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INTEGRATING SCIENCE IN AGRICULTURAL EDUCATION: ATTITUDES OF INDIANA AGRICULTURAL SCIENCE AND BUSINESS TEACHERS

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Abstract

The purpose of this study was to determine how Indiana Agricultural Science and Business (ASB) teachers perceived the impact of integrating science on agricultural education programs. The population consisted of all Indiana ASB teachers employed during the fall 1999 semester (N = 243). The Integrating Science Survey Instrument developed by Thompson (1996) was used to identify the perceptions of the ASB instructors. From the data it was concluded that many of Indiana's Agricultural Science and Business instructors have responded positively to the call for the integration of science into the agricultural education curriculum. As a result of their efforts, over half of the teachers reported their students receive science credit toward high school graduation after successfully completing one or more of the approved Agricultural Science and Business courses. Indiana Agricultural Science and Business teachers agreed they felt prepared to teach integrated biological science concepts but that it required more preparation time than before they integrated scientific concepts into their agricultural education curriculum. Teachers identified specific barriers to integrating scientific concepts into their programs as a lack of appropriate equipment, and a lack of adequate funding to support their integration efforts.

Introduction/Theoretical Framework

The notion of integrating more scientific concepts into agricultural education programs has been supported from various sources for over a decade (National Commission on Excellence in Education, 1983; National Academy of Sciences, 1988; Secretary's Commission on Achieving Necessary Skills, 1991). More recently, the United States Department of Agriculture funded a competitive grants program designed to strengthen agricultural education with the specific intent to prepare more students to pursue careers in agriscience and agribusiness by incorporating agriscience into science, business, and consumer education programs (Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, 1999).

In fact, the call for increased integration of academic and applied concepts can be heard from both academic and vocational sources. The American Association for the Advancement of Sciences has recommended connecting what students learn in school through interdisciplinary links, real-world connections, and connections to the world of work (American Association for the Advancement of Science, 1993). Furthermore, research findings have supported the claim that integration of science into agriculture curricula is a more effective way to teach science and that students taught by integrating agricultural and scientific principles demonstrated higher achievement than did students taught by traditional approaches (Enderlin & Osborne, 1992; Enderlin, Petrea, & Osborne, 1993; Roegge & Russell, 1990; Whent & Leising, 1988).

Currently, in Indiana, curriculum reform encompasses every level of instruction from primary through pre-service and in-service teacher education. Purdue University Agricultural Education faculty are in the process of restructuring the plan of study used to prepare Agricultural Science and

Business teachers in Indiana. At the center of the debate: What courses should be required of undergraduate Agricultural Education majors to prepare them for teaching secondary Agricultural Science and Business in the 21st century? And, what significant factors exist that cause teachers in the classroom to integrate science into the agriculture curriculum? Several researchers have recommended that in-service programs be offered to assist teachers in integrating science into the agricultural education curriculum as a means of encouraging more integration of curricula (Kirby, 1990; Neason, 1992; Newman & Johnson, 1994; Thompson & Schumacher, 1997).

However, before significant changes are made in the current undergraduate teacher education program, it is important to measure the perceptions and practices of teachers now in the field. The perceptions and attitudes of practitioners can add significant evidence that could influence what courses and experiences should be included in the teacher education program and future teacher in-service workshops.

The theoretical/conceptual model that supports the integration of science with applied sciences is found in brain-based theory. Caine and Caine (1994) summarize that various disciplines relate to each other and share common information that the brain can recognize and organize. They also add, "the part is always embedded in a whole, the fact is always embedded in multiple contexts, and a subject is always related to many other issues and subjects" (p. 7).

In a national study, Thompson (1996) found that Agriscience teachers perceived that undergraduates would be better prepared to teach if they received instruction on how to integrate science and if they student taught with a cooperating teacher who integrated science. Thompson also concluded that agriscience teachers believed teacher preparation programs should provide in-service training for teachers on how to integrate science and recommended that in-service programs be offered to assist teachers in integrating science into the agricultural education curriculum.

Waters and Haskell (1989) emphasized that involving the learners in the process of planning an in-service education program increases the likelihood of implementing relevant programs. Norris and Briers (1989, p. 42) stated that "teachers' perceptions toward the change process (need for the change, amount of teacher input into the change process, and manner in which the change was managed, etc.) is the single best predictor of the teacher's…decision concerning adoption of the change."

