Interactive Agricultural Experiences of 4\textsuperscript{TH} Grade Students in the Arid Southwest: An Examination of the Impact of Hands-on Learning Experiences as a Component of Agriculture in the Classroom Curriculum

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Interactive Agricultural Experiences of 4TH Grade Students in the Arid Southwest: A Pilot Examination of the Impact of Hands-on Learning Experiences as a Component of Agriculture in the Classroom Curriculum

Abstract

There exists a general belief among K-16 educators as well as scientists that people must be scientifically and agriculturally literate in order to make wise and informed economic and political decisions about the use of renewable resources (Cardwell, 1994). Each State approaches Agriculture in the Classroom from the basis of its own needs and resources and is responsible for organization, funding, public outreach, materials development and teacher training (Traxler, 1990). The introduction of score-based funding as well as statewide implementation of standardized testing coupled with the ever-increasing importance of agricultural knowledge of the general population in areas with resource management issues has made the issue of agricultural education in arid regions very important. The purpose of this study was to assess the impact of various types of Agriculture in the Classroom curricula and instruction on the agricultural arid lands literacy of 4th grade students. A pre-test/post-test was administered to 21 classrooms in a Public School District in order to compare the agricultural literacy scores of students who participated in three agriculture in the classroom treatments. All treatment groups scored significantly higher than the control group and there were no statistically significant differences between the results of three levels of treatment.
Agriculture in America is a broad-based dynamic industry, employing people in virtually every community in the nation. Playing a vital role in the history of the nation and the food and fiber system, agriculture continues to play a vital role in our nation’s economy and national security. Vital to the continued success of this industry, and the nation as a whole, is a well-informed literate society with regard to knowledge about agriculture. The ability to produce food and materials for human usage is a system that the average American generally takes for granted. This attitude has proliferated through the years and when combined with the shift from rural communities to more urbanized areas, the real success story of American agriculture has been lost (Pope, 1990). As special interest groups revolving around issues such as animal rights, pesticide usage, soil and water conservation, and other environmental concerns gain more media and public attention, it becomes even more important that the general public have some background and understanding of not only what agriculture is all about, but how it affects each person’s life on a daily basis (Law, 1990). A basic agricultural understanding is needed by those members of the community who are involved in agricultural policy decision making. The current pool of agriculturally literate policy decision-makers is dwindling at an alarming rate (Law, 1990).

According to the National Research Council (1988), approximately two percent of the national population lives on a farm. Since then, this number has continued to decline closer to one percent as more land is taken out of production due to regulation and urban growth. Contrasting this low percentage with 30% in 1920 and 15% in 1950, this means that most of today’s elementary school children are at least two generations away from first-hand knowledge of agriculture (American Farm Bureau Federation, 2002). The future of agriculture rests in the hands of the ninety-eight percent of the United States population who are removed from the farm because agricultural policy decisions are made by those who represent everyone, the vast majority of whom are not agricultural producers. As fewer people are directly involved in production agriculture, public support of the industry becomes even more important. Those without a basic understanding of agriculture react without knowledge, oftentimes participating in resource allocation and purchasing decision adverse to agriculture. The resulting damage to the industry in irreparable (Tisdale, 1991). Many of the issues and problems facing agriculture today are important to more than those persons who are employed by the industry. Food safety, soil conservation, and animal welfare are examples of issues, which directly affect agriculture but are of serious concern to a broader range of citizens (Birkenholz, 1990).

In 1981 the USDA established Agriculture in the Classroom programs, which has been endorsed by all living former Secretaries of Agriculture, the National Association of State Departments of Agriculture, the National Conference of States Legislatures, most of the Governors of the States, and the major agricultural organizations and commodity groups. Significant progress has been made through these partnerships of agriculture, business, education, government and dedicated volunteers in order to create curriculum that may be infused into local school districts. This collaboration is evidenced through programs that have risen around the country, providing students with hands-on learning experiences created collaboratively between trade groups and school districts.
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, 1988). Agricultural literacy was defined by the National Research Council as the goal of education about agriculture. It has been noted that an agriculturally literate population aids in ensuring that citizens make intelligent and informed decisions concerning agricultural policies that benefit society (Ryan & Lockaby, 1996). Agriculturally literate people are defined as those who have some knowledge of food and fiber production, processing, marketing and the practical knowledge needed to care for their outdoor environments, which include lawns, gardens, recreational areas and parks (National Research Council, 1988). Though functional agricultural literacy does not imply a complete level of understanding about agriculture, it does consist of minimum levels which take into account an understanding of basic agricultural methods, the basic vocabulary of agricultural terms, and the ability to understand the impact of agriculture on society (Frick & Spotanski, 1990, Elliot, 1999a). Frick, Kahler, and Miller in 1991 in the *Journal of Agricultural Education*, 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.”

