Integrating Science into Agricultural Education: A Survey of South Carolina Teachers' Perceptions

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Abstract

The purpose of this study was to determine agriculture teachers' perceptions toward and barriers regarding the integration of science into South Carolina agricultural education. The target population of the study consisted of all secondary agriculture teachers in South Carolina. Results of the study showed that teachers believe they are prepared to teach biological and physical science concepts and that the greatest barriers regarding science integration include a lack of necessary equipment, funding, and in-service. Teachers also indicated the need for the agricultural teacher education program to teach undergraduates science integration concepts and indicated a need for increased in-service of science integration. Both statements align with the goals of the newly formed Department of Biology Instruction and Agricultural Education at Clemson University. Recommendations singled out the need for continued focus on collaboration between secondary agriculture and science teachers, access to funding opportunities, and revision of state curricular-equipment lists.

Introduction and Theoretical Framework

Over a decade has passed since the National Research Council's Committee on Agriculture (1988) recommended that agricultural education shift its emphasis from a largely vocational-based curriculum to one that more clearly integrates scientific thinking with traditional studies of production agriculture. This pedagogical approach has come to be known as agriscience, defined by Conroy and Walker (1998, p. 12) as "identifying concepts of biological, chemical, and physical science in the teaching of agriculture, and using agricultural examples to relate these concepts to the student." As educational reforms continue, the shift to teaching agriscience has occurred quite rapidly. Indeed, the change is clearly reflected in the use of the words "science" or "agriscience" in the titles of at least three popular secondary school agriculture textbooks (Burton, 1992; Cooper & Burton, 2002; and Herren, 2002). Hillison (1996) also notes that the shift to agriscience returns the focus of agricultural education to its original 1887 Hatch Act mission of promoting scientific agriculture, while reducing (but not eliminating) the emphasis on vocational programs that was ushered in by the Smith-Hughes Act of 1917. This balanced blend of conceptual agriscience and practical agriculture training is viewed by many as an ideal mix for agricultural education curricula (Shelley-Tolbert, Conroy, & Dailey, 2000).

The national report "Before It's Too Late" (2000) directed by John Glenn stressed the need for science in education, stating that "no one citizen of America can participate intelligently in his or her community or, indeed, conduct many mundane tasks, without being familiar with how science affects his daily life." While the increase in agriscience teaching was met with

general approval from teachers, parents, students, and guidance counselors as well as the scientific and business communities it has also generated concern among agriculture teachers (Osborne & Dyer, 2000; Dyer & Osborne, 1999; AAAS, 1993; Stasz & Grubb, 1991; Secretary's Commission on Achieving Necessary Skills, 1991). A number of formal surveys have been conducted that specifically assess teachers' perceptions regarding the trend toward a more agriscience-oriented curriculum. These include surveys from Indiana (Balschweid & Thompson, 1999), Michigan (Connors & Elliot, 1994), Mississippi (Newman & Johnson, 1993; 1994), Ohio (Peasley & Henderson, 1992), Oregon (Thompson & Balschweid, 1999) and Texas (Norris & Briers, 1989), as well as surveys or other analyses done with a more national focus (Whent, 1994; Connors & Elliot, 1995; Thompson & Schumacher, 1998; Johnson, Wardlow, & Franklin, 1998; Shelley-Tolbert et al., 2000). In general, these studies identify the following common themes:

1. Many teachers feel that they did not receive adequate science coursework in college to teach agriscience effectively;
2. There is a shortage of in-service training available to make up for this lack of science knowledge;
3. There is a need for more interaction between agriculture and science teachers;
4. Teaching resources and institutional support for agriscience curriculum revision are not always available in needed amounts, and
5. Pre-service agricultural education curricula need to focus specifically on agriscience as a core theme. These programs also need to provide would-be teachers with practical experience in how to successfully integrate science with agriculture in the classroom.

At Clemson University, agricultural education and introductory biology teaching faculty were recently merged into a single department of Biology Instruction and Agricultural Education (BIAE). This unique partnership of biologists and agricultural educators has given the opportunity to begin revising undergraduate agricultural education curriculum with a new focus on agriscience. The ultimate goal of BIAE is to produce a new generation of secondary school agriculture teachers who are comfortable with agriscience in the classroom, and who are capable of teaching core science concepts throughout the agriculture curriculum. As the first step in this retooling effort, a survey of South Carolina agricultural education teachers was conducted to see how their opinions regarding agriscience matched or differed from the results of surveys from other states.

