

## SCIENCE CREDIT FOR AGRICULTURE: PERCEIVED SUPPORT, PREFERRED IMPLEMENTATION METHODS AND TEACHER SCIENCE COURSE WORK

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### Abstract

Arkansas agriculture teachers ( $N=259$ ) were surveyed to obtain information needed by a planning committee studying the issue of science credit for agriculture. Objectives were to determine: (a) the level of support for granting science credit for agriculture; (b) teachers' support for methods of granting science credit for agriculture for agriculture; (c) teachers' support for methods of certifying teachers to offer science credit; (d) the extent to which science objectives were being taught in agriculture; and, (e) teachers' undergraduate preparation in science. A majority (88.8%) of respondents supported granting science credit for agriculture. The respondents also perceived that parents (87.4%), administrators (76%), guidance counselors (75%) and science teachers (64.5%) in their school districts would support granting science credit for agriculture. The largest percentage of teachers (65.6%) supported granting science credit for a limited number of existing agriculture courses, with changes made to enhance the science content of the courses. The two methods of certifying teachers to teach agriculture for science credit receiving the most support were: (a) granting a blanket endorsement to all certified agriculture teachers (71.5%) and (b) granting an endorsement to only certified agriculture teachers completing an in-service workshop (56.6%). The respondents reported teaching a majority (55.1%) of the state science objectives studied. As a group, the respondents reported earning the undergraduate credits and grades required for science certification.

Hammonds (1950) provided a compelling argument for teaching agriculture as a science. According to Hammonds:

*The "organized body of knowledge" we call the science of agriculture is deeply rooted in the sciences that contribute to agriculture. If we strip away from agriculture the portions of other sciences that bear upon it, we perhaps do not have left a science of agriculture. To teach agriculture as a science is to recognize that it is a science. (p.5)*

More recently, the National Research Council (1988) recommended that science credit should be granted for certain agriculture courses. Dormody (1993), in a nationwide study, found that approximately 34% of agriculture teachers were

teaching one or more agriculture courses that received science credit.

Several states have implemented new agricultural education curricula that place additional emphasis on the science of agriculture. In Mississippi, agricultural educators introduced two pilot agriscience courses in 41 public secondary schools during the fall 1991 semester. An end-of-year evaluation found that administrators, guidance counselors, science teachers and agriculture teachers in the pilot-test schools strongly supported the agriscience courses and agreed that students completing the courses should receive science credit (Johnson & Newman, 1993; Newman & Johnson, 1993).

Michigan agricultural educators also adopted an agriscience and natural resources (ANR) curriculum during the fall 1991 semester. In an

evaluation study, Conners and Elliot (1994) found that Michigan agriculture teachers supported the new curriculum. The teachers strongly agreed that students should receive science credit for ANR courses.

Science credit for agriculture would constitute a dramatic change in current practice for Arkansas agricultural educators. According to Norris and Briers (1989, p. 42), "Teacher's perceptions toward the change process (need for the change, manner in which the change was managed, and amount of teacher input into the change process, etc.) [is] the single best predictor of the teacher's ... decision concerning adoption of the change." Goodland (1975) and Owens (1987) also noted that teacher readiness is one of the most important variables associated with the success of school change in terms of student outcomes. Thus the current study was conducted to both gather information needed by the planning committee, and to serve as a mechanism for Arkansas agriculture teachers to have input into the change process.

### **Purpose and Objectives**

The purpose of this study was to determine the perceptions of Arkansas secondary agriculture teachers concerning science credit for agriculture. Specific objectives were to determine:

1. the level of support for granting science credit for agriculture, as perceived by agriculture teachers;
2. agriculture teachers' level of support for five methods of granting science credit for agriculture;
3. agriculture teachers' level of support for four methods of certifying teachers to offer science credit for agriculture;
4. the extent to which agriculture teachers provided instruction related to

objectives listed in the Arkansas Science Curriculum Framework (Arkansas Department of Education, 1993); and,

5. the number of undergraduate semester credit hours completed and grades earned in science and mathematics courses, as reported by agriculture teachers.

### **Methods and Procedures**

#### Population

The population for this study was composed of all Arkansas agriculture teachers employed in state reimbursed agricultural education programs during the fall 1994 semester (N=259). Personnel in the agricultural education section of the Arkansas Department of Education provided the researcher with a current database containing the name and school address of each teacher. The entire population of teachers was surveyed.

#### Instrumentation

This study employed the descriptive research design using a mailed survey instrument. The 12-page instrument was designed to collect information on: (a) teacher, school and community support for offering science credit for agriculture (six items); (b) perceived effects of offering science credit (20 items); (c) preferred methods for offering science credit (six items); (d) preferred teacher certification methods (five items); (e) science content currently taught (26 items); (f) college science and mathematics course work and grades (10 items); and, (g) teacher and program characteristics (eight items). Additionally, the back cover of the instrument contained both space and an invitation for written comments concerning science credit for agriculture.

