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SCIENCE CREDIT FOR AGRICULTURE: RELATIONSHIP BETWEEN PERCEIVED EFFECTS AND TEACHER SUPPORT

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Abstract

This study was conducted to determine the relationship between Arkansas agriculture teachers' perceptions of the effects of offering science credit for agriculture and their support for offering science credit for agriculture. Vroom's (1964) expectancy theory of human motivation formed the theoretical framework for the study. The results indicated that: (a) Arkansas agriculture teachers strongly support granting science credit for agriculture, and (b) that a practically significant portion of the variance in support for science credit could be explained by a linear combination of five perceived effect components. Teachers' perceptions of the Student Benefits effect component was the most powerful predictor of support for science credit, followed (in descending order) by the Negative Impact, Program Benefits, Enrollment, and Science Content effect components. The results of the study support the efficacy of Vroom's (1964) expectancy theory of human motivation. Recommendations are made for professional practice and for further research.

During their July 1994 business meeting, members of the Arkansas Vocational Agriculture Teachers Association (AVATA) voted to investigate the possibility of science credit for agriculture. An *ad hoc* committee, composed of six teachers, was charged with the responsibility of evaluating the feasibility and possible methods of securing science credit.

The committee met for the first time in August 1994. During the course of the meeting, committee members realized that meaningful plans could not be made until more information was available concerning Arkansas teachers' perceptions concerning science credit for agriculture. Due to this need, the AVATA requested and funded a statewide study. This article is based on further analyses of a portion of the data collected to provide the information requested by the AVATA ad hoc committee. Specifically, this article explores the relationship between teachers' support for science credit and their perceptions concerning the effects of offering science credit for agriculture.

Vroom's (1964) expectancy theory of human motivation offers a promising model for studying the acceptance of educational change and formed the theoretical framework for this study. According to Robbins (1993), expectancy theory posits the following relationship between motivation, expectation and outcome:

> The strength of a tendency to act in a certain way [motivation] depends on the strength of an expectation that an act will be followed by a given outcome and on the attractiveness of that outcome to an individual. (p. 226)

In this study, teacher support for science credit was considered to be a form of motivation in that support represented a "tendency to act in a certain way" (Robbins, 1993, p. 226). Teachers' perceptions concerning the effects of offering science credit for agriculture were considered to be a measure of the attractiveness of the outcome. Since, for the purpose of this study, the outcome (science credit for agriculture) was assumed a priori, assessment of the strength of the expectation linkage between action and outcome was not necessary.

Purpose and Objectives

The purpose of this study was to explore the relationship between Arkansas agriculture teachers' perceptions of the effects of offering science credit for agriculture and their level of support for offering science credit for agriculture. Specific research objectives were to:

1. determine teachers' level of support for offering science credit for agriculture;

2. determine teachers' perceptions concerning the effects of offering science credit for agriculture;

3. determine the relationship between perceived effects and teachers' support for offering science credit for agriculture; and

4. determine if a linear combination of perceived effect components could explain a practically significant portion of the variance in teachers' support for science credit.

Procedures

The population for this census 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.

This study employed the descriptive-correlational research design (Ary, Jacobs & Razavieh, 1990), using a mailed survey instrument. This paper is based on data collected in two sections of the instrument used in the overall study.

Two items from the first section of the questionnaire assessed agriculture teachers' support for granting science credit for agriculture. Teachers responded to these items using a 1 to 5 Likert-type scale (1=”strongly disagree”; 5=”strongly agree”).

The second section of the instrument contained 20 statements concerning the effects of offering science credit for agriculture. Respondents rated their level of agreement with each effect statement using a 1 to 5 Likert-type scale (1="Strongly disagree"; 5="Strongly agree"). Several effect statement were negatively worded in order to avoid response-set.

The overall instrument was developed by the researcher based on input from the AVATA *ad hoc* committee on science credit for agriculture. A draft version of the instrument was administered to 11 senior agricultural education majors 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, minor wording changes were made.

Next, the instrument was reviewed for face and content validity by a committee of agricultural education state staff members. The committee, composed of the AVATA president, three district supervisors and the state supervisor of agricultural education, one postsecondary agriculture teacher, and seven teacher educators from three universities, judged the instrument to be valid.

Finally, the instrument was mailed to the AVATA *ad hoc* committee on science credit for agriculture. The teachers were instructed to critically examine the instrument for face and content validity and clarity using explicitly stated 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. Thus, 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). The coefficient of stability for the two teacher support item was .70; for the 20 perceived effect statements, the overall coefficient of stability was .85.