The need to determine South Carolina agriculture teachers' perceptions of science integration gives light to the theoretical base for this study. The theoretical frame for this study is grounded in Fishbein and Ajzen's (1975) planned behavior theory. They determined that attitudes, intentions, and behaviors could be predicted based upon knowledge, observation, or other information about an issue. Therefore, this theory would allow the researchers to suggest that agriculture teachers' intent to integrate science can be predicted by analyzing his/her beliefs (perceptions) towards this subject matter.

Purpose/Objectives

The purpose of this study was two-fold: 1) identify and describe the perceptions of South Carolina agriculture teachers toward the integration of science into secondary agricultural education and 2) identify barriers that might exist to this integration. The objectives of this study were as follows:

1. Describe the demographic characteristics of South Carolina agriculture teachers and their students;
2. Describe the perceptions of agriculture teachers toward the integration of science into agricultural education;
3. Describe the perceptions of agriculture teachers regarding barriers of integrating science into their agricultural education courses;
4. Describe the perceptions of agriculture teachers regarding teacher education programs as related to the integration of science into agricultural education, and
5. Describe the perceptions of agriculture teachers toward the integration of science into agricultural education regarding program support.

Methods/Procedures

The population for the study consisted of all secondary agriculture teachers in the state of South Carolina (N = 105). The list of agriculture teachers was obtained from the 2000-2001 South Carolina Directory of Agricultural Educators. Census populations were used, and as such, the findings from this study can only be generalized to the population.

The instrument used in the study – "Integrating Science Survey Instrument," was developed by Thompson and Schumacher (1997) and later modified by Balschweid and Thompson (1999). The instrument was also slightly modified to meet the objectives of this study. The participants in the study were asked to respond to 39 statements regarding the integration of science into agricultural education. Teacher responses were measured using a Likert-type scale with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. A panel of experts from the Department of Biology Instruction and Agricultural Education at Clemson University was asked to review the instrument for content and face validity. A post-hoc reliability analysis was calculated on the 39 questions regarding the integration of science for the beginning teachers. Cronbach's alpha for reliability was 0.86.

Data were collected by sending the instrument and cover letter to all teachers in the study during October 2000. A follow-up postcard reminder was mailed two weeks after the initial mailing, requesting completion and return of the instruments that were not yet returned. A complete second mailing to non-respondents was sent two weeks following the post card. The response rate for the study was 78/105 (74%). A t-test of the 39 statements regarding the integration of science into agricultural education revealed no significant differences between early and late respondents (Miller & Smith, 1983). Therefore, the findings of this study can be generalized to the entire population of agriculture teachers in South Carolina.

Statistical data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS 10.0) for Windows and Microsoft Excel 2000. Descriptive statistics (frequencies, means, and standard deviations) were also used to analyze the data.

Results/Findings

The first objective of the study was to describe the demographic characteristics of South Carolina agriculture teachers. The average number of years teaching was 16, and the most prevalent age group of respondents was 41-50 (30.3%), followed by the 51-60 age group (26.3%). Ninety-three percent of the respondents were male. Teachers reported that 21.5% of their students were female, 28.6% were minorities, 71.8% of their students were members of the National FFA Organization, and 77.6% had some form of Supervised Agricultural Experience (SAE).

The second objective of the study was to describe the perceptions of agriculture teachers toward the integration of science into agricultural education. Table 1 shows the survey statements that were intended to probe agriculture teachers' attitudes toward the integration of science into agricultural education. Responses are ranked on the basis of the Mean Score. Mean scores regarding the topic of teaching integrated science ranged from 3.36-3.81, with the highest-ranked statement being "I feel prepared to teach integrated biological science concepts." This statement had an agreement of 73.1% (57/78 respondents indicating that they agree or strongly agree). It should also be noted that this statement scored the highest in the Balschweid and Thompson (1999) study of Indiana Agricultural Science & Business Teachers and the Thompson and Balschweid (1999) study of Oregon Agricultural Science and Technology Teachers.

Table 1.