The draft survey instrument was developed by the researcher based on input from the AVATA *ad hoc* committee on science credit for agriculture. The draft survey instrument was administered to 11 senior agricultural education students enrolled in the professional (student teaching) semester to determine if the instructions, items, and response modes were clear. Based on individual written input and group discussion of instructions and items, minor wording changes were made.

Next, the revised instrument was reviewed for face and content validity, as well as clarity, by a committee of state agricultural education staff members attending a fall planning meeting. The committee was composed of the AVATA president, three district supervisors and the state supervisor of agricultural education, one post-secondary agriculture instructor, and seven teacher educators from three universities. The committee judged the instrument to be valid and no changes were suggested.

Finally, the instrument and a draft cover letter were mailed to the six teachers on the AVATA *ad hoc* committee on science credit for agriculture. The teachers were instructed to critically examine the survey instrument (and cover letter) for face and content validity and clarity using specified criteria. One week after the instruments were mailed, the researcher telephoned the committee members to get their input. The committee members responded positively to each of the six specified evaluation criteria. Based on these two reviews (by the state staff and the teacher committee), the instrument was judged to possess face and content validity, as well as clarity.

In order to establish test/retest reliability, a pilot test was conducted with seven upper division pre-service agricultural education teachers enrolled in a methods of teaching agriculture course. The students completed the instrument twice (at 14 day intervals). Based on procedures outlined by Ferguson (1976), Spearman rank-order rho

correlations were calculated for each item and standardized by converting to Fisher's Z scores. Then a mean Fisher's Z score was computed for the items within each of five instrument parts (reliability was not calculated for the teacher/program characteristics section as a part of the pilot test).

The reliability estimates (coefficients of stability) were as follows: (a) teacher, school and community support for offering science credit for agriculture ( $r = .67$ ); (b) perceived effects ( $r = .85$ ); (c) preferred methods for offering science credit ( $r = .83$ ); (d) preferred teacher certification methods ( $r = .83$ ); (e) science content currently taught ( $r = .70$ ); and (f) college science and mathematics course work and grades ( $r = .96$ ). Test/retest reliability was also estimated for the main study using a random sample of 10 respondents. The 10 respondents were contacted by telephone, and using the mailed survey instrument as an interview guide, responses to 26 selected items were obtained. The overall coefficient of stability for the instrument was .72. The period between completion of the mailed survey and the telephone interview varied from 3 to 12 weeks.

#### Data Collection

Data were collected during October - December 1994 following the Dillman (1978) procedure for mail questionnaire administration. An 82% (213 of 259) response rate was obtained after three mailings. To determine if non-response bias was a threat to the study, a random sample of six (13%) non-respondents was contacted by telephone and data were obtained on 32 (39.5%) survey items. A comparison of respondents to non-respondents did not indicate any differences between the two groups. Therefore, the researcher determined that the results were generalizable to the population.

## Results

The average teacher-respondent was 39.1 years of age ( $SD = 9.4$ ), had taught agriculture for 14.2 years ( $SD = 9.0$ ), and worked in a single-teacher department (74.5%). The mean student enrollment per teacher was 84.4 students ( $SD = 30.8$ ).

Over one-half (56.1%) of the respondents reported the bachelors degree as the highest degree earned; 42.9% reported earning the masters degree; and 0.9% held the associates degree. Approximately one in every four (26.9%) respondents reported they currently held a valid certificate to teach science in Arkansas. Of those certified to teach science, 57.6% indicated having taught science in an Arkansas public school.

### Support for Science Credit

As a group, the teachers were strong in their support for granting science credit for agriculture (Table 1). In response to the statement, "I believe students should receive science credit toward high school graduation for agriculture courses," 88.8% agreed, 6.1% were undecided, and 5.1% were opposed.

The teachers also felt that agriculture should be recognized as a science for admission to postsecondary institutions. In response to the statement, "I believe Arkansas colleges and universities should accept agriculture courses as a science credit toward meeting admission requirements," 85.3% agreed, 9.5% were undecided, and 5.2% were opposed.

A majority of the teachers believed that selected educators and parents in their school districts would support granting science credit for agriculture. As shown in Table 1, perceived support was highest among parents and lowest among science teachers.

### Support for Methods of Granting Science Credit

To satisfy objective two, teachers first rated their level of support for each of five methods of granting science credit for agriculture. As shown in Table 2, three of the methods were supported by 60% or more of the respondents. These three methods involved restricting science credit to a specified group of currently existing, modified, or new courses. Less than one-third of the teachers supported granting science credit for all agriculture courses, either with or without changes to enhance the science content of the courses.