Data were collected during October - December 1994 following the Dillman (1978) procedure for mailed 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 conducted by telephone and data were obtained on 32 (39.5%) of the items on the overall survey. 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.

Descriptive statistics were used to summarize and analyze the data. Principal components analysis was used as a data reduction technique (Hatcher & Stepanski, 1994). Correlation and multiple regression analyses were used to identify the individual effect components which best predicted teacher support for science credit (Hair, Anderson & Tatham, 1987). Since data collected for this study were from a population, inferential statistics were not used.

Results

The average teacher-respondent was 39.1 years of age (SD=9.4), had 14.2 years (SD=9.0) of teaching experience, 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 a masters degree; and 0.9% held the associate degree. Approximately one in every four (26.9%) respondents reported holding a valid certificate to teach science in Arkansas.

Objective One -- Support for Science Credit for Agriculture

The teachers strongly supported granting science credit for agriculture. As shown in Table 1, teachers agreed that high school students completing agriculture courses should receive science credit toward high school graduation. The teachers also agreed that agriculture should be accepted as a science credit for meeting admission requirements for Arkansas colleges and universities.

Table 1 also shows the mean and standard deviation for the composite variable, "Overall level of support for granting science credit for agriculture." This variable was created by summing responses to items Q1 and Q6 and dividing the sum by two (so as to maintain the original scaling). The coefficient alpha reliability estimate for the variable, which was used as the criterion in subsequent analyses, was .82.

Objective Two - Perceived Effects of Science Credit

Teachers responded to 20 statements dealing with the possible effects of offering science credit for agriculture. Responses to the 20 items were

Table 1. Teachers' Level of Support for Granting Science Credit for Agriculture

Item	Statement	x[a]	SD	Median
Q1	I believe students should receive science credit toward high school graduation for agriculture courses.	4.49	.91	5.0
Q6	I believe Arkansas colleges and universities should accept agriculture courses as a science credit for meeting admission requirements.	4.37	.89	5.0
[b]Overall level of support for granting science credit for agriculture.		4.43	.83	5.0

[a]1=strongly disagree, 2=mildly disagree, 3=neither disagree nor agree, 4=mildly agree, 5=strongly agree.
[b]Calculated as (Q1+ Q6)/2.

subjected to principal components analysis with an oblique (promax) rotation. Principal component analysis was selected as the data reduction technique (as opposed to common factor analysis) because the primary objective was to "summarize most of the original information (variance) in a minimum number of factors [components] for prediction purposes" (Hair, Anderson, Tatham, & Grablowsky, 1979, p.221). Additionally, since no a priori assumptions were made about an underlying causal model, principal components analysis was deemed to be the most appropriate data reduction technique (Hatcher & Stepanski, 1994).

Based on the Kaiser criterion (Kaiser, 1960), examination of the scree plot of eigenvalues, and on conceptual soundness, only the first five components were retained for rotation. The five component solution accounted for 63% of the total variance in the 20 items. The first four principal components were composed of from three to seven effect statements. The names and coefficient alpha reliability estimates for these four principal components were as follow: Student Benefits (r = .87), Negative Impact (r = .84), Program Benefits (r = .68), and Enrollment (r = .57).

The fifth principal component, Science Content, was variable specific, thus a measure of internal consistency could not be calculated. For this reason, readers should exercise caution in interpreting results related to the Science Content principal component. Table 2 lists the five principal components, the individual items in each component and the factor loading for each item.

ObjectiveThree -- Relationship Between Perceived Effects and Support for Science Credit

The intercorrelation matrix for the five principal components and support for science credit are reported in Table 3. Based on the descriptors suggested by Davis (1971), the Student Benefits

Table 2. Rotated Principal Components and Descriptive Statistics for Perceived Effects of Offering Science Credit for Agriculture (n = 212)

