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EVALUATION OF THE INCUBATORS IN THE CLASSROOM PROGRAM: DOES IT INCREASE FOURTH GRADE STUDENTS' AND TEACHERS' KNOWLEDGE ABOUT AGRICULTURAL PROFESSIONS?

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Abstract

The purpose of the study was to determine the effectiveness of agricultural literacy materials designed for the Incubators in the Classroom program used in Indiana fourth grade classrooms. This article reports on the study objectives: determine the impact of the educational materials on fourth grade students' and teachers' knowledge level of agricultural professions and identify fourth grade students' perceptions and opinions of agricultural careers and their possible career plans. Effectiveness of the educational materials was measured through a pretest-posttest research design on Indiana fourth grade school children (n=736) and their respective teachers (n=39). The sample of students and teachers was divided into treatment and control groups. Quantitative data were collected through questionnaires. The findings indicated the educational materials developed and assessed for this study were effective in increasing knowledge of agricultural professions among both the treatment group students and teachers. The treatment group students were significantly more likely to see agricultural careers as interesting and exciting.

Introduction

In 1997-98, the Purdue University Cooperative Extension Service began planning for the five-year period 1999-2004 by asking communities, "What are the high-priority issues in your community, and what difference could and should we make with our educational programs?" (Purdue Extension Service, 1998, p. 1). Responses from Indiana communities formed the basis for Purdue University's Cooperative Extension 1999 Five-Year Plan of Work. The plan included 16 broad categories. Among this list of topics was a plan of action for increasing agricultural literacy and understanding among Indiana's citizens. The Purdue Extension Service's vision for agricultural literacy stated, "Indiana's residents will make informed decisions about agriculture; improve farm/non-farm relations; increase their awareness of the importance of agriculture; and heighten their understanding of the food and fiber system" (Purdue Extension Service, p. 8). In accordance with the plan of action, the Purdue University Animal Science Department developed an educational program to increase the agricultural literacy levels of fourth grade students.

Theoretical Framework

In 1988, the National Research Council recommended, "All students should receive at least some systematic instruction about agriculture beginning in kindergarten or first grade and continuing through twelfth grade" (p. 10) and that agricultural literacy efforts in elementary schools be incorporated through modules or units of instruction. Although the National Research Council recommended that career exploration in agriculture be focused in middle school, the literature suggested that career awareness could begin earlier. Exactly how and when a child's career aspirations begin are not fully understood (Trice, McClellan, & Hughes, 1992). Super, Crites, Hummel,

Moser, Overstreet, and Warnath (1957) described career development as a life-long process beginning at birth. Arguably, the most important experiences in career development are first-hand experiences. Trice (1991) concluded that children at young ages possess somewhat stable career aspirations that are related to the careers of their parents and other people in the community. This means, however, that if parents and community members were the only influence on a child's career aspirations, then the child may not be exposed to some vocations or career opportunities.

Super et al. (1957) believed that children at the fourth grade level are particularly receptive to concepts regarding vocations. Around 10 years of age, children begin to form career aspirations based on enjoyable activities and their interests (Seligman, 1994). Super (1990) further theorized that learning experiences, such as the school-based Incubators in the Classroom, are crucial for development of career interests. Further, little to no exposure to a particular vocation or subject at this stage of development generally results in little desire to learn about this subject later in life. Thus, exposure to numerous vocations at the fourth grade level may allow children the opportunity to later explore career opportunities outside their everyday experiences, such as agricultural ones.

Some career development theorists (Seligman, Weinstock, & Helflin, 1991; Trice, 1991; Trice et al., 1992; Trice & Tillapaugh, 1991) have examined the role that parents play in the career choice process of children. Trice found that 11-year-old rural children, more than urban children, selected a career similar to that of their parents and demonstrated stability in choosing careers. Trice speculated that these results were attributed to the relatively lower number of career choices encountered by rural children as compared to urban children. Trice et al. hypothesized that parental suggestions of their child being good at a particular job would influence that child's career selection. Trice et al. concluded that direct suggestions from parents do not account for high aspiration levels that second, fourth, and sixth-grade school children report toward parental occupations. In an attempt to analyze children's aspirations toward parental occupations, Trice and Tillapaugh (1991) found children's aspirations to a parent's occupation were related to a parent's overall job satisfaction. Seligman et al. (1991) found strong parental influence on children's social and academic patterns. Parental influence, however, was only one of many influences affecting a child's thought on career goals and interests. Although, parents play a role in their children's career selection process, other factors can have as strong or stronger influences.

