IMPLICATIONS OF INTEGRATING SCIENCE IN SECONDARY AGRICULTURAL EDUCATION PROGRAMS

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Abstract

The purpose of this study was to determine how the National FFA AgriScience Teacher of the Year Award Program winners perceived the impact that integrating science has had on their agricultural education program. The target population consisted of all state, regional, and national winners of the National FFA AgriScience Teacher of the Year Award Program from the years I988 - 1995. Responses were collectedfrom 131 teachers (71.98% response rate). A Jive point Likert-type scale (1 = strongly disagree; 5 = strongly agree) was used to measure the teachers' perceptions toward integrating science into their agricultural education programs. The respondents perceived that integration of science was an effective delivery method for agricultural education, as over one-third of the instrument items received mean scores greater than 4.0 and 90% of the items received mean scores of 3.0 or greater. The findings of this study support the need to integrate science into agricultural education programs.

Introduction/Theoretical Framework

Educational initiatives (A Nation at Risk, 1983; The Unfinished Agenda, 1984; An Imperiled Generation: Saving Urban Schools, 1988) have called for educators to find ways for students to learn more effectively and more efficiently. The A Nation at Risk report alarmed many Americans with students' low levels of basic skill performance in science (National Commission on Excellence in Education, 1983). In response, educational policymakers increased basic skills graduation requirements in an attempt to improve students' academic knowledge and stimulate higher order thinking (Case, 1986; Wirt, 1991). Jennings (199 1) contended that raising academic standards had not been effective for most students who performed poorly in academic settings. In an interview by the New York Times (1990), George Tressel of the National Science Foundation pointed out that the general idea in present science education has been:

> "Don't educate them better; raise the standards, filter harder. We've gotten so good at weeding out that no one's left" (p. B-18).

Ten years after the A Nation at Risk report, USA Today ("Riskline," 1993) printed results of the International Assessment of Educational Progress; U.S. students ranked 13 out of 15 participating countries in science scores. These low science scores resulted in a demand for improved science education for American students. Wirth (1992) portrayed the delivery of science as a depressing picture, citing evidence that large numbers of American students avoided science in both secondary and higher education. Cole (1990) agreed, "Science education in the United States right now is largely a misnomer. It has little to do with science as scientists practice it, nor does it seem to educate anyone particularly well" (New York Times, p. B-18).

The National Science Board Commission on Precollege Education in Mathematics, Science, and Technology (1983) joined in stating an urgent need for curricula that utilized science and math applications in practical situations to improve student learning. The American Association for the Advancement of Science began a major effort to improve the delivery

method of science education through Project 2061, science for all Americans (1989). Teachers and administrators devised the science curriculum to encourage students to make their own discoveries instead of reading about them in a book.

Policymakers, educators, employers, scholars, and social critics have advocated vocational education reform that dealt with "integration" (Stasz, Kaganoff, & Eden, 1994). According to researchers (Stasz and Grubb, 1991; O'Neil, 1992), vocational educators as well as critics of vocational education viewed integration of academics as a curricular reform that improved the academic content of vocational education and helped prepare students for employment in an ever-changing world of work. The pursuit to integrate science into agriculture programs could improve the image and quality of programs while meeting the needs of a rampant changing industry.

Little objection to integrating academic and vocational education has been found in the literature. While supporters of integration have had a strong rationale for supporting integration in the American education system, it has remained a complex issue with different implementation strategies and models. Integration will academically strengthen vocational courses and make academic courses more relevant. Hence, instruction in vocational classes reinforced academic classes and instruction in academic classes reinforced vocational classes (Grubb, 1995)

The National Research Council (1988) reported that much of the curriculum in agricultural education programs was outdated and additional science-based curriculum should be incorporated. According to Budke (1991), agricultural education provided an excellent means to teach biological sciences such as genetics, photosynthesis, nutrition, pollution control, water quality, reproduction, and food processing. The use of live examples as a part of the classroom for experimentation and observation provided an effective method to teach science concepts (Budke, 1991).

Whent (1992) indicated that many agriculture teachers were reluctant to change traditional agriculture programs because they believed integrating too much science into the curriculum might threaten the program. To assist in developing programs that integrate science into agricultural education, knowledge must be gathered about the perceptions and beliefs of teachers with exemplary agriscience programs.

Johnson (1995) reported that Arkansas teachers perceived that offering science credit for agriculture courses would increase enrollment, benefit students, and enhance the program image. Researchers (Roegge and Russell, 1990; Whent and Leising, 1988; Enderlin and Osborne, 1992; Connors and Elliot, 1995) found that students who have been taught science using agriculture and natural resources perform equally well or better than students who have been taught science using traditional instructional methods.

