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THE INFLUENCE OF AGRISCIENCE AND NATURAL RESOURCES CURRICULUM ON STUDENTS' SCIENCE ACHIEVEMENT SCORES

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Abstract

Over the past several years, poor science test results have increased the demand for improved science education for American students. New and innovative methods of presenting scientific materials are needed to improve student achievement and enthusiasm for learning science. One solution to this dilemma has been to increase students' interest in science by using agricultural and natural resources concepts to teach science. This teaching method incorporated agricultural concepts of plant science, animal science and natural resources into the curricula to more effectively teach general science concepts and improve students' interest in the subject. This research sought to determine if students who enrolled in agriscience and natural resources comprehend science principles on an equal level as students who did not enroll in agriscience and natural resources. A standardized science test, High School Subject Test-Biology, was used to measure students' science knowledge. The results showed that there was no difference in the science test scores of students who had and had not enrolled in agriscience and natural resources. The variables that explained the most variance in science test scores were the number of science credits completed and the students' overall grade point average.

The past decade has seen many calls for educational reform in the United States. Parents, teachers, and educational professionals have called for new and innovative approaches to teaching English, mathematics, and science. According to *A Nation at Risk* (National Commission on Excellence in Education, 1983), "There was a steady decline in science achievement scores of U. S. students" (p 9).

The trend in science achievement scores has not improved. Former Secretary of Education William Bennett (1988) wrote that "A new assessment places American science students in rough international perspective" (p 13). Ten-year-olds placed 8th among 15 countries tested. Fourteen-year-olds placed 14th out of 17 countries. These poor science test results have increased the demand for improved science education for American students.

Typically, these demands have only led to more hours added to the school day or more days added to the school year. *A Nation at Risk* (National Commission on Excellence in Education, 1983) stated that, "School districts. . . should strongly consider 7-hour school days, as well as a 200 to 220-day school year" (p 29). However, the American Association for the Advancement of Science (1989), in its *Project 2061 Report: Science for All Americans* stated that "A fundamental premise of Project 2061 is that the schools do not need to be asked to teach more and more content, but rather to focus on what is essential to scientific literacy and to teach it more effectively" (p 4). This indicates a new method of teaching science is needed.

This research followed the theoretical framework that agriscience and natural resource (ANR) programs contain most of the same science objectives as other science courses and that students who complete agriscience and natural resource courses perform as well as students who

receive science credit from other science classes.

Moss (1986) found that "A total of 76 instructional objectives from the Basic Program of Vocational Agriculture in Louisiana Curriculum Guide were identified as science related objectives" (p 3). Anderson and Boddy (1985) stated that "specific secondary vocational programs that contain significant components of chemistry, biology, and physics related skills are: production agriculture, and horticulture" (p 8).

Many educators consider agriscience and natural resources examples excellent for use when teaching science. Budke (1991) stated that, "agriculture provides a marvelous vehicle for teaching genetics, photosynthesis, nutrition, pollution control, water quality, reproduction, and food processing where real live examples can become part of the classroom experimentation and observation" (p 4).

Two research studies have shown that students taught science using agricultural and natural resource examples perform equally or better than students taught science using traditional science examples. Whent and Leising (1988) reported that, "agricultural students in test schools achieved slightly higher on the biology test than did bio-science students" (p 14). The researchers concluded that agricultural students were mastering the state science standards on an equal level with students in general science classes. Enderlin and Osborne (1991) studied science achievement of middle school science students. The researchers compared a laboratory oriented agricultural approach with a traditional science instructional approach in teaching a plant science unit of study. Enderlin and Osborne also used a post-test only, control group design for their study. The researchers concluded that, "student acquisition of science knowledge differs significantly between those students who receive traditional science instruction" (p 7). The agriculturally oriented students received higher scores.

After reviewing the relevant literature, the researcher developed the following conceptual framework for the study. The framework in Figure 1 shows how agriscience and natural resources courses fit into a complete secondary science education program.