Super (1990) stated that elementary school classrooms are appropriate places for career interest and knowledge activities. In the social cognitive career theory (Lent, Brown, & Hackett, 1994), successful learning experiences are believed to raise a person's self-efficacy for the activity, which increases the person's goals for that activity. This suggested that students who are successful at incubating fertilized chicken eggs may have an increased self-efficacy for agricultural science activities and may have a greater interest in related agricultural careers.

Conceptual Framework

What perceptions do elementary school students hold regarding agriculture-related careers? Trexler (1997) found that elementary students with limited exposure to agricultural production believed farms: were small (size of two football fields), grew multiple varieties of crops in rows next to each other, and were tended by one farmer. Many students see agriculture as only farming crops, tending livestock, and doing manual labor (DeWerff, 1989). These misconceptions are especially prevalent among urban students (Tevis, 1996). To address these misconceptions, DeWerff suggested learning about agriculture should begin at younger ages.

If efforts to influence and inform the career decision process of students are to begin in elementary schools, then elementary teachers must be agriculturally literate. However, the American Association for the Advancement of Science (1993) questioned whether elementary

teachers or their students could trace the path that a food has traveled on its way to a grocery store and more specifically the "hazards that food encounters from the time it is a seed until it reaches the kitchen" (p. 184). Terry, Herring, and Larke (1992) found 75% of 510 Texas fourth grade teachers had low knowledge about agriculture. Humphrey, Stewart, and Linhardt (1994) found only 20% of the University of Missouri-Columbia pre-service elementary education majors were confident to teach agricultural concepts. Balschweid, Thompson, and Cole (1998) found classroom teachers felt the greatest barriers to implementing agriculture in classrooms were time to make the necessary curricular changes and locating agricultural information.

Purpose and Objectives of the Study

The purpose of the study was to determine the effectiveness of agricultural literacy materials designed for the Incubators in the Classroom program used in Indiana fourth grade classrooms. More specifically, the study was to measure the impact of the materials in the agricultural literacy areas of science-related concepts and career awareness. This article reports on the evaluation of the program's effectiveness on increasing knowledge of agriculture-related professions. The specific objectives of the study were to:

1. Determine the impact of the educational materials on fourth grade students' and teachers' knowledge level of agricultural professions.
2. Identify fourth grade students' perceptions and opinions of agricultural careers and their possible career plans.

Methodology

A quasi-experimental, non-equivalent group pretest-posttest research design was used for this study (McMillan & Schumacher, 1997). The main threat to internal validity for this type of research design is that of differential selection (Gall, Borg, & Gall, 1996). To control for the confounding effects of extraneous variables, the researchers used selective sampling procedures. Fourteen schools were selected based on community population size, spending per pupil, student and teacher demographics, student achievement on state testing, community level of industry, and community access to interstates/major highways. Schools were classified as (a) small – less than 5,000 residents, (b) medium – between 5-15,000 residents, or (c) large – higher than 15,000 residents. The schools were randomly assigned, using the community population size, as either control (n=7) or treatment (n=7) so that both groups contained small, medium, and large schools. To address experimental treatment diffusion (Gall, Borg, & Gall, 1996), all classrooms within a school were either control or treatment.

Treatment/Intervention

Hands-on instructional materials were developed as a component of the Purdue University Poultry Extension Staff program "Incubators in the Classroom." These materials consisted of daily lesson plans, student and teacher resource and reference materials, and planned hands-on activities divided across five classroom days with each day requiring at least 30 minutes of formal instruction. The instruction consisted of information related to the general concept and scope of agriculture, agricultural careers, farm animals, egg formation within the hen, chick embryonic development, and agricultural products. The Incubators in the Classroom program provided each teacher with one dozen fertile eggs, an incubator, an embryology poster, and related reference materials. All instructional materials were developed in accordance with the Indiana Science Standards for Indiana fourth grade students. The instructional materials were at Flesch-Kincaid Grade level 5.7 with Flesch Reading Ease of 73% (Microsoft Word, 1997). This is a typical level for fourth grade science materials as science instruction contains advanced terminology and concepts. The classroom teachers, each of whom had received training on using the equipment and materials, delivered the educational intervention.