Next, teachers selected their one most preferred method of granting science credit for agriculture from the list of five options. The two most favored methods both involved specifying a group of currently existing courses to receive science credit, either with (34%) or without (32%) changes made to enhance the science content of the courses. A sizeable percentage (23.9%) of the teachers preferred granting science credit for new agriculture courses specifically developed to emphasize science applications in agriculture. Small percentages of teachers preferred granting science credit for all agriculture courses, either with (4.6%) or without (5.6%) changes made to enhance the science content of the courses.

### Support for Methods of Certifying Teachers

For objective three, teachers first rated their level of support for each of four methods of certifying teachers to teach agriculture for science credit. The largest percentage of teachers (71.5%) supported granting an endorsement in agricultural science to all teachers currently holding a valid agriculture teaching certificate. Granting an agricultural science endorsement to only those teachers holding valid certificates in both agriculture and science was supported by the smallest percentage (17.9%) of teachers. Table 3 shows the response percentages for each of the four certification methods.

Table 1. Support for Granting Science Credit for Agriculture, as Perceived by Agriculture Teachers

Statement	Disagree %	Neutral %	Agree %
<u>Parents</u> in my school district would support granting science credit toward high school graduation for agriculture courses. (n=210)	2.4	12.9	84.7
My <u>building administrator</u> (principal or vocational director) would support granting science credit toward high school graduation for agriculture courses. (n=208)	6.3	17.8	76.0
The <u>guidance counselor(s)</u> in my school would support granting science credit toward high school graduation for agriculture courses. (n=208)	5.3	19.7	75.0
The <u>science teacher(s)</u> in my school would support granting science credit toward high school graduation for agriculture courses. (n=209)	10.5	25.4	64.5

Table 2. Teachers' Level of Support for Methods of Granting Science Credit for Agriculture

Method	Oppose %	Neutral %	Support %
Award science credit for <u>any one of a specified group</u> of agriculture courses, with changes made to enhance the science content of the courses. (n=212)	16.0	18.4	65.6
Award science credit for <u>any one of several new</u> agriculture courses, specifically designed to teach science applications in agriculture. (n=212)	16.0	20.3	63.7
Award science credit for <u>any one of a specified group</u> of agriculture courses, with no changes in course content. (n=211)	19.9	18.5	61.6
Award science credit for <u>all agriculture courses</u> , with changes made to enhance the science content of courses. (n=211)	53.6	15.2	31.2
Award science credit for <u>all agriculture courses</u> , with no changes in course content. (n=211)	64.0	15.2	20.9

Table 3. Teachers' Level of Support for Methods of Certifying Agriculture Teachers to Offer Science Credit for Agriculture

Method	<u>Oppose</u> %	<u>Neutral</u> %	<u>Support</u> %
Grant an endorsement in <u>agricultural science</u> to all teachers currently holding a valid agriculture certificate. (n=212)	13.8	14.7	71.5
Grant an endorsement in <u>agricultural science</u> to only teachers holding a valid agriculture certificate, <u>and</u> completing a special agricultural science education in-service workshop. (n=212)	24.1	19.3	56.6
Grant an endorsement in <u>agricultural science</u> to only teachers holding a valid agriculture certificate, <u>and</u> scoring above a designated level on an agricultural science achievement test. (n=212)	54.0	25.1	20.8
Grant an endorsement in <u>agricultural science</u> to only teachers holding valid certificates in both agriculture <u>and</u> science. (n=212)	64.6	17.5	17.9

Next, respondents selected their one most preferred method of certifying teachers to teach agriculture for science credit from the list of four options. Granting an agricultural science endorsement to all teachers currently holding a valid agriculture certificate was the most favored method of 43.3% of the respondents. A sizeable percentage (37.8%) of teachers most favored granting an agricultural science endorsement to only those certified agriculture teachers completing an agriscience in-service education workshop. Endorsing only teachers certified in both agriculture and science was the method most preferred by 11.9% of respondents. Finally, 7.0% of respondents most preferred granting an agricultural science endorsement to only those certified agriculture teachers scoring above a designated level on an agricultural science achievement test.

#### Science Content Currently Taught

The Arkansas Science Curriculum Framework (Arkansas Department of Education, 1993) contains 50 learner outcomes (objectives) for secondary school science. These objectives are divided into five strands (content areas): (a) scientific inquiry, eight objectives; (b) connections and applications, six objectives; (c) physical systems, 17 objectives; (d) life systems, nine objectives; and, (e) earth and space systems, 10 objectives.