Due to increases in technology and production costs as well as efficiency in farming practices in 1991 Americans spent less than 15 percent of their disposable income on food which had become readily available the year round (Tisdale, 1991). Agriculturally literate consumers realize and appreciate the bargain prices offered by U.S. agriculture for their abundant safe food supply (Tisdale, 1991). Yet, the problem of agricultural illiteracy is widespread, having serious ramifications in the arenas of public policy development, development of personnel to serve the broad agricultural industry, and in the education of people from kindergarten through adult levels (Russell, McCracken & Miller, 1990).

A 1996 study throughout the state of Missouri, which was designed to assess secondary educators’ knowledge of and attitudes toward agriculture, found that agricultural teachers were the most knowledgeable and had the most positive attitudes towards agriculture and that each of the educators surveyed were judged to be knowledgeable of and had a positive attitude toward the industry of agriculture (Harris, Clark & Birkenholz, 1996). Several other studies (Elliot, 1999b; Elliot & Frick, 1995) also verified that one important aspect of properly educating students was to have agriculturally literate educators.

In addition to researching the agricultural literacy levels of educators, there has been considerable research as to the agricultural literacy levels of community leaders who make overall policy decisions for communities. This research found that there was no significant relationship between agricultural knowledge of community leaders and the high school agricultural courses, agricultural youth group membership, or involvement in raising animals or crops when compared with general knowledge, agricultural awareness, or local agricultural knowledge (Bell-Ritz & Lockaby, 1996; Elliot & Olson, 1995). A 1996 study on the agricultural literacy of radio station news reporters in Oklahoma found that typical radio station respondents felt qualified to report agricultural news and events even though they had little or no agricultural background or education. These results were found even though the majority of Oklahoma radio
station reporters who responded were educated in the liberal arts with no agricultural experiences (Howell & White, 1996). These findings indicate that without a basic standard of agriculture across the entire population, there is a risk that people will most likely learn agricultural issues from those who are not accurately versed on the industry or its impacts on the community. By studying the causal affects of various activities on policy makers and other community people that impact the perspectives of the everyday citizen, researchers have been able to narrow down those activities that may positively drive the agricultural literacy of a community.

Nunnery (1996) noted the necessity for building a literacy framework for understanding agriculture’s perspectives and viewpoints; Leising and Zilbert (1994) also 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 (FFSL) 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, 9-12, the framework provided a systematic means of addressing agricultural literacy.

A positive relationship has been established at the kindergarten through eighth grade levels utilizing the Food and Fiber Systems Literacy framework when the food and fiber knowledge of students was assessed using instruction based upon the framework (Igo & Frick, 1999). Classroom manuals and hands-on materials for teachers have been supported through research by Lombardi and Malone (1990) who investigated agricultural education in Montana schools. Swortzel (1996) looked at the impact of incorporating the content of AgVenture Magazine into the core curriculum and found that worthwhile efforts exist in providing instruction about agriculture and making school-aged students more aware about the importance of agriculture. Of particular interest were two recent studies that looked at the impacts of elementary school field trips on agricultural learning and the impacts of hands-on in-classroom activities. In 2003, Morrell discovered that 3rd and 4th graders who had the opportunity to participate in a three-hour field experience where students were exposed to information about forestry and forest products showed an increase in student knowledge after participating in this experience (Morrell, 2003). Another study led by Meunier in 2002 utilized fourth grade students in seven Indiana schools and examined the impacts of incorporating chicken egg incubators into the classroom learning experience to provide enhanced hands-on learning for animal reproduction. A quasi-experimental, non-equivalent groups pretest-posttest research design was used for this study; seven schools were controls, with a total of 736 students and 39 teachers participating. The treatment group increased in agriculturally-related science knowledge based on the instrument that was designed and used for both the pre-test and post-test (Meunier, Talbert & Latour, 2002).