Purpose/Objectives

The purpose of this study was to determine how Indiana Agricultural Science and Business (ASB) teachers perceived the impact of integrating science on agricultural education programs. To fulfill the purposes of the study, the following research questions were addressed:

1. What are the selected demographic characteristics of Indiana ASB teachers?
2. What were the perceptions of ASB teachers concerning teaching integrated science?
3. What are the barriers to integrating science in the agricultural education program as perceived by Indiana Agricultural Science and Business teachers?
4. What are the ASB teachers' perceptions concerning student enrollment since integrating science into their agricultural education program?
5. What are the ASB teachers' perceptions concerning support of the agricultural education program since integrating science?

Methods/Procedures

The population for this study consisted of current Indiana ASB teachers (N = 243). Purdue University's Agricultural Education Program provided the researchers with a current database containing the name and school address of each teacher. Caution should be exercised when generalizing the results of the study beyond the accessible sample.

Elements of the Integrating Science Survey Instrument developed by Thompson

(1996) were used to identify the perceptions of the ASB instructors. Statements were added to the survey instrument to acquire state specific information concerning teacher preparation curriculum reform efforts. As a measure of the reliability of the attitude scale, internal consistency was established using Cronbach's alpha. Internal consistency for the instrument was measured at $\alpha = .84$.

The survey instrument and cover letter were mailed to the subjects. Elements of Dillman's Total Design Method (1978) were utilized to achieve an optimal return rate. Usable responses were received from 170 teachers for an overall response of 70%. Nonresponse error was examined by comparing early and late respondents utilizing a t-test. The subsequent t-values verified that the difference between early and late respondents was not statistically significant.

The authors agreed a priori, for the purpose of reporting, that aggregate mean responses for the Likert-type statements would be grouped into categories to aid in interpretation. Responses equivalent to 4.50 or higher were categorized as "strongly agree." Responses ranging from 3.50 to 4.49 were categorized as "agree", and those with mean scores ranging from 2.50-3.49 were categorized as "neutral." Responses ranging from 1.50 to 2.49 were categorized as "disagree", while those responses receiving mean scores lower than 1.50 were categorized as "strongly disagree."

Results/Findings

Research question one sought to determine demographic information for the respondents involved. Indiana's Agricultural Science and Business teachers reported an average age of 40.2 years (*SD*=11.0), had 15.4 years (*SD*=10.6) of teaching experience, and had taught approximately 13.1 years (*SD*=10.5) at their current school. Almost three out of four teachers (72.2%) responded positively when asked if they had attended a workshop on integrating science into the agriculture curriculum, while 39.1% of teachers surveyed indicated they possessed a science endorsement. Slightly more than half of the teachers (56.2%) reported their students received science credit for successful completion of one or more of the approved Agricultural Science and Business courses taught in their Agricultural Education program.

For research questions two through five the participants were asked to respond to 33 statements regarding integrating science into their Agricultural Education Programs. Their responses were measured using a five-point Likert-type scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree. The raw mean scores for the 33 statements ranged from a low of 2.35 for the statement "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 4.41 for the statement "people pursuing a career in agriculture must have a greater understanding of biological science than ten years ago". Overall, none of the items in the instrument were rated above 4.50. Indiana Agricultural Science and Business teachers rated 42% of the statements (14 items) between 3.50 and 4.49 on a five-point Likert-type scale indicating they "agreed" with the statement. Eighteen statements (53%) were rated between 2.50 and 3.49 on the five-point scale indicating respondents were "neutral" concerning the statement, and one statement (5%) was rated with a score between 1.50 and 2.49 indicating teachers "disagreed" with the contents of the statement. None of the items in the instrument were rated below 1.50.

Research question two asked teachers their perceptions concerning integrating science. The results from 13 questions used to determine teacher attitudes toward this concept are shown in Table 1. Scores in this section ranged from 3.45 to 4.41, indicating respondents generally agreed with the statements, while the statement "people pursuing a career in agriculture must have a greater understanding of biological sciences than ten years ago" received the highest rating.

Table 1
Indiana Agricultural Science and Business Teachers' Perceptions of Teaching Integrated Science (N = 170)

Teaching Integrated Science Item	*Mean*	*SD*
People pursuing a career in agriculture must have a greater understanding of biological science than ten years ago.	4.41	.75
Science concepts are easier to understand for students when science is integrated into the agricultural education program.	4.27	.67
Students are better prepared in science after they completed a course in agricultural education that integrated science.	4.26	.68
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.	4.18	.71
People pursuing a career in agriculture must have a greater understanding of physical science than ten years ago.	4.11	.82
Students learn more about agriculture when science concepts are an integral part of the instruction.	4.02	.77
I feel prepared to teach integrated biological science concepts.	3.89	.86
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.	3.86	.89
I teach integrated science concepts in agricultural education that focus more on the biological science concepts than the physical science concepts.	3.81	.86
I feel prepared to teach integrated physical science concepts.	3.71	.91
I have integrated more science in the advanced courses than the introductory courses that I teach in agricultural education.	3.60	1.04
Integrating science into agriculture classes has increased my ability to teach students to solve problems.	3.47	.79
Students are more motivated to learn when science is integrated into the agricultural education program.	3.45	1.03