South Carolina Agricultural Educators' Perceptions of Teaching Integrated Science (N = 78)

Teaching Integrated Science	M	SD
I feel prepared to teach integrated biological science concepts.	3.81	.93
I feel prepared to teach integrated physical science concepts.	3.68	.96
I teach integrated science concepts in agricultural education that focus more on the biological science concepts than the physical science concepts.	3.65	.96
Integrating science into agriculture classes has increased my ability to teach students to solve problems.	3.60	.87
Integrating science into the agricultural education program requires more preparation time for me than before I emphasized integrated science concepts in my agricultural education program.	3.39	.95
I have integrated more science in the advanced courses than the introductory courses that I teach in agricultural education.	3.36	.90

Note. Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

The third objective was to describe the perceptions of agriculture teachers regarding barriers to integrating science into their agricultural education courses. Table 2 presents the perceived barriers to integrating science as perceived by South Carolina agriculture teachers. Mean scores ranged from 2.62-4.03, with the highest ranked mean statement being "The lack of appropriate equipment is a barrier to integrating science into the agricultural education program." This statement had an agreement of 75.7% (59/78 respondents indicated that they agreed or strongly agreed). It should be noted that the top three statements in this objective mirror the top three found in the Balschweid & Thompson (1999) study of Indiana Agricultural Science & Business Teachers and the Thompson and Balschweid (1999) study of Oregon Agricultural Science and Technology Teachers.

Table 2

South Carolina Agricultural Educators' Perceptions of Barriers to Integrating Science into Their Agricultural Education Program (N = 78)

Barriers to Integrating Science	M	SD
The lack of appropriate equipment is a barrier to integrating science into the agricultural education program.	4.03	.97
The lack of adequate federal, state, or local funds is a barrier to integrating science in the agricultural education program.	3.62	1.13
The lack of agriscience in-service workshops/courses for agricultural education teachers is a barrier to integrating science into the agricultural education program.	3.58	1.06
The lack of an integrated science curriculum is a barrier to integrating science into agricultural education programs.	3.55	.94
The lack of student preparation in science (prior to enrolling in agricultural education) is a barrier to integrating science into agricultural education programs.	3.21	1.01
The lack of science competence among teachers in agricultural education is a barrier to integrating science in agricultural education.	3.03	1.00
The lack of close proximity to high-technology firms is a barrier to Integrating science in agricultural education programs.	3.00	1.01
The lack of agriscience jobs in the local community is a barrier to Integrating science into agricultural education programs.	2.82	.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 agricultural education program.	2.62	1.02

Note. Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

The fourth objective of this study was to describe the perceptions of agriculture teachers regarding teacher education programs as related to the integration of science into agricultural

education. Mean scores ranging from 3.31-4.21 (Table 3) expressed perceptions regarding teacher preparation programs concerning the integration of science. The highest mean score statement was "Teacher preparation programs in agriculture should provide instruction for undergraduates on how to integrate science," with 71/78 (91.1%) of respondents in the "agree" or "strongly agree" categories. Additionally, teachers indicated agreement on the statement "Teacher preparation programs in agriculture should provide in-service for teachers in the field on how to integrate science into their agricultural education program," (M = 4.15) with 72/78 or 92.3% responding.

Table 3

South Carolina Agricultural Educators' Perceptions of Teacher Preparation Programs Regarding Integration of Science Into Agricultural Education (N = 78)

Perceptions Regarding Teacher Preparation	M	SD
Teacher preparation programs in agriculture should provide instruction for undergraduates on how to integrate science.	4.21	.63
Teacher preparation programs in agriculture should provide in-service for teachers in the field on how to integrate science into their agricultural education program.	4.15	.69
Teacher preparation programs in agriculture should place student teachers with a cooperating teacher that integrates science into the agricultural education program.	3.77	.88
Teacher preparation programs in agriculture should require that students conduct their early field experience program with a teacher who integrates science into the agricultural education program.	3.49	.94
Teacher preparation programs in agriculture should require students to take more basic science courses.	3.41	1.02
Teacher preparation programs in agriculture should have a follow-up in-service activity that requires Agricultural Education teachers to cooperate with a science teacher in their district to integrate science into the curriculum.	3.31	1.14

Note. Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

The final objective of the study was to describe the perceptions of agriculture teachers toward the integration of science into agricultural education regarding program support. As can be seen in Table 4, mean scores of teacher perceptions regarding program support ranged from 3.21-3.47.