In October of 2001 the Agricultural Experiment Station Western Coordinating Committee (WCC207) for Agricultural Literacy, which is made up of agricultural education researchers from many of the land grant agricultural education departments in the West, convened to continue their discussion about the impacts and future goals of agricultural education. Now called the Western Education/Extension and Research Activity (WERA207), the group determined that it would work collectively to achieve three main objectives: 1. To identify and describe the organizational structure of Agriculture in the Classroom (AITC) state programs. 2.
To identify and describe those components and practices which correlate with AITC program success. 3. To determine the relationship of AITC programs to learner outcomes. The overarching goal of this committee is to improve the understanding of the critical significance agriculture plays in our quality of life and the quality of our environment; locally and globally. Specifically, agricultural literacy will be addressed in the following areas: Food and Fiber Systems: Understanding Agriculture; Historical, Cultural, and Geographic Significance of Agriculture; Science: Agricultural-Environmental Independence; Business and Economics; and Food, Nutrition, and Health (Leising, Igo, Heald, Hubert & Yamomoto, 1998).

Statement of the Problem

Though each of these studies provides unique insight into the impacts of hands-on learning experiences in agricultural education, there has been no readily available research that examines the impacts of participation in a hands-on learning experience through visitation to a working farm or agricultural learning center which are working farms operating for teaching purposes. Little research has been reported comparing the affects of teaching hands-on curriculum both in and outside the classroom to compare the impact of agricultural learning experiences on a state’s assessment of academic achievement and the agricultural knowledge of elementary age students. The problem is that as educational resources continue to diminish it is imperative that educators have quantifiable justification as to the benefits of Agriculture in the Classroom to sustain agriculture as a component of elementary education.
According to Cardwell (1994), there exists a general belief among K-16 educators as well as scientists that people must be scientifically and agriculturally literate in order to make wise and informed economic and political decisions about the use of renewable resources (Cardwell, 1994). Agricultural education can introduce students to the concepts of plant growth and component parts of greenhouses, horticulture in the areas of gardening and commercial ornamental production, environmental concerns such as campus beautification and landscaping, and technological innovation such as with various methods of hydroponics and drip irrigation (Kuempel & Spivey, 1990). Each state approaches Agriculture in the Classroom from the basis of its own needs and resources and is responsible for organization, funding, public outreach,
materials development and teacher training (Traxler, 1990). The introduction of score-based funding as well as statewide implementation of standardized testing coupled with the importance of agricultural knowledge of the general population necessary for beneficial natural resource allocation decisions has made the issue of agricultural education in arid regions increasingly important. The issues of land and water management are very important in arid land regions. Additionally, the fourth grade level is an age at which young people are receptive to new ideas. The purpose of this study was to assess the agricultural arid lands literacy of 4th grade students.

**Objective of the Study**

1. Compare the agricultural arid lands literacy scores among those students who participated in the agricultural fieldtrip with those students who received the same materials in the form of a four-day arid lands curriculum as well, those who received both, and those who received no treatment.

As illustrated in the operational framework the researcher randomly selected four groups and provided each group with a different level of agriculture in the classroom treatment: The control group received no agriculture in the classroom or hands-on learning experiences. Group two received four days of in-class agricultural curriculum. Group three received a full-day field trip including hands-on learning experiences which mirrors the four-day curriculum taught in class at the University of Arizona Maricopa Agricultural Experiment Station Center. Group four received four days of in-class agricultural curriculum and the Experiment Station the field trip.

![Operational Framework](image-url)
Methods and Procedures

The research model was designed to ensure that groups were assigned randomly to the various levels of treatment in order to create a scenario in which agricultural arid lands literacy was compared.

\[
\begin{align*}
R & O \quad X_1 \quad O & \text{Where } X_1 = \text{control group} \\
-- & -- & -- & -- & \quad X_2 = 4 \text{ days of curriculum} \\
R & O \quad X_2 \quad O & \quad X_3 = \text{Field trip} \\
-- & -- & -- & -- & \quad X_4 = \text{Field trip} + 4 \text{ days of curriculum} \\
R & O \quad X_3 \quad O & \\
-- & -- & -- & -- \\
R & O \quad X_4 \quad O
\end{align*}
\]

