

## **INTEGRATING SCIENCE INTO AGRICULTURE PROGRAMS: IMPLICATIONS FOR ADDRESSING STATE STANDARDS AND TEACHER PREPARATION PROGRAMS**

*Gregory W. Thompson, Assistant Professor*  
Oregon State University

*Mark M. Balschweid, Assistant Professor*  
Purdue University

### **Abstract**

*The purpose of this study was to determine the attitudes of Agricultural Science and Technology teachers toward integrating science into their curricula. Perceptions regarding integrating science and agriculture, the role of teacher preparation programs in integrating science, and integrating science to meet state standards indicated teachers had a positive attitude toward integrating science into agricultural education programs. More specifically, teachers believed that integrating science assists students in better understanding science concepts and their application to agriculture. According to the teachers in this study, students are more aware of the connection between scientific principles and agriculture and students are better prepared in science after completing a course in agricultural education that integrated science. Teachers felt that teacher preparation programs should provide instruction at the pre-service and in-service level on how to integrate science into the curriculum and that student teachers should be placed with cooperating teachers who integrate science into their agriculture programs. As many states face educational reform, teachers contend that integrating science is a solution in helping students and aligning agriculture programs to meet state standards and that little or no changes will have to be made for agriculture programs to facilitate educational reform.*

### **Introduction/Theoretical Framework**

The American Educational system is currently undergoing reform in funding, governance structures, curriculum standards, staff development, assessment and student support services (Fraser, 1996). Oregon set its course for improved student performance when the legislature passed the Oregon Educational Act of the 21<sup>st</sup> Century. The Act calls for raising student achievement by setting higher standards in curriculum, instruction and accountability (Oregon Department of Education, 1998). The new standards specify what students should know and be able to do in English, math, science, social studies, the arts, second language, and career-related learning.

The pressures of increasing state standards

have caused concern among many agricultural educators in Oregon. Increased high school graduation requirements have put pressure on agricultural programs by limiting opportunities for students to enroll in elective courses. Changing college entrance requirements have further challenged secondary agricultural educators to make their programs become more than just 'vocational'. Johnson (1995) reported that Arkansas teachers perceived that offering science credit for agriculture courses would increase enrollment, benefit students, and enhance the program image.

Although science has been a part of agricultural education since the passage of the Hatch Act in 1887 (Budke, 1991; Christian & Key, 1994; Hillison, 1996; True, 1929; Vaughn, 1993), it wasn't until 1988 when the National Research

Council gave a distinct charge to researchers to define methods necessary to guide educators as they updated their curriculum to make it more science based. Buriak (1992) defined agriscience as “instruction in agriculture emphasizing the principles, concepts and laws of science and their mathematical relationships supporting, describing, and explaining agriculture” (p. 4)

Policy makers, educators, employers, scholars and social critics have advocated vocational education reform that dealt with ‘integration’ (Stasz, Kaganoff, & Eden, 1994). According to researchers (Stasz & 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.

Teacher educators can benefit from reviewing current research to establish a baseline for curriculum changes in their own states. In a Louisiana study, researchers found that educators perceived in-service workshops to be the most effective means for learning about biotechnology (Kirby, 1990). Neason (1992) stated:

The development of teacher in-service programs is the next step for implementing the revised agricultural science curricula. Information is needed to identify the technical areas which teachers feel they need in-service assistance in. This information will serve as a basis for planning in-service programs (p. 113).

In developing significant changes in educational programs, assessing perceptions of practicing teachers is an important first step in the process. 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. Furthermore, Norris and Briers (1989, p.42) stated “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.” And finally, Fullan (1991) indicated, even the most promising innovation may be doomed to failure if teachers do not support its implementation. As applied to this study, if teachers have a positive attitude toward integrating science, they will likely support and become actively involved in integrating science into their program.

The theoretical/conceptual model that supports the integration of science with applied sciences is found in brain-based theory where Caine and Caine (1994) summarize that various disciplines relate to each other and share common information that the brain can recognize and organize. The authors 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). Evidence exists that student performance increases when students are taught courses that integrate science and agriculture (Roegge & Russell, 1990).

Finn, Petrilli, and Vanourek (1998) contended that state standards would improve with time. Raising standards for student achievement and increasing the knowledge and skills of graduates are occurring separately in most states (Koki, 1998). Educational agencies must ascertain the perceptions of educators and external stakeholders to determine the effectiveness of educational reform. Will integrating science into the agricultural education curricula be a solution to helping students achieve higher state standards?

### **Purpose/Objectives**

The purpose of this study was to determine how Oregon Agricultural Science and Technology

(AST) teachers perceived the impact of integrating science in agricultural education programs. To fulfill the purposes of the study, the following research questions were addressed:

1. What were selected demographic variables of Oregon AST teachers?
2. What were the perceptions of AST teachers concerning teaching integrated science?
3. What were the AST teachers' perceptions concerning the role of teacher preparation programs in integrating science into agricultural education programs?
4. What effects will state standards have on agricultural education programs as perceived by AST teachers?