Research question three asked teachers to identify perceived barriers to integrating science into their agricultural education program. The results from the nine statements used to determine teacher opinions regarding this concept are illustrated in Table 2. Scores in this section ranged from 2.35 to 4.14 with the statement "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" receiving the lowest score.

Table 2
Indiana Agricultural Science and Business Teachers' Perceptions of Barriers to Integrating Science Into Their Agricultural Education Program (N = 170)

Barriers to Integrating Science	*Mean*	*SD*
The lack of appropriate equipment is a barrier to integrating science into the agricultural education program.	4.14	.89
The lack of adequate federal, state, or local funds is a barrier to integrating science in the agricultural education program.	3.66	1.08
The lack of agriscience in-service workshops/courses for agricultural education teachers is a barrier to integrating science into the agricultural education program.	3.31	.98
The lack of close proximity to high-technology firms is a barrier to integrating science in agricultural education programs.	3.15	.92
The lack of an integrated science curriculum is a barrier to integrating science into agricultural education programs.	3.12	.93
The lack of student preparation in science (prior to enrolling in agricultural education) is a barrier to integrating science into agricultural education programs.	3.08	1.03
The lack of science competence among teachers in agricultural education is a barrier to integrating science in agricultural education	3.02	.95
The lack of agriscience jobs in the local community is a barrier to integrating science into agricultural education programs.	2.84	1.01
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.	2.35	.87

Research question four asked the perceptions of Agricultural Science and Business teachers towards student enrollment since integrating science into their agricultural education programs. Five statements were included in this section. Scores in this section ranged from 3.11 to

3.63 with the statement "high ability students are more likely to enroll in agricultural education courses that integrate science" receiving the highest mean score in this section. This section also exhibited the highest degree of variance of any section with all standard deviations exceeding .90. The response of teachers in the area of student enrollment is shown in Table 3.

Table 3
Indiana Agricultural Science and Business Teachers' Perceptions of Student Enrollment Since Integrating Science Into Their Agricultural Education Program (N = 170)

Student Enrollment Item	*Mean*	*SD*
High ability students are more likely to enroll in agricultural education courses that integrate science.	3.63	1.06
Average ability students are more likely to enroll in agricultural education courses that integrate science.	3.45	.90
Total program enrollment in agricultural education will increase if I integrate more science into my program.	3.44	.95
Low ability students are more likely to enroll in agricultural education courses that integrate science.	3.19	1.14
Integrating science into the agricultural education program more effectively meets the needs of special population students (i.e., learning disabled).	3.11	1.00

Research question number five asked Agricultural Science and Business teachers for their perceptions regarding support of the agricultural education program since integrating science. Six statements made up this category in which teachers scored all six items higher than 3.00. The statements concerned teacher perceptions of program support from school personnel, parents, and community supporters if more science were integrated into the agriculture curriculum. The scores for this section are illustrated in Table 4.

Table 4
Indiana Agricultural Science and Business Teachers' Perceptions of Program Support Since Integrating Science Into Their Agricultural Education Program (N = 170)

Program Support Item	*Mean*	*SD*
Local administrator support will increase if I integrate more science into the Agricultural Science and Business program.	3.45	.99
School counselor support will increase if I integrate more science into the Agricultural Science and Business program.	3.45	.97
Parental support will increase if I integrate more science into the Agricultural Science and Business program.	3.35	.86
Community support will increase if I integrate more science into the Agricultural Science and Business program.	3.26	.88
Science teacher support will increase if I integrate more science into the Agricultural Science and Business program.	3.19	.99
Other teacher support will increase if I integrate more science into the Agricultural Science and Business program.	3.16	.86

The final section of the survey asked subjects to respond to two open-ended questions. The first question asked teachers what they had to "give up" or what did they believe they "had to give up" in the Agricultural Science and Business program to develop a more integrated science curriculum. Eighty-two respondents (48.2%) provided answers to this question. The most common response was preparation and/or personal time. Of those who answered the question, 30 respondents (36.6%) indicated they had less time to prepare for classes and/or less personal time during their teaching day as a result of integrating or planning to integrate science into the Agricultural Science and Business curriculum. Twelve respondents (14.6%) believed they had lost or would have to give up "good farm kids" as a result of integrating science into their program. Additional items Agricultural Science and Business instructors indicated giving up as a result of integrating science included "FFA instruction" (8.5%), instruction in production agriculture (8.5%), and instruction in agricultural mechanization (8.5%). No other item was listed by more than three teachers.