Figure 3. Research Design

The null hypothesis for this study was that variation in curriculum treatment would result in no variation on agricultural literacy of fourth grade students. The alternative hypothesis was that varying levels of agricultural curriculum will impact the agricultural literacy of students. The level of significance chosen for this research was .05 which means that any findings that show a significant difference resulting from the various levels of treatment will only have a 5 percent chance of being incorrect.

\[H_0=\text{There is no difference between various treatments} \]
\[H_1=\text{Students who receive 4 days of agricultural arid lands curriculum will increase literacy} \]
\[H_2=\text{Students who receive a hands-on field trip will increase literacy} \]
\[H_3=\text{Students who receive 4 days of agricultural arid lands curriculum and a field trip will increase literacy} \]

Both prior to and after receiving the various levels of treatment all of the students within the population received a test which assessed their arid land literacy, but also incorporated the Food and Fiber Systems Literacy benchmarks with the aspects of the water and resources lessons valuable to arid regions. Additionally, the materials tested for benchmarks that are established and cross-referenced for the state’s academic standards. A series of steps were taken to ensure that the nine threats to internal validity (Campbell & Stanley, 1963) were minimized or dealt with as they related to the independent variables (agricultural field-trip and four days of agricultural curriculum instruction) and the dependent variable (arid land literacy):

*Subject Selection*

Meunier (2002), Perritt (1990), and Morrell (2003) each focused their research on the fourth grade level and each discovered that their particular treatment resulted in increased agricultural literacy by their populations. Therefore, in an effort to effectively evaluate the effectiveness of the various levels of treatment it was determined to maintain consistency by examining the sample at the fourth grade level.
The researcher made a presentation to all of the superintendents of public school districts within Pima County, Arizona, which was attended by the Dean of the College of Agriculture and Life Sciences from the University of Arizona, and which included an interactive lesson taught by staff from the extension office. From this group, one school district volunteered to participate in this study. The public school district had 21 classes of 4th graders. The population was appropriate and the experimentally accessible population matched the target population. There was no sampling procedure for this study because one-hundred percent of the target population participated in the study. The population studied was all of the 435 fourth-grade students in the public school district. Due to Human Subjects Review Board approval from the University of Arizona, the school district chose to incorporate this study as a component of its Spring curriculum. Parental consent was obtained prior to participation from all students. The final number of students analyzed was 400 because those students who were unable to participate in all aspect of the pre-test, post-test, and specific treatments were eliminated from the analysis. Therefore, 92% of the population studied participated completely.

**Vail Public School District.**

Founded in 1903, the Vail school district was once a ranching community with a one-room schoolhouse. As the district celebrated its 100th birthday, over 20,000 people from all walks of life called the community home. Only twenty minutes southeast of the City of Tucson, a city of 750,000, the residents enjoyed performances by the Symphony Orchestra and the Theater Company. The public school district was directly in the path of urban encroachment. The district was one of the fastest growing districts in the state, and was responding to this exciting challenge head-on. The district operated five elementary schools, two middle schools, and a comprehensive high school, along with two small charter schools. A third middle school and a second comprehensive high school were under construction. The district had almost 6,000 students in grades K-12. It was expected that by 2010 the school district enrollment should exceed 10,000 students.

**Sampling**

At the time of the study the school district contained five elementary schools with three to six classes at the fourth grade level per school. The number of students per classroom ranged from 19 to 25. The classrooms receiving the various levels of treatment were selected randomly.

**Controls**

1. 4-day agricultural arid lands curriculum- The students received four-days of agricultural education curriculum focusing on arid land issues which was aligned with state academic standards. The curriculum was cumulated from existing extension and Agriculture in the Classroom curriculum already aligned to state standard benchmarks. Teachers were trained on the proper techniques for teaching the curriculum during a three-hour teacher in-service facilitated by instructional experts in the areas that they would be teaching. Additionally, the researcher provided each teacher with quality supplies for each lesson plan that would be used during the application of the treatment.
2. The pre- and post-test was developed directly from the 4-day curriculum and was aligned with state academic standards.

3. The hands-on learning experience at the agricultural experiment station corresponded directly to 4-day agricultural curriculum. The lessons were taught by research instructors who specialized in the fields they were teaching.