### Methods/Procedures

The target population for this study consisted of current Oregon Agricultural Science and Technology (AST) teachers ( $N = 111$ ). The Oregon Department of Education 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.

The Integrating Science Survey Instrument developed by Thompson and Schumacher (1997) was used to identify the perceptions of the AST instructors. Three additional questions were added to the survey to acquire state specific information. The authors (Thompson and Schumacher, 1997) established validity and reliability of the instrument.

The survey instrument and cover letter were mailed to the subjects. Two weeks after the initial mailing, a telephone call was placed and/or an e-mail message was sent to all non-respondents. Usable responses were received from 106 teachers for an overall response of 95.5%. Comparing

early and late respondents on the mean attitude scales using a f-test controlled non-response error. The t-values showed the attitude means were not statistically significant.

### Results/Findings

The average respondent was 41 years old ( $SD = 9.3$ ), male (92%) with 14.3 years of teaching experience ( $SD = 8.95$ ) and had taught approximately 11 years at his current school ( $SD = 8.4$ ). Over 77% of the respondents had been enrolled in agricultural education as high school students. Almost 61% of those enrolled completed four years of high school agricultural education courses.

The respondents indicated that 84% had participated in inservice workshops/course(s) that taught them how to integrate science into their curricula. Of the 84% that attended integrating science workshops, 18% had participated in one workshop, 23% had participated in two workshops, 12% had participated in 3 workshops, and 22% had participated in four or more workshops that taught them how to integrate science. While 49.5% of the respondents indicated their students receive science credit for agricultural education classes in their school, 50.5% indicated students in their classes did not receive science credit for agricultural education classes. One in every five (23%) respondents reported they currently had a teaching license with a science endorsement.

The respondents 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. Cronbach's Alpha for reliability was .77.

Table 1 presents the means and standard deviations for Oregon AST teachers' perceptions of integrating science. Research question number

Table 1. Teacher's Perceptions of Integrating Science and Agriculture (N = 106)

Integrating Science and Agriculture Item	M	SD	Agreed/Strongly Agreed	
			f	%
Science concepts are easier to understand for students if science is integrated into the agricultural education program.	4.52	.53	103	98.1
People pursuing a career in agriculture must have a greater understanding of biological science than ten years ago.	4.51	.64	99	94.3
Students are more aware of the connection between scientific principles and agriculture when science concepts are an integral part of their instruction.	4.47	.55	102	97.2
Students are better prepared in science after they completed a course in agricultural education that integrated science.	4.40	.65	96	91.5
Students learn more about agriculture when science concepts are an integral part of their instruction.	4.18	.72	87	82.9
People pursuing a career in agriculture must have a greater understanding of physical science than ten years ago.	4.18	.72	90	85.7
Students will be more motivated to learn when science is integrated into the agricultural education program.	3.69	.82	61	58.1

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

2, "Agriculture and Science" contained seven items with mean scores that ranged from 3.69 - 4.52. Only one item had a mean score below 4.0, however, 58.1% of the respondents still agreed or strongly agreed that students will be more motivated to learn when science concepts are integrated into the agriculture curriculum.

Two open-ended questions were asked to teachers regarding integrating science into the agricultural education program. Teachers were asked what had to be given up or what they will have to give up to develop a more integrated science curriculum. Of the seventy-one responses to this question, the most common response was: "nothing" (43.66%), followed by "traditional agriculture classes" (15.49%), "time" (12.68%), and "hands-on activities" such as agricultural mechanics (11.27%). The most commonly listed items that caused or will cause the respondents to integrate science were "update curriculum" (22.66%) the "need to integrate" agriculture and science (21.33%) "student needs" (20%) and

"enrollment" ( 10.67%).

Research question three was designed to address the teachers perceptions of the role of teacher preparation programs regarding their role in assisting teachers in integrating science. Mean scores ranged from 3.33 - 4.26 (Table 2). Oregon AST teachers agreed (mean scores greater than 4) that teacher preparation programs should provide instruction for undergraduates (8 8.7% agreed or strongly agreed) and inservice for teachers (90.5% agreed or strongly agreed) on how to integrate science into the agricultural education program. It can also be noted that 6 1.9% of the respondents agreed or strongly agreed that teacher preparation programs should place student teachers with a cooperating teacher that integrates science into the curriculum.