To assess the degree to which agriculture teachers were currently teaching content related to the state secondary school science objectives, a random sample (proportionally stratified by strand) of 26 objectives (52%) was listed in the survey instrument. For each objective, respondents were instructed to circle "yes" if the objective described content they currently taught in one or more agriculture courses; respondents were instructed to

circle "no" if the objective described content they did not currently teach in any agriculture course.

The respondents taught the highest percentage of objectives in the connections and applications strand, which emphasizes the relationship between science and its common applications. Respondents taught the lowest percentage of objectives in the physical science strand, which emphasizes chemistry and physics. Overall, the teachers reported providing instruction related to slightly over one-half of the 26 objectives investigated. Table 4 summarizes data concerning the science objectives currently taught, as reported by the respondents.

### Undergraduate Credit Hours and Grades in Science and Mathematics

The final objective of the study was to determine the number of credit hours and average grades earned by the respondents in undergraduate science and mathematics courses. The respondents reported earning the most semester credit hours in biology followed by chemistry. Teachers reported earning the least number of credit hours in physics; fewer than 20% of the teachers had taken any course work in this area. Teachers reported earning the highest average grades in earth sciences, while earning the lowest average grades in chemistry. Table 5 summarizes data related to the credit hours and grades earned in science and mathematics, as reported by the teachers.

Table 4. Science Objectives Currently Taught, as Reported by Agriculture Teachers

Strand (Example objective)	Number of Objectives Sampled	Objectives Taught		
		X	SD	%
Connections & Applications (n=206) (Assess the connection between pure science and the world of work.)	3	2.66	.73	88.7
Life Systems (n=201) (Understand that DNA is the basis for genetic transfer.)	5	3.79	1.26	75.8
Scientific Inquiry (n=208) (Perform error analysis on collected data.)	4	2.18	1.20	54.5
Earth/Space Systems (n=202) (Explain how earth materials are conserved and recycled.)	5	2.29	1.33	45.8
Physical Systems (n=199) (Understand the rationale of the periodic chart.)	9	3.53	2.65	39.2
Total (n=188)	26	14.32	5.57	55.1

Table 5. College Science and Mathematics Credit Hours and GPAs, as Reported by Agriculture Teachers

Area	Semester Credit Hours				GPA Earned*			
	n	X	SD	Med.	n	X	SD	Med.
Biology	204	11.58	6.29	10.0	204	2.74	0.66	3.0
Chemistry	210	10.00	3.39	10.0	206	2.43	0.74	2.0
Earth Sciences	209	6.55	4.29	6.0	202	3.04	0.65	3.0
Mathematics	207	4.91	2.83	3.0	203	2.58	0.74	3.0
Physics	197	0.76	1.79	0.0	36	2.78	0.76	3.0

\*Note. Based on A=4, B=3, C=2, D=1, F=0.

### Conclusions and Recommendations

The following conclusions and recommendations, based on the results of this study, have been presented to the *ad hoc* committee on science credit for agriculture, the AVATA board of directors, and the state supervisory staff in agricultural education:

1. Because of the perceived level of support by selected educators and parents, any initiative to secure science credit for agriculture should be planned and conducted as a cooperative effort involving these groups.
2. Science credit should only be sought for a specified group of agriculture courses. A committee of agricultural and science educators should examine the content of currently existing courses to determine if they qualify for science credit, either with or without modification. Consideration should also be given to implementing new courses specifically designed to teach science in agriculture. Knowing that a majority of agriculture teachers support each of these three methods should allow decision makers to select the most educationally sound option(s).
3. Majority support exists for granting certified agriculture teachers an endorsement to teach agriculture for science credit either through blanket certification (certify all teachers holding valid agriculture certificates) or through successful completion of an agriscience education in-service workshop. Even though blanket endorsement has more support among teachers, the researcher recommends that agriscience certification be earned through successful workshop completion.
4. As a group, the teachers reported they taught material related to over one-half of the Arkansas science curriculum objectives studied. Further research should be conducted to determine the depth and rigor of the instruction provided.
5. Initial efforts to identify agriculture courses for science credit should focus on those related to the life sciences (e.g. plant- and animal-related courses). This recommendation is based on both the distribution of science objectives currently taught by the respondents and on their college science course work.

6. In-service workshops should be conducted to assist teachers in infusing physical sciences (especially physics) into the curriculum. This recommendation is based on the teachers' lack of course work in physics and on the low percentage of physical science objectives taught by the respondents.
7. On average, Arkansas agriculture teachers reported having earned the credit hours and grades necessary to qualify for science certification (biological and general science endorsement). Eligible teachers should be encouraged to complete the National Teachers' Examination (NTE) science specialty test and become science certified, especially if they desire to teach agriculture for science credit.

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