The educational reform movement has led to rapid changes in education and agricultural education. One result of the changes in agricultural education has been the establishment of new FFA Award Programs to recognize teachers in agriscience and technology. Duval (1988) stated that the AgriScience Teacher of the Year Award Program recognized outstanding agricultural educators who emphasized agriscience technology in their curriculum. "The program has surfaced some of the finest agriscience programs in the country. They have recognized the need for retaining the assets of today's vocational agriculture program, leadership training and SOE programs, while placing renewed emphasis upon the scientific and technological aspects of agriculture" (p. 20).

Few studies have been conducted to evaluate agriscience programs and ascertain the perceptions of award winning agriscience teachers. Moore (1994) suggested that we can best integrate agricultural and academic education by studying the schools and teachers who are experiencing success in these areas. "At times we need to identify the best programs, best teachers, and best FFA Chapters and study them in detail" (Moore, 1994, p. 11).

Purpose/Objectives

The purpose of this study was to determine how agriscience teachers perceived the impact that integrating science has had on their agricultural education program. To fulfill the purposes of the study, the following research questions were addressed to state, regional, and national winners of the National FFA AgriScience Teacher of the Year Award Program:

1. What were the perceptions of agriscience teachers concerning integrating science and agriculture?
2. What were the perceptions of agriscience teachers concerning teaching integrated science?
3. What were the perceived barriers to integrating science into the agricultural education program?
4. What were the agriscience teachers' perceptions concerning the role of teacher preparation programs in integrating science into agricultural education programs?
5. What were the agriscience teachers' perceptions concerning student enrollment since integrating science into their agricultural education program?
6. What were the agriscience teachers' perceptions concerning support of the agricultural education program since integrating science?

Methods/Procedures

The target population of this study consisted of all state, regional, and national winners of the National FFA AgriScience Teacher of the Year Award Program from the years **1988 - 1995 (N = 253).** The accessible population was limited to agriculture teachers whose names were provided by the National FFA Organization and consisted of all available records of AgriScience winners that were still teaching. The list of names and addresses was cross-referenced with the Agricultural Educators Directory (1995) to determine if they maintained the same address and/or school since winning their respective AgriScience Teacher of the Year Award. If the agriscience teacher was not listed as currently teaching at the same school, the Agricultural Educators Directory (1995) was used to verify if the teacher was teaching in the same state. Finally, the National Vocational Agriculture Teachers Association (NVATA) office verified if individuals whose names were not listed in the Agricultural Educators Directory (1995) were members of the NVATA. If the teacher's name was not found in the Agricultural Educators Directory (1995) or in the membership records of NVATA, they were eliminated from the sample. AgriScience winners who no longer taught at the secondary level, were also eliminated from the sample. A purposive sample of 187 teachers that were still teaching was identified from the population for inclusion in the study.

The survey instrument was constructed based on a review of the literature and examined by a panel of experts for content validity and readability. The panel of experts consisted of members of the agricultural education profession representing teachers, state supervisors, teacher

educators, and National FFA Organization staff (n = 7). The instrument was pilot tested with a sample of teachers (n = 16) to gain insight on clarity, appropriateness, reliability, and validity. The results of the pilot test indicated that only formatting and clarification changes were needed. Cronbach's alpha coefficient was .88 for the pilot test.

The survey instrument and cover letter were mailed to the subjects with a self-addressed, stamped return envelope. Two weeks after the initial mailing, a reminder post card was sent to non-respondents. After another two-week waiting period, a telephone call was placed to all non-respondents by using a phone number that was obtained through the internet (WWW.Swithboard.com, 1996). A new cover letter with a survey instrument and return envelope was mailed to those individuals who indicated that they had misplaced or discarded the original survey instrument. Responses were received from 13 1 teachers for an overall response of 71.98 percent.

Results/Findings

The respondents were asked to respond to **3 8** statements regarding integrating science into their Agricultural Education Programs. Their responses were measured using a five point Liker-t-type scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree. Cronbach's alpha coefficient revealed item reliability ranging from .80-.8 1. Cronbach's alpha reliability of the 38 scaled items was 8 1.

The raw mean scores on the 38 Likert-type items ranged from a low mean of 2.55 for the item, "the lack of a science teacher who is willing to help me integrate science concepts has been a barrier to integrating science in the agricultural education program" to a high score of 4.65 for the item "people pursuing a career in agriculture must have a greater understanding of biological science than ten years ago." The respondents rated 15 (37.5%) of the items 4.00 or higher while 34 (90%) of the items received mean ratings of 3 .OO or higher. Only four (10%) of the items received a mean score less than 3.00.

Table 1 presents the means and standard deviations for agriscience teachers' perceptions of integrating science. Research question number 1, "Agriculture and Science" contained seven items with mean scores that ranged from 3.82 - 4.65. The items within this category had the highest mean scores for the six categories with only one item that had a mean below 4.00.