Research question four (Table 3) contained three items that addressed state standards or Certificate of Initial Mastery (CIM) and Certificate of Advanced Mastery (CAM). Two of the three

Table 2. Teachers' Perceptions Concerning the Role of Teacher Preparation Programs in Integrating Science in Agricultural Education Programs (N= 106)

Teacher Preparation Programs Item	<u>M</u>	SD	Agreed/Strongly Agreed	
			<u>f</u>	%
Teacher preparation programs should provide instruction for undergraduates on how to integrate science.	4.26	.70	95	90.5
Teacher preparation programs should provide inservice for teachers in the field on how to integrate science.	4.21	.70	93	88.7
Teacher preparation programs should place student teachers with a cooperating teacher that integrates science into the agricultural education program.	3.73	.88	65	61.9
Teacher preparation programs should require that students conduct their early field experience program with a teacher that integrates science.	3.39	.89	54	51.4
Teacher preparation programs should require students to take more basic science courses.	3.38	1.03	55	52.4
A follow-up inservice activity requiring agriculture teachers to cooperate with a science teacher in their district to integrate science.	3.33	.99	48	45.7

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

Table 3. Teachers' Perceptions Concerning Integrating Science to Meet State Standards (N = 106)

Meeting State Standards Item	<u>M</u>	<u>SD</u>	Agreed/Strongly Agreed	
			<u>f</u>	%
Integrating science will support AST Programs by helping our students meet CIM/CAM requirements.	4.21	.66	98	94.3
Integrating science will help align AST Programs with emerging educational standards (CIMKAM).	4.17	.61	93	88.6
State standards (CIM/CAM) will be an asset to what I am trying to do in my AST Program.	3.64	.89	65	61.9

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

items in this category had mean scores that were above 4.0. Respondents agreed that integrating science will support AST Programs by helping students meet CIMKAM requirements (m = 4.21) and that integrating science will help align AST programs with emerging educational standards (m = 4.17). Although the mean score

was below 4.0, almost 62% of the teachers agreed that state standards would be an asset to their Agricultural Science and Technology Program.

Participants were asked to respond to an open-ended question concerning changes that AST Programs would have to go through to meet state

standards (CIM/CAM). Of the 66 responses, most teachers felt that “no changes” (42.42%) would have to be made to meet state standards. “Integrating science” (15.15%), and “don’t know” (13.63%) were the changes most often listed that respondents felt would have to be made to meet state standards.

## Conclusions and Recommendations

Based on the findings of this study, the following conclusions and recommendations were drawn

A majority of Oregon’s Agricultural Science and Technology teachers have a positive attitude toward integrating science into their programs. Almost one-fourth of Oregon’s AST teachers reported having a teaching credential with a science endorsement, while 50% of the teachers indicated their students receive science credit for agriculture classes in their school. Consequently, 84% of the teachers have attended a workshop on integrating science into their curriculum. Teachers should be encouraged to earn their science endorsement, especially if they desire to teach agriculture for science credit. Teacher preparation programs will be putting their students at a distinct advantage if they assist them in attaining their science endorsement upon entering the teaching profession.

Oregon AST teachers believed that integrating science assists students in more thoroughly understanding science concepts and their application to agriculture. This concurs with the findings of Enderlin and Osborne (1992) and Thompson and Schumacher (1997) that integrating science will produce more science literate students who are better prepared to compete in today’s society. According to teachers, students are more aware of the connection between scientific principles and agriculture when science concepts are an integral part of instruction. Moreover, teachers felt that

students would be better prepared in science after completing a course in agricultural education that integrated science and students would learn more about agriculture when science concepts are an integral part of their instruction. Teachers felt that agriculture is changing and people pursuing careers in agriculture must have a better understanding of biological and physical sciences in the next decade. Consequently, more teachers emphasized a greater understanding of biological sciences (94%) than physical sciences (85%) necessary for future careers in the agriculture industry. In-service workshops and business/industry tours that demonstrate the use of biological and especially physical sciences in agriculture will assist teachers in infusing these scientific concepts into their curriculum and understanding the importance of both biological and physical sciences in agricultural careers.

Teachers felt that teacher preparation programs should provide instruction on how to integrate science into the curriculum as a part of the undergraduate curriculum and as in-service for practicing teachers. Teacher education programs need resources to develop and implement courses that focus on an integrated track. Universities also need support to disseminate integrated information in the form of workshops and in-service programs for teachers in the field. Consequently, teachers were undecided as to the concept “more is better” concerning adding additional science courses to pre-service teachers’ curriculum. Undergraduates don’t necessarily need more science courses, but more instruction on how to integrate science. Teacher educators should develop coursework and inservice activities that demonstrate using agricultural contexts to integrate science.

Most teachers agreed that student teachers should be placed with a cooperating teacher that integrates science into the agricultural education program. Teacher preparation programs should identify programs that are doing a good job of integrating science into their programs and consider these as placements for student teachers.

Student teachers will better understand the concept of integrating science if they learn from a practicing teacher that integrates science. These placement centers will also give student teachers the opportunity to practice integrating science into the curriculum under the guidance of a mentor teacher.

Oregon AST teachers felt that integrating science is an important component in helping students meet the standards involved in Oregon's Certificate of Initial Mastery (CIM) and Certificate of Advanced Mastery (CAM). Teachers believe that integrating science will help align Agricultural Science and Technology (AST) Programs to meet educational standards. Will agriculture programs survive this round of educational reform and state standards? It is the belief of many Oregon agriculture teachers that little or no changes will have to take place in agricultural education programs to facilitate educational reform. Further research is needed to determine if administrators and school boards hold the same perceptions.

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