4. The students in the control group received the pre- and post-test with no other treatment. Threats to maturation and history were minimized by this step.

Conditions of Testing

A panel of experts established curriculum and test content and context validity. A group of similarly aged students with similar backgrounds were administered the test and its results established that the instrument was reliable. Using test/re-test procedures there was no significant difference at an alpha level of .05. The testing took place in the classrooms of the individual students and was administered by the researchers in collaboration with the classroom teachers. The pre-test was given during the first thirty minutes of the first school day and the post-test was given immediately after the students arrival at the school following their field-trip or during the last thirty minutes of class depending on which treatment the students received. A uniform script was read to all of the students informing them of what the test entails and instructing them to answer all of the questions to the best of their abilities.

Data Analysis

The data collected during the pre- and post-test analysis were used to determine the impact of the various levels of treatment on the dependent variable: arid lands agricultural literacy as measured by the modified assessment. The levels of independent variable were; 1. Control- no agricultural instruction; 2. Four-days of in-class instruction; 3. One-day agricultural field-trip out of the classroom. 4. Four-days of in-class instruction and one-day agricultural field-trip out of the classroom.

Due to the design of this research single-factor ANOVA was used to compare the means. The four groups were compared with each other in order to determine whether there were statistical differences. The Scheffe post-hoc test examined the specific differences among the four groups.

Conclusions

Analysis of the pre-test completed by the entire population supported the field tests and test/re-test of the instrument which found no significance at the alpha .05 level. The pre-test median score was 46.5% for the entire 400 students that participated and the median post-test score was 60% highlighting an overall arid land literacy improvement. Yet, once the data were separated it was discovered that there was a statistically significant difference between the results of the control group and each of the three additional treatment levels. The three treatment groups scored significantly higher on the agricultural arid lands literacy test than the control group. The median scores for the four levels of treatment were 52.9% for the control group, 62.5% for the
in-class only group, 63.2% for the field-trip only group, and 65.1% for the group that received both the in-class and field-trip treatments. By completing a Scheffe analysis it was discovered that there was no statistically significant correlation between the three levels of treatment outside of the control group. This means that any type of treatment, field-trip only, in-class only, or field-trip and in-class, will have a positive impact on the arid land agricultural literacy of elementary students but that there was no statistically significant impact of including a field-trip as a component of a well-implemented in-class agricultural in the classroom curriculum. Therefore, these finding would support classroom-focused, activity-based agricultural education delivered by teachers rather than more expensive off-site field trips. Although the findings are not generalizable beyond the participants in this study, the results are meaningful and do have transferability to a variety of settings.

Implications-Recommendations

When students were given the opportunity to learn subject matter, in this study, they tend to do well. In addition, when effective teaching strategies are employed that engage the brain learning takes place at higher levels. This study verified both of these statements and it provides direction for AITC programs. AITC efforts must be aligned with state standards or educators will not be able to consider utilizing the curricula within their classrooms. There are simply too many demands on teachers and AITC must promote itself by improving and enhancing what they are already doing in the classroom.

This study sheds light on a unique aspect of AITC by examining the impact of various types of curriculum on the same population. What this research demonstrates is that though there was a curriculum combining hands-on learning both in the classroom and on the farm has the highest impact on the arid lands literacy of students, there was not statistical support that providing children with a hands-on field trip that provides an experience similar to that in the classroom has statistically significant impact on the children’s knowledge. Additionally, this study provided data which shows that if classroom instructors are provided with the appropriate materials and curriculum as well as instruction on the subject matter that these inputs can actually be as effective as actual field-trips and hands-on agricultural experiences.

Whereas this research investigated the impacts of various types of arid land AITC curriculum on the literacy of elementary school students and found that students were impacted positively with various types of treatment but that no particular AITC stood out above the rest future researchers should investigate resource requirements with the different treatments. Each of the treatments for this research had similar teaching resources such as supplies and training and therefore it will be important, prior to simply stating that field-trips and hands-on classroom learning are interchangeable to examine the importance of classroom resources and their impact on AITC curricula as they relate to arid land agricultural literacy.

A more agriculturally literate society means a better-educated populace, which can make better decisions as a citizenry and as consumers. In addition, more students will be exposed to agricultural opportunities, as agricultural literacy improves, and will be more likely to enter agricultural science careers.
References