Research question number 2, "Teaching Integrated Science" contained six items with mean scores that ranged from 3.28 - 4.18 (Table 2). The respondents agreed (a mean greater than 4) with statements regarding feeling prepared to teach integrated biological science concepts, more preparation time required to integrate science, and that they teach more biological than physical science concepts.

Research question number 3, "Barriers to Integrating Science" contained nine items with mean scores that ranged from 2.55 - 3.99 (Table 3). No items in this category received mean scores above 4.00. This category also had the lowest mean scores. As indicated by the data, the respondents were undecided (a mean greater than 3 and less than 4) with all statements regarding barriers to integrating science.

Research question number four, "Teacher Preparation Programs" contained five items with mean scores that ranged from 3.46 - 4.44 (Table 4). Agriscience teachers agreed (mean scores greater than 4) that teacher preparation programs should provide inservice for teachers and instruction for undergraduates on how to integrate science. Agriscience teachers also agreed (mean scores greater than 4) that student teachers and students in early field experience programs should be placed with teachers that

Table 1. Means (M) and Standard Deviations (SD) for Aariscience Teachers' Percentions of Integrating Science and Agriculture (N=13 1)

Agriculture and Science Item	M	SD
People pursuing a career in agriculture must have a greater understanding of biological science than ten years ago.	4.65	.52
Students are more aware of the connection between scientific principles and agriculture when science concepts are an integral part of their instruction in agricultural education.	4.56	.60
Students are better prepared in science after they completed a course in agricultural education that integrated science.	4.45	.67
Students learn more about agriculture when science concepts are an integral part of their instruction.	4.40	.73
Science concepts are easier to understand for students since I integrated science into the agricultural education program.	4.39	.66
People pursuing a career in agriculture must have a greater understanding of physical science than ten years ago.	4.33	.73
Students are more motivated to learn since I integrated science into the agricultural education program.	3.82	.83

Table 2. Means (M) and Standard Deviations (SD) for Agriscience Teachers' Perceptions Toward Teaching Integrated Science in Their Agricultural Education Program (N= 13 1)

Teaching Integrated Science Item	M	SD
I feel prepared to teach integrated biological science concepts.	4.18	.74
Integrating science into the agricultural education program requires more preparation time for me than before I emphasized integrating science concepts in my agricultural education program.	4.18	.84
I teach integrated science concepts in agricultural education that focus more on the biological science concepts than the physical science concepts.	4.13	.78
Integrating science into agriculture classes has increased my ability to teach students to solve problems.	3.90	.72
I feel prepared to teach integrated physical science concepts.	3.89	.83
I have integrated more science in the advanced courses than the introductory courses that I teach in agricultural education.	3.28	1.13

Table 3. Means (M) and Standard Deviations (SD) for Perceived Barriers in Integrating Science Into the Agricultural Education Program (N = 130)

Barriers to Integrating Science Item	M	SD
The lack of appropriate equipment is a barrier to integrating science into the agricultural education program.	3.99	1.00
The lack of adequate federal, state, or local funds is a barrier to integrating science in the agricultural education program.	3.56	1.23
The lack of agriscience inset-vice workshops/courses for agricultural education teachers is a barrier to integrating science into the ag. ed. Program.	3.50	1.11
The lack of close proximity to high-technology firms is a barrier to integrating science in agricultural education programs.	3.25	1.07
The lack of science competence among teachers in agricultural education is a barrier to integrating science in agricultural education.	3.13	1.11
The lack of an integrated science curriculum is a barrier to integrating science into the agricultural education program.	3.04	1.08
The lack of agriscience jobs in the local community is a barrier to integrating science into agricultural education programs.	2.90	1.09
The lack of student preparation (prior to enrolling in agricultural education) in science is a barrier to integrating science into agricultural education programs.	2.86	.99
The lack of a science teacher who is willing to help me integrate science concepts has been a barrier to integrating science in the ag. ed. program.	2.55	1.21

integrate science into their agricultural education program

Research question number five, "Student Enrollment" contained five items with mean scores that ranged from 2.89 - 4.07 (Table 5). Only two statements had mean scores that were over 4.0. Agriscience teachers had high mean scores (greater than 4.0) in increased program enrollment and that high ability students are more likely to enroll in agricultural education courses that integrated science into the curriculum.

"Program Support" contained six items with mean scores that ranged from 3.5 1 - 3.79 (Table 6). No items in this category had a mean score above 4.00. The respondents were undecided (mean scores greater than 3 and less than 4) as to groups of people that have increased support since integrating science into the agricultural education program.