Figure 1. Conceptual Framework for Including Agriscience into a Secondary Science Program

Purpose and Objectives

Teachers use activity-oriented instructional methods in many agriscience and natural resource (ANR) programs to instruct students in science. However, many parents, educators, and administrators don't believe that agriscience and natural resources classes are alternatives to more traditional science courses for high achieving college-bound students. Is an agriscience and natural resources class a legitimate science course? Do students who enroll in agriscience and natural resources classes perform as well on science tests as students who take more traditional science classes? These are questions this research study

attempted to answer.

The purpose of this research was to determine the factors influencing students' science test scores. The specific objectives for the study included:

1. Determine if there was any difference between students who had agriscience and natural resources courses and those who did not, on standardized science tests.

2. Determine which demographic characteristics influenced students' science test scores.

3. Determine if student's number of science credits and their overall grade point average influenced their science test scores.

A research hypothesis tested the influence of science courses on students' science test scores.

The hypothesis stated that:

H_0 No difference in biology test scores is found between students who had agriscience and natural resources courses and students who did not have agriscience and natural resources courses.

The alternative hypothesis stated that:

H_1 Students who had agriscience and natural resources courses have mean scores different from those of students who did not have agriscience and natural resources courses.

For testing purposes, the hypotheses were diagramed using μ_2 to represent those students who did not have agriscience and natural resource classes.

$$H_0 \quad \mu_1 = \mu_2$$
$$H_1 \quad \mu_1 \neq \mu_2$$

Methodology

Research Design

This study was a pre-experimental study that used a static-group comparison design. The independent variable in this study was the number of credits students had completed in science classes, including agriscience and natural resources. Extraneous independent variables included gender, race, grade point average, socioeconomic status, and school characteristics. The socioeconomic status of the students was determined using a family information questionnaire. The dependent variable in this study was science achievement of high school students.

Population and Sample

The population for this study was all seniors in four Michigan high schools that offered agriscience and natural resource classes. These four schools were randomly selected from those schools that had completed the State Department of Education's mandatory restructuring process to offer an Agriscience and Natural Resources program. The total population consisted of 156 senior high school students. The study was limited to seniors because they had completed all science classes required for graduation and to control grade level as an extraneous variable.

Instrumentation

A standardized science achievement test developed by a professional test development company, American Testronics, was used to measure the dependent variable. Content and face validity of the instrument was determined by American Testronics. A Kuder-Richardson reliability coefficient of .85 was reported for the test (American Testronics, 1990).

Data Analysis

The data were analyzed using the Statistical

Package for the Social Sciences (SPSS/PC+)(SPSS Inc., 1991). The analysis included frequencies, means, standard deviations, *t* tests, correlations and multiple regression.

Each student's socioeconomic score was calculated using a family information questionnaire. The responses were recalculated into Z scores for analysis (Rossetti, Elliot, Price, & McClay, 1989). Students' grade point averages and the number of science credits they had completed were obtained from official school transcripts.

A multiple regression analysis was conducted to determine if relationships existed between the independent variables and the dependent variable, science test score.

Results

Seniors at participating high schools completed a family information questionnaire. The questionnaire asked the students' parents' or guardians' occupation and level of education, family income, and household possessions. Each response was coded with a specific value. Z scores were calculated for each individual's socioeconomic status. Z scores were then categorized into quartiles for reporting purposes. Raw Z scores were used for regression analysis.

Seniors were asked four demographic questions: gender, age, race, and current grade point average. Fifty-four percent of the high school seniors were male and 46% were female. The youngest senior was 17 years old and the oldest was 19 years old. The mean age for all the seniors was slightly over 17 1/2 years. Over 86% of the seniors were white, 7.2% were black, 2.0% were American Indian, 1.3% were Asian, and 0.7% were Hispanic.

The seniors were asked to specify their current grade point average. To increase the validity of the research, the information that the seniors provided was checked with their official school records. Where discrepancies existed, the official grade point average was used for analysis. Seniors also listed the different science classes they had completed and the grade they received. Grade point averages for students who had completed classes in agriscience and natural resources were calculated.