Sampling and Research Subjects

The sample size was determined through the Krejcie and Morgan (1970) formula and consisted of two groups: the control group (*n*=363 students, *n*=20 teachers) and the treatment group (*n*= 373 students, *n*=19 teachers). The total teacher response rate (*n*=39) was 100%. The total student response rate (*n*=736) for analysis was 86.6%. This was reduced from 850 possible student respondents due to the lack of complete data on some individuals. Students may not have completed both the pretest and posttests due to a number of factors: student illness, school activities involving certain students, short-term disciplinary actions, and/or any other miscellaneous school-related reasons. The overall student sample was evenly distributed for treatment, community population sizes, and gender. Demographically, students were Caucasian (89.8%), 10 years of age (81%), and non-members of the 4-H program (83.1%). Teachers were exclusively Caucasian (100%), predominantly female (94.9%), not involved in the 4-H program (76.8%), but were involved in classroom programs containing agricultural activities (56.4%).

Instruments

Researcher-developed pretest and posttest instruments for the students and teachers were used to collect quantitative data. The pretest and posttest instruments for both the students and teachers were identical for the questions, response categories, and the order of the questions. The student instrument consisted of four demographic questions, eight multiple-choice questions, and nine true-false questions, while the teacher instrument added a demographic question on involvement in agriculture and deleted two multiple choice questions on future plans. The authors chose to focus on key objectives from the instructional materials in order to keep the instruments at a reasonable length for fourth grade students. This article reports on the four multiple-choice questions and eight true-false questions pertaining to knowledge of agriculture as a profession and perceptions of agriculture. Teachers were not asked the two perception questions. Content validity was examined by a panel comprised of fourth-grade teachers not involved in the study and animal science and agricultural education university faculty.

Data Collection and Analysis

The treatment and control groups received the pretest one-week prior to the intervention or non-intervention and a posttest one-week following the intervention or non-intervention period. Therefore, the time between the pretest and the posttest was three weeks for both groups. The data were analyzed using Statistical Package for the Social Sciences (SPSS for Windows, 1998). For analysis purposes an answer of "yes" or "true" on the perception questions was entered as a correct response. The data were analyzed using descriptive statistics and cross tabulations including cell frequencies and percentages of correct and incorrect responses. Chi-square statistical procedures were conducted to test for differences between the responses of treatment and control groups. Statistical significance was established a priori at the .05 level.

Results

Students

Instrument questions for knowledge of agricultural careers and perceptions toward those careers were utilized to draw comparisons between the treatment and control groups. Table 1 shows the percent of students answering correctly for the 10 questions regarding agricultural careers. Initially the control and treatment groups were significantly different on five of the 10 questions. On the pretest, the control group was more likely to correctly answer the question "why agriculture is important." On the pretest, the treatment group was more likely to correctly answer the questions related to the percentage of Americans working in agriculturally-related jobs, the number of scientists/researchers in agriculture, the educational level of agricultural careers, and that agriculture is a part of science. The treatment group increased in percentage correct between the pretest and the posttest for all questions but the "percentage of American adults that

work in an agriculturally related job." This question, on both the pretest and posttest, had the lowest percentage correct for both the treatment and control groups. The treatment group had the highest overall percent correct (91.9) on the posttest question "agriculture is only farming." On the posttest, the treatment group had higher percent correct responses on six of the 10 questions.

There was no statistically significant difference between the treatment and control groups on career plans after high school (Table 2). The treatment group had a significantly higher percentage responding true on the posttest for "careers in agriculture seem interesting and exciting."