Item #	Abbreviated Variable Label	Factor Loading	x[b]	SD
First Principal Component = Student Benefits				
25	Increase student interest in agriculture	.83	4.06	.84
24	Increase student interest in science	.80	3.80	.94
22	Benefit students in my school	.79	4.35	.85
26	Result in higher student science achievement	.77	3.60	.94
14	Improve student attitudes toward agriculture as a career	.71	4.14	.93
11	Make science more meaningful to students	.65	4.06	.95
20	Increase importance of agriculture program	.62	4.07	1.02
Second Principal Component = Negative Impact				
19[a]	Prevent teaching of important vocational skills	.80	3.72	1.22
21[a]	Cause me to teach fewer practical skills	.79	3.42	1.29
12[a]	Not serve needs of local agriculture industry	.73	4.00	1.18
13[a]	Make me feel like a "second-rate" science teacher	.70	4.14	1.13
23[a]	Cause agriculture to be thought of as "watered-down" science	.67	3.47	1.31
10[a]	Weaken my FFA chapter	.65	4.22	1.08
Third Principal Component = Program Benefits				
8	Enhance agriculture program's image	.77	4.28	.90
7	Increase enrollment in agriculture	.76	4.42	.85
9	Cause me to work more closely with science teacher	.71	4.17	.86
Fourth Principal Component = Enrollment				
16	Cause more high-ability students to enroll	.81	3.57	1.26
15[a]	Cause more low-ability students to enroll	.78	2.58	1.27
17	Cause more average-ability students to enroll	.45	3.81	.90
Fifth Principal Component = Science Content				
18	Require me to increase science content of courses	.85	3.52	1.25

[a]Negative items reverse-coded prior to analysis.
[b]1 = strongly disagree, 2 = mildly disagree, 3 = neither disagree nor agree, 4 = mildly agree, 5 = strongly agree.

component was substantially related to support for science credit; the Negative Impact and Program Benefits components were moderately related to support for science credit; and the Enrollment and Science Content components had negligible relationships with support for science credit.

As shown in Table 3, the intercorrelations between the five principal components ranged from

Table 3. Intercorrelations Between Principal Component Scores and Support for Granting Science Credit for Agriculture (n = 211)

	Intercorrelations					
Variable	1	2	3	4	5	6
1. Student benefits	1.00					
2. Negative impact[a]	.53***	1.00				
3. Program benefit	.43**	.27**	1.00			
4. Enrollment	.35**	.36***	.23*	1.00		
5. Science contents	.15*	.08	.31**	.06	1.00	
6. Support for science credit	.58***	.49**	.41**	.08	.02	1.00

[a]Items were reverse-coded prior to analysis.
* Low association, ** moderate association, *** substantial association (Davis, 1971).

low to substantial. Both of the two components having negligible correlations with support for science credit (Enrollment and Science Content) had low to moderate correlations with one or more of the first three principal components (Student Benefits, Negative Impact, and Program Benefits).

<u>Objective Four -- Variance in Support for Science Credit Explained by Perceived Effects</u>

To satisfy this objective, support for science credit scores were regressed on a linear combination of the five principal components. All five potential predictor variables (principal components) were included in the regression analyses because, according to Pedhauzer (1982), "Inspection of the zero-order correlations is not sufficient to reveal the potential usefulness of variables that are used simultaneously to predict or explain a dependent variable" (p. 104). When potential predictor variables are correlated, variables having near-zero correlations with the criterion variable may explain a significant portion of the variance. Pedhauzer termed such variables suppressor variables and stated that:

> The inclusion of a suppressor variable in the analysis... serves to suppress, or control for, irrelevant variance, that is variance that is shared with the predictor and not with the criterion, thereby ridding the analysis of irrelevant variation, or noise (p. 104).

The multiple regression equation containing the five predictor variables accounted for 47% of the variance in support for science credit. As shown in Table 4, the Student Benefits component (which had the largest zero-order correlation with support for science credit) entered the multiple regression equation first, explaining 34.1% of the variance in support for science credit. Taken together, the remaining four components explained an additional 12.9% of the variance and entered in

Table 4. Multiple Regression Analyses Predicting Support for Science Credit (n=211)

Variable	Partial R^2	Model R^2	Beta[a] Weight	Uniqueness[b] Index
Student Benefits	.341	.341	.420	.108
Negative Impacts	.047	.388	.294	.059
Enrollment	.035	.423	-.221	.040
Program Benefits	.033	.456	.242	.044
Science Content	.014	.470	-.124	.014

Note: Adjusted R^2 = .457. [a] Standardized multiple regression coefficients. [b] Squared semi-partial correlations obtained when partialling out variance in support for science credit shared with the other four predictors.

the following order: Negative Impact, Enrollment, Program Benefits and Science Content.