The mean grade point average for all students was 2.70 with a standard deviation of .69. The total number of science credits and agriscience and natural resource credits was determined from the questionnaires. All credits were measured using Carnegie units. The mean number of science credits completed for all respondents was 2.79. The mean number of agriscience credits completed was 1.47. Over 100 seniors (69%) never had a class in agriscience and natural resources. Forth-nine students (31.4%) had classes in agriscience and natural resources. Table 1 displays the means, standard deviations, minimum, and maximum number of credits for the respondents.

Table 1. Mean Number of Science and Agriscience and Natural Resource Credits Completed by Respondents

Class	N	Mean	SD	Minimum	Maximum
Science	156	2.79	1.13	0.5	6.0
Agriscience and Natural Resources	49	1.47	.79	0.5	3.5

The High School Subject Test - Biology that was used to measure science achievement consisted of 60 multiple choice questions. The mean score of all seniors who completed the test was 22.79.

Correlational Analysis

Correlations were performed to find out if the dependent variable, score on the science test, was related to students' demographic variables such as

GPA, number of science credits, agriscience GPA and credits, and socioeconomic status. Because all variables were measured on the interval scale, Pearson product-moment coefficients were used for the correlations. The correlations found a substantial positive (Davis, 1971) correlation between students' grade point average and their science test scores. There was a moderate correlation between students' scores and the number of science credits they had completed. Results of the correlations are shown in Table 2.

Regression Analysis

A multiple regression analysis was conducted to determine which independent variables were associated with students' scores on the science test. The beta value shows the amount of change associated with the intercept for each unit of the variable being measured. The comparison group for the regression analysis was white male high school students. This group was chosen because there were ample subjects to warrant comparison with the other groups. Students' overall GPA and the number of science credits completed were the significant variables in the regression (Table 3).

Table 2. Correlations Between Students' Science Achievement Scores and Various Demographic Variables

Variable	Coefficient	Description
Overall GPA	.57	Substantial
Science credits	.49	Moderate
Agriscience & Natural Resources G.P.A.	.27	Low
Socioeconomic status	.24	Low
Agriscience & Natural Resources Credits	-.07	Negligible

Table 3. Multiple Regression of Students' Science Achievement Scores on Their Independent Variables

Independent Variables	Beta (β)	*t* value
Intercept	-6.26	.67
Demographic variables		
ANR students/non ANR students	-1.56	.13
Gender	-1.26	.19
Age	.74	.36
Blacks	-1.14	.56
Race (other than black or white)	2.20	.26
Overall G.P.A.	4.70	.00*
Science credits	2.08	.00*

* $p < .05$; $R_2 = .43$

The regression analysis was also used to determine if seniors who had agriscience and natural resources (ANR) classes differed from seniors who did not have ANR classes on the science test scores. Alpha was set *a priori* at .05. Because H_0 was a nondirectional hypothesis, a two-tailed *t* test was used. Two-tailed probability was .13 with a *t* value of -1.48. No significant differences were found between the two groups. Therefore, H_0 was tenable. The alternative

hypothesis, H_1 , was rejected.

Conclusions

This research found that high school seniors who had agriscience and natural resource classes performed as well as seniors who did not have agriscience and natural resource classes on the science achievement test. The multiple regression, while controlling for extraneous variables such as age, gender, socioeconomic status, and science credits completed by students, found no significant differences between seniors who had ANR classes and those who did not have ANR classes.

The regression analysis also determined that high school seniors' overall grade point averages and the number of completed science credits were directly related to their scores on the science achievement test. Forty-three percent of the variance was explained.

Recommendations

As a result of the findings of this study several recommendations were made. Local school boards should study the possibility of offering science credit for agriscience and natural resource classes that contain a significant amount of science objectives. State supervisors of agricultural education should also lobby for community colleges and four-year universities to recognize agriscience and natural resources as a science credit when a student applies for admission. Additional studies should be undertaken that include more schools that offer agriscience and natural resources and include a larger number of students.

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