Table 1
Student Responses on Agricultural Professions Knowledge by Group and Time

Time	Treatment		Control		Cramer's *V*
	n[a]	%[b]	*n*[a]	%[b]	
Why is agriculture important?					
Pre	360	43.1	373	59.5	19.87*
Post	361	46.5	373	52.3	2.42
What percentage of American adults works in an agriculturally related job?					
Pre	359	31.2	371	24.0	4.75*
Post	363	30.3	371	27.8	.58
One American farmer feeds about ____ number of people per year.					
Pre	360	40.6	373	41.8	.12
Post	363	62.8	373	45.6	22.00*
The agriculture industry has many career opportunities.					
Pre	359	79.9	370	79.5	.03
Post	360	91.1	368	80.2	17.67*
Agriculture involves marketing, merchandising, and sales of agricultural products					
Pre	359	62.4	370	66.8	1.52
Post	360	77.2	370	75.1	.44
Many researchers and scientists are involved in the agriculture industry.					
Pre	358	61.2	371	53.9	3.93*
Post	359	83.6	370	64.9	33.18*
Agriculture is important to society.					
Pre	356	78.1	371	83.6	3.51
Post	357	80.7	370	80.5	.00
Many agricultural jobs require a college education.					
Pre	357	75.6	369	68.6	4.50*
Post	360	77.2	370	65.4	12.43*
Agriculture is only farming.					
Pre	359	86.9	371	83.8	1.38
Post	360	91.9	370	87.0	4.68*
Agriculture is considered a part of science.					
Pre	359	72.1	370	61.6	9.10*
Post	358	89.4	370	74.6	26.82*

[a] Number of respondents to the question.
[b] Percentage of respondents with correct response.
* Indicates significance at the .05 level.

Table 2
Student Responses on Agricultural Careers by Group and Time

Time	Treatment		Control		Cramer's *V*
	n[a]	%[b]	*n*[a]	%[b]	
After you graduate from high school or college, do you see yourself employed in an agricultural career?					
Pre	362	23.2	372	22.3	.08
Post	362	20.4	372	19.9	.03
Careers in agriculture seem interesting and exciting.					
Pre	356	66.0	368	64.1	.28
Post	358	74.9	367	61.6	14.72*

[a] Number of respondents to the question.
[b] Percentage of respondents answering "Yes" or "True."
* Indicates significance at the .05 level.

Teachers

There were no statistically significant differences between the teacher treatment and control groups on the pretest (Table 3). For the teacher posttest, the treatment group had a higher percentage of correct responses for the question "the number of people per year one American farmer feeds." The control group had the lowest percent correct responses for both the teacher pretest and posttest (35) for the question on "the number of people per year one American farmer feeds." Both the treatment and control groups had 100% correct responses for several questions on both the teacher pretest and posttest.

Table 3
Teacher Responses on Agricultural Professions Knowledge by Group and Time

Time	Treatment		Control		Cramer's *V*
	n[a]	%[b]	*n*[a]	%[b]	
Why is agriculture important?					
Pre	19	50.0	20	50.0	.98
Post	19	100.0	20	100.0	-------
What percentage of American adults works in an agriculturally related job?					
Pre	19	36.8	20	45.0	.27
Post	19	57.9	20	40.0	1.25
One American farmer feeds about ____ number of people per year.					
Pre	19	42.1	20	35.0	.21
Post	19	84.2	20	35.0	9.76*
The Agriculture industry has many career opportunities.					
Pre	19	100.0	20	95.0	.98
Post	19	100.0	20	100.0	-------
Agriculture involves marketing, merchandising, and sales of agricultural products					
Pre	19	100.0	20	100.0	-------
Post	19	100.0	20	100.0	-------
Many researchers and scientists are involved in the agriculture industry.					
Pre	19	100.0	20	100.0	-------
Post	19	100.0	20	100.0	-------
Agriculture is important to society.					
Pre	19	100.0	20	100.0	-------
Post	19	100.0	20	100.0	-------
Many agricultural jobs require a college education.					
Pre	19	94.7	20	85.0	1.00
Post	19	100.0	20	90.0	2.00
Agriculture is only farming.					
Pre	19	100.0	20	100.0	-------
Post	19	100.0	20	100.0	-------
Agriculture is considered a part of science.					
Pre	19	100.0	20	95.0	.98
Post	19	94.7	20	100.0	1.08

[a] Number of respondents to the question.
[b] Percentage of respondents with correct response.
* Indicates significance at the .05 level.

Student Conclusions

For objective one of this study, it was concluded that the educational materials were effective in increasing fourth grade students' knowledge about agricultural professions, thus increasing agricultural literacy levels. This supports the theoretical framework (Super et al., 1957), that fourth grade students are receptive to learning about agricultural careers. In addition, a teacher-facilitated (Seligman et al., 1991) career awareness program was successful in increasing knowledge about and perceptions of agricultural careers. The initial differences among the two student groups were interesting, which may be attributed to the combination of student experiences and classroom activities prior to the educational intervention or non-intervention.