The highest mean score statement was "Science teacher support will increase if I integrate more science into the Agricultural Education program" with 40/78 (51.3%) of respondents in "agree" or "strongly agree" categories. It should be noted that two of the top three statements (local administrator support and school counselor support) found below were the same in the Balschweid & Thompson (1999) study of Indiana Agricultural Science &

Business Teachers and the Thompson and Balschweid (1999) study of Oregon Agricultural Science and Technology Teachers.

Table 4

South Carolina Agricultural Educators' Perceptions of Program Support Toward the Integration of Science Into Their Agricultural Education Program (N = 78)

Program Support	M	SD
Science teacher support will increase if I integrate more science into the Agricultural Education program.	3.47	.80
Local administrator support will increase if I integrate more science into the Agricultural Education program.	3.41	.80
School counselor support will increase if I integrate more science into the Agricultural Education program.	3.37	.87
Community support will increase if I integrate more science into the Agricultural Education program.	3.31	.79
Other teacher support will increase if I integrate more science into the Agricultural Education program.	3.23	.84
Parental support will increase if I integrate more science into the Agricultural Education program.	3.21	.84

Note. Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

Conclusions/Recommendations/Implications

This study resulted in the following conclusions and recommendations. South Carolina agriculture teachers perceive (73.1% agreed or strongly agreed) they can teach integrated biological and physical science concepts in their agriculture courses. Many programs in South Carolina offer horticultural sciences and agricultural mechanics, which may lead to a higher comfort level in the physical and biological sciences. These facts may explain teacher ease incorporating a new subject, however the question still exists – why has this not occurred?

In order for agriculture programs to integrate science, identification of existing barriers is necessary. Teachers indicated that lack of equipment, funding and lack of in-service training were the greatest barriers that exist. These same barriers (as well as other categories) were noted in studies in other states by Thompson and Balschweid (1999) and Balschweid & Thompson (1999). Findings from this study were very similar to those conducted with Indiana Agricultural Science & Business Teachers and Oregon Agricultural Science and Technology Teachers, adding validity to their conclusions and recommendations. In past years, budgets for funding in agriculture programs have generally focused on purchase of traditional vocational agriculture equipment. Shifting some of the spending focus from traditional to agriscience-related equipment might serve as a viable solution (Agnew, Lipford, & Clements, 1993).

Another aspect of this study queried agriculture teachers' perceptions of the teacher education program at Clemson University relating to agriscience integration. Undergraduate education of agriscience concepts was found to have the highest priority ($\underline{M}$ = 4.21) among teachers. This implies that teachers recognize the pre-service program must initiate change toward agriscience instruction systemically. However, teachers indicated another priority should be in-service programming ($\underline{M}$ = 4.15). Both of these findings support the new mission of the Department of Biology Instruction and Agricultural Education as previously discussed.

Based on the findings of this study, the recommendations are as follows:

1. State equipment lists should include recommendations of specific agriscience-related equipment;
2. State-level funding should be appropriated to develop a planned program for in-service in agriscience for agriculture teachers;
3. Teacher education faculty at Clemson University should encourage pre-service students to develop equipment lists that consider agriscience concepts and applications;
4. Secondary agriculture teachers should consider funding from external sources, such as the Secondary Education Challenge Grants program funded by the United States Department of Agriculture;
5. Faculty in BIAE should develop an extensive program that offers regular in-service on agriscience concepts;
6. Faculty in BIAE should develop hands-on activities that use inexpensive supplies to ease funding concerns of agriculture teachers;
7. Faculty in BIAE should collaborate with faculty in the Agricultural Mechanics program at Clemson to develop undergraduate instruction and teacher in-services that promote teaching the process of physical science and not product in agricultural mechanics as suggested by Osborne (1992), and
8. In-service for agriculture teachers should include invitations for local biology/science teachers to encourage collaboration and resource sharing between programs.

The findings of this study warrant the following recommendations for future research related to the integration of science into agricultural education:

1. A longitudinal study of teacher attitudes and perceptions as opportunities are provided to agriculture teachers by BIAE faculty;
2. Faculty in BIAE should initiate a longitudinal study of undergraduate students in the program 1) prior to graduation to observe paradigms related to science integration and 2) following graduation concerning science integration as teachers;
3. Studies should be conducted on the efficacy of teacher in-service programs, and
4. Studies should be initiated to assess improvements in secondary agriculture students' learning through science integration.

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