.22		9.35	3.06	37.92