The educational intervention positively affected agricultural knowledge of the treatment group students. It is interesting to note that treatment group students scored significantly higher on the pretest, compared to control group students, when asked about the importance of agriculture and what percentage of American adults work in an agriculturally related job; but they did not score significantly higher on the posttest on those questions. The present study offers no answers as to why the treatment group students did not achieve higher percentages of correct responses for these posttest questions.

"After you graduate from high school or college, do you see yourself in an agricultural career?" was an opinion-based question. The authors expected students in the treatment group to respond more favorably to the opinion-based question on the posttest due to findings from Seligman et al. (1991). Seligman et al. found 50% of 10 year-old students' career aspirations were influenced by school learning activities. Further, when students receive career education in school, their aspirations increase towards those careers. The findings from the present study differ from Seligman et al. and require further investigation as to whether there may be concepts within the educational materials that turned treatment students away from agricultural careers. It was interesting to note that students in the treatment group found careers in agriculture to be more interesting and exciting than students in the control group, however they were no more likely to see themselves in an agricultural career after high school or college graduation (Table 2).

The combination of student responses as to whether they saw themselves working in an agricultural career and whether they saw agricultural careers as interesting and exciting differs from previous research. Student responses in this study suggest at least two possible conclusions. First, students in the treatment group may not be motivated by careers they find interesting and exciting. This, however, contrasts Seligman et al. (1991) finding that students are motivated towards careers they find interesting. Second, students find careers in agriculture interesting and exciting, but do not see themselves in an agricultural career after high school or college graduation. This, however, contrasts Trice and Tillapaugh (1991) finding that students are more likely to aspire to careers they feel are satisfying.

"Careers in agriculture seem interesting and exciting" was an opinion-based question. After the intervention, treatment group students more than control group students saw agricultural careers as interesting and exciting. This is consistent with Williams and White (1991) finding that including agriculture in day-to-day curriculum would increase student knowledge and interest of agriculture.

Teacher Conclusions

Overall, the teachers from the treatment and control groups were quite similar, with both groups performing quite well on the tests. Treatment and control group teachers scored 100% on many test items. However, due to concerns of teacher knowledge of agriculture in the literature (Humphrey et al., 1994; Terry et al., 1992), the researchers felt it was necessary to test the teachers via the same instrument completed by the students prior to and following the educational intervention or non-intervention. The teacher groups were not significantly

different on any question of the pretest. The treatment teachers did, however, demonstrate significantly higher percent correct responses on one posttest question (Table 3). Treatment group teachers responded significantly higher on the item "how many people one American farmer feeds per year." It appears that the teachers in this study are aware of the scope and breadth of agricultural careers.

Recommendations

Hands-on learning activities excite and motivate student learning at the fourth grade level because they are concrete-operational thinkers (Dembo, 1994). Students at this level are developmentally ready for activities designed to increase their agricultural career knowledge and awareness (Seligman, 1994; Super, 1990). Future Indiana Cooperative Extension Service intervention programs on the fourth grade level should focus on the students' acquisition of agricultural information and development of positive perceptions of agriculture and agricultural careers. These programs should include hands-on activities, using Incubators in the Classroom as a model, to help students understand the scope and breadth of agricultural professions. Additionally, the Indiana Cooperative Extension Service should continue to include experimental research in its mixture of program evaluation tools.

Much of the literature in the area of agricultural literacy focuses primarily on teacher knowledge (Balschweid et al., 1998; Terry et al., 1992; Trexler, Johnson, & Heinze, 2000). The quasi-experimental research reported in this article provides an insight into student perceptions and knowledge regarding agricultural careers. However, additional research on the impact of elementary intervention programs on students' career awareness needs to be conducted. In future studies, student perceptions and opinions of agriculture will be better assessed through multi-item concept scales. These scales should be developed to measure the constructs of "student's perceptions regarding agricultural careers" and "student's perceptions regarding their personal involvement in agricultural careers." Additionally, replication studies should be conducted to confirm or refute the findings of this study regarding treatment students not seeing themselves employed in agricultural careers after high school or college graduation.

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