The respondents had an opportunity to respond to an open-ended question at the end of the survey instrument. When asked to identify the most significant factor(s) that caused the agriscience teachers to integrate science into their agricultural education program, 44 different responses were generated. The most frequently stated factor with 45 responses (34.4%) was to increase enrollment. Seven of the enrollment responses were to specifically increase enrollment of higher level students. The application of how science theory applied to agriculture and how agriculture applied to science was another high response rate (42 responses). Eighteen respondents listed building program credibility as the most significant factor that caused them to integrate science into the agricultural education program.

Table 4. Means (M) and Standard Deviations (SD) for Agriscience Teachers' Perceptions Concerning the Role of Teacher Preoaration Programs in Integrating Science in Agricultural Education Programs (N = 130)

Teacher Preparation Programs Item	M	SD
Teacher preparation programs should provide inservice for teachers in the field on how to integrate science into their agricultural education program.	4.44	.56
Teacher preparation programs in agriculture should provide instruction for undergraduates on how to integrate science.	4.38	.67
Teacher preparation programs in agriculture should place student teachers with a cooperating teacher that integrates science into the ag. ed. program.	4.19	.73
Teacher preparation programs should require that students conduct their early field experience program with a teacher that integrates science into the agricultural education program.	4.05	.70
Teacher preparation programs in agriculture should require students to take more basic science courses.	3.46	1.03

Table 5. Means (M) and Standard Deviations (SD) for Agriscience Teachers' Perceptions Concerning Student Enrollment Since Integrating Science into Their Agricultural Education Program (N = 130)

Student Enrollment Item	M	SD
High ability students are more likely to enroll in agricultural education courses that integrate science.	4.07	.89
Total program enrollment in agricultural education has increased since I integrated science.	4.03	.87
Average ability students are more likely to enroll in agricultural education courses that integrate science.	3.71	.85
Integrating science into the agricultural education program more effectively meets the needs of special population students.	3.19	1.02
Low ability students are more likely to enroll in agricultural education courses that integrate science.	2.89	1.15

Conclusions/Recommendations/Implications

The conclusions of this study were based on the responses of the winners of the National FFA AgriScience Teacher of the Year Awards Program from 1988-1995. Although other agricultural education programs that integrate more science may have similar characteristics, caution must be exercised when generalizing the results of this study beyond the population. Based on the findings of this study, the following conclusions were formulated:

1. Agriscience teachers believed that integrating science assists students in better understanding science concepts and their application to agriculture. This concurs with the findings of Enderlin and Osborne (1992)

Table 6. Means (M) and Standard Deviations (SD) for Aariscience Teachers' Perceptions Concerning Program Support Since Integrating Science into Their Agricultural Education Program (N = 130)

Program **Support** Item	M	SD
Local administrator support has increased since I have integrated more science into the agricultural education program.	3.79	1.01
Parental support has increased since I have integrated more science into the agricultural education program.	3.68	.79
Community support has increased since I have integrated more science into the agricultural education program.	3.65	.84
School counselor support has increased since I have integrated more science into the agricultural education program.	3.64	.94
Science teacher support has increased since I have integrated more science into the agricultural education program.	3.60	1.10
Other teacher support has increased since I have integrated more science into the agricultural education program.	3.51	.86

that integrating science will produce more science literate students that are better prepared to compete in today's society.

2. Agriscience teachers indicated they need more preparation time than before they emphasized integrated science concepts. Agriscience teachers felt better prepared to teach biological than physical science concepts and consequently, indicated they taught more biological science concepts than physical science concepts in their curriculum.

3. Undergraduates should receive instruction on how to integrate science and should student teach with a cooperating teacher who integrates science. Agriscience teachers also believed that teacher preparation programs should provide inservice for teachers on how to integrate science

4. Agriscience teachers perceived that total program enrollment, and more specifically the number of high ability students, will increase as agriscience teachers integrate more science into their agricultural education program. Teachers listed increased program credibility as an important benefit for integrating science into their agricultural education program. This supports a 1995 finding by Johnson that offering science credit for agriculture courses would increase enrollment, benefit students, and enhance the program image.

Recommendations

1. Inservice programs should be offered to assist teachers in integrating science into the agricultural education curriculum. Specifically targeting workshops that emphasize the physical sciences of agriculture will assist teachers in feeling more comfortable in integrating physical sciences into their curriculum.

2. Administrators should schedule planning time for teachers to better prepare them to integrate science. The profession should initiate an effort to educate administrators

that time demands to integrate science are significant.

3. Teacher Preparation Programs must identify and select cooperating teachers that are integrating science into their curriculum as placement centers for student teachers and early experience students. The student teaching experience should be enhanced as a result of placement in a model student teaching center that integrates science and agriculture in the curriculum.

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