The beta weights (standardized multiple regression coefficients) and uniqueness indices (squared fourth-order semi-partial correlations) in Table 4 indicate the Student Benefits component was the most influential predictor of support for science credit, followed (in descending order) by the Negative Impact, Program Benefits, Enrollment, and Science Content components.

Comparison of the R^2 increments associated with the Enrollment and Science Content Components (Table 4) and the zero-order correlations between these components and support for science credit (Table 3), indicated that Enrollment and Science Content served as suppressor variables. The inclusion of these two components in the multiple regression equation resulted in the explanation of an additional 5.4% of the variance in support for science credit.

Discussion

Arkansas agriculture teachers clearly support granting science credit for agriculture. On measures designed to assess teachers' support for science credit, mean responses were in the mild to strong agreement range. Furthermore, the median response to each of these three measures was "5" on a 1-5 scale (1=strongly disagree; 5=strongly agree).

The results of principal components analysis indicated that a majority (63%) of the variance in teachers' responses to 20 items concerning the effects of offering science credit for agriculture could be accounted for by five principal components. These components were: Student Benefits, Negative Impact, Program Benefits, Enrollment, and Science Content.

The Student Benefits component was substantially related to support for science credit. Both the Negative Impact and Program Benefits components were moderately related to support for science credit. Thus, teachers supporting science credit for agriculture tended to agree that offering science credit will benefit students, enhance agriculture's status within the schools, and will not adversely affect the existing agriculture program. Although causality cannot be established in a correlational study, these relationships between support for science credit and the perceived effects are both intuitively appealing and consistent with Vroom's (1964) expectancy theory of human motivation.

Negligible relationships existed between support for science credit and the Enrollment and Science Content components. The coefficients of determination (r^2) indicate that neither component shared as much as 1% of its variance with support for science credit.

A linear combination of the five principal components explained 47% of the variance in support for science credit. Thus, the correlation between actual and predicted levels of support, as calculated using the multiple regression equation developed, was .686. According to Davis (1971), this represents a substantial association. The magnitude of this correlation should be interpreted in view of the relative homogeneity of the criterion variable (support for science credit). According to Hinkle, Wiersma, and Jurs (1982), "The homogeneity of the group affects the correlation in such a way that increased homogeneity tends to limit the size of the correlation coefficient" (p.114).

Based on examination of the beta weights and uniqueness indices (Table 4), it appears that the Student Benefits component is the most influential predictor of teachers' support for science credit. Conversely, the Science Content component appears to be the least influential predictor of support for science credit.

The results of this study support the efficacy of Vroom's (1964) expectancy theory of human motivation in predicting agriculture teachers' support for curriculum change. The present study identified five perceived effect components having practical significance in predicting teacher support for science credit.

Conclusions and Recommendations

The following conclusions were made based on the results of this study:

1. Arkansas agriculture teachers support granting science credit for agriculture, both for high school graduation and for college admission.

2. Overall, teachers feel that offering science credit for agriculture will have positive effects on students and on agriculture programs.

3. As a group, the teachers did not feel that offering science credit for agriculture will have any serious negative impact in agriculture programs.

4. Teachers' support for offering science credit for agriculture was positively related to their perceptions of: (a) benefits to students, (b) lack of negative program effects, and (c) benefits that would accrue to the agriculture program.

5. A practically significant portion of the variance in teachers' support for science credit can be explained by a linear combination of the five effect components.

6. Teachers' perceptions of the Student Benefits component is the most powerful predictor of support for science credit.

7. Vroom's (1964) expectancy theory appears to be an effective model for use in predicting support and/or acceptance of educational change.

The following recommendations were made based on the results of this study:

1. Arkansas agricultural educators should initiate the dialogue, study and planning necessary to explore the possibility of securing science credit for agriculture.

2. The primary objective of any science credit for agriculture initiative should be to benefit students by using agriculture as a context through which to increase student interest and achievement in science. This objective appears consistent with both teacher perceptions and ethical practice.

3. If a science credit for agriculture initiative is successful in Arkansas, further research should be conducted to determine the actual effects of offering science credit.

4. Researchers studying teachers' support for a new policy, program or other innovation should consider the potential predictive power of teachers' perceptions concerning the effects of the proposed change.

5. This study should be replicated in other states in order to determine the repeatability of both the principal components and their capacity to predict agriculture teachers' perceptions of the effects of offering science credit for agriculture.

6. Further research should be conducted to test the efficacy of Vroom's expectancy theory in predicting support and/or acceptance of educational change.

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