A second open-ended question sought to identify the factor(s) responsible for Agricultural Science and Business teachers integrating science into their curriculum. Of the 125 responses given, teachers indicated the opportunity for students to receive science credit for successful completion of Agricultural Science and Business courses as the motivating factor more than any others listed (30.4%). Other commonly occurring responses included a general desire to better prepare kids for their future (20.0%), their programs were in need of more students (16.8%), and they wanted to gain more academic-minded students (8.0%). No other item was reported by more than four teachers.

Conclusions/Implications/ Recommendations

From the data, it was concluded that many of Indiana's Agricultural Science and

Business instructors have responded positively to the call for the integration of science into the agricultural education curriculum. Seventy percent of the teachers have attended a workshop on integrating science into their curriculum. Forty percent of Indiana's Agricultural Science and Business teachers responding to possessing a science endorsement, and over half of the teachers reported their students receive science credit toward high school graduation after successfully completing one or more of the approved Agricultural Science and Business courses. This concurs with Waters and Haskell (1989) and Norris and Briers (1989), supporting their theory that if teachers respond positively to the concept of integrating science into the agricultural education curriculum, it increases the likelihood they will be positive toward implementing science into their Agricultural Science and Business programs.

It can be concluded that Indiana Agricultural Science and Business teachers agreed they were prepared to teach integrated biological and physical science concepts, but that it required more preparation time than before they integrated scientific concepts into their agricultural education curriculum. Making changes to how curriculum is delivered can take time. Therefore, it is recommended that university faculty and state staff in agricultural education provide workshops for in-service and pre-service teachers on integrating science into the agricultural education program to help reduce the time required for providing a more science-rich curriculum. Furthermore, it is recommended that pre-service training for Agricultural Science and Business teachers focus on the methods of integrating science with applied science to shorten the time period needed to integrate curricula once those teachers reach the field.

Teachers identified specific barriers to integrating scientific concepts into their programs. The three barriers receiving the highest scores on the Likert-type scale included a lack of appropriate equipment, a lack of adequate funding to support their integration efforts, and a lack of in-service workshops and courses for learning how to integrate science into their curriculum. It is recommended that teachers pursue extramural funding from sources such as the United States Department of Agriculture's Competitive Grants Program to secure funding to purchase needed equipment and supplies. In addition, the Competitive Grants Program can be used to fund in-service workshops for teachers who desire training in curriculum integration.

Teachers disagreed that a lack of a science teacher willing to help them was a barrier to integrating science into their agricultural education program. It is concluded that Agricultural Science and Business teachers believe science teachers in their building are helpful and willing to offer their assistance to Agricultural Science and Business teachers in their efforts to integrate science into their curriculum. Therefore, it is recommended that Agricultural Science and Business teachers look to science teachers and their schools' science departments for assistance in borrowing equipment and supplies and capitalizing on the opportunity to receive assistance in curricular planning for integrating science into the agricultural education curriculum.

Indiana Agricultural Science and Business teachers were unsure of the effect that integrating science had upon student enrollment in the agricultural education program. Teacher perceptions were mostly neutral to statements indicating students, regardless of ability level, were drawn to their program as a result of integrating science into the agricultural education curriculum. However, many instructors indicated the reason for integrating science into their curriculum was to boost student enrollment. Further studies should focus on the impact that integrating science into agricultural education programs has on the number and ability level of students enrolling in Agricultural Science and Business programs. Although over half of Indiana's Agricultural Science and Business teachers report their students receive credit toward high school graduation for the completion of one or more Agricultural Science and Business courses, currently no Agricultural Science and Business courses count toward university entrance requirements. It is recommended that university faculty in agricultural education, state agricultural education staff, and

Agricultural Science and Business teachers petition the appropriate governing authorities for the purpose of approving the Agricultural Science and Business courses which satisfy current high school science competencies to be included as meeting university admissions.

Finally, teachers were unsure how stakeholders would respond as a result of integrating science into the agricultural education program. Teachers neither agreed nor disagreed that administrators, counselors, parents, community members, or science teachers would increase their support of the agricultural education program if they integrated more science into the curriculum. Therefore, it is recommended that Agricultural Science and Business teachers publicize their efforts to increase the science content of the local agricultural education program.

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