EFFECT OF ENROLLMENT IN AGRISCIENCE ON STUDENTS' PERFORMANCE IN SCIENCE ON THE HIGH SCHOOL GRADUATION TEST

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Abstract

This study determined whether enrollment in agriscience education was related to high school students' science achievement. The results of the mandatory high school graduate exit exams were used to measure science achievement. All test scores from non-special education students were utilized for the study. The comparison of the science achievement of agriscience education students to that of non-agriscience education students revealed that there were significant differences in scores on the science test and the subtests. The effect size for each of these areas was either small or of negligible practical significance. Regression analyses were used to determine if enrollment in agriscience education explained variance in the science scores, after controlling for variance attributed to age, grade level, gender, ethnicity, 504 status, and socioeconomic status. Significant models with moderate or large effect sizes existed that explained a portion of variance in scores on the science tests and subtests. However, after controlling for the six variables listed above, the contribution of enrollment in agriscience education to the science test and subtest scores was negligible. This result is positive evidence for the value of agriscience education since agriscience education students acquire knowledge, skills, and experiences substantially beyond the academic content in the courses.

Introduction

Modern society is increasingly dependent on new complex technologies and advancements in older technologies. This increasing dependence on technological advancements can be seen in many aspects of modern life such as the use of computers, development of genetically modified foods, increasing world population, and the threat of bio-terrorism. Thus, the level of scientific literacy needed to understand and make informed decisions concerning the use of technology is also continually increasing (McLure & McLure, 2000; National Research Council, 1996). Those who can reflect about experiences, articulate what is known, and continue to learn will be at an advantage (Cech, 2003; Fennema & Romberg, 1999).

Recently, the American educational system has undergone numerous reforms in funding, curriculum, standards, staff development, student assessment, and accountability to address the concerns of such a rapidly changing world. The reforms have focused on improving the quality of education received by students, raising the accountability of schools for their students' learning, and assessing student learning and achievement. One widely used method of assessing student learning and achievement is the use of standardized tests that are developed based on objective criteria with established performance norms. This allows comparison of scores across a wide range of individuals or groups (Payne, 1997).

Louisiana initially set its course in reforms by raising graduation requirements to include a minimum of 23 Carnegie units. Of these units, 15 are specified, while the remaining 8 can be taken as electives. Three of the 15 units must be in science. The completion of Agriscience I and II is accepted as one of the three required science units (Louisiana Department of Education [LDE], 2005). Besides successfully completing these 23 units of approved course work, public high school students are required to pass standardized tests in the 10th and 11th grades to receive a high school diploma. These tests are known as the graduate exit exams (GEE). The mathematics and English language arts tests are administered at the end of the sophomore year, while the science and social studies tests are given at the end of the junior year. Students must score at the Approaching Basic level on both the English language arts and mathematics GEEs and either the social studies or science GEE by the spring of their senior year in order to be awarded a high school diploma (LDE).

Agriscience education provides a means for students to learn and develop skills needed in the adult world. The mission statement of agriscience education states that ―Agricultural Education prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber, and natural resources systems" (National FFA Organization, 2008, p. 3). Agriscience education addresses goals in science through units in agronomy, plant physiology and cultivation, genetics, plant and animal nutrition, natural resource management, integrated pest management, and aquaculture (LDE, 2005). Although much of the science content taught in agriscience education is also taught in science courses, this content is taught in agriscience education through contextual, experiential methods which gives them real world meaning and applications (Edwards, Leising, & Parr, 2002).

According to Connors and Elliot (1995), agriscience education can be incorporated into the framework for science achievement very easily. Connors and Elliot (p. 62) went on to say ―...local school boards should study the possibility of offering science credit for agriscience and natural resource classes that contain significant amount of science objectives...." as a means of increasing science achievement scores. In 1986, Moss reviewed Louisiana's agriscience education curriculum and found that it contained 76 instructional objectives that were science related. Using *t*-test comparisons, Chiasson and Burnett (2001) concluded that agriscience education students achieved higher overall scores than non-agriscience education students on the science portion of their state graduation test. Due to the connection in the area of scientific concepts, the LDE has recognized the impact that agriscience education programs have on student science achievement and allows students who successfully complete Agriscience II to waive one of their science courses for graduation purposes (LDE, 2005).

Achievement

Measuring achievement is a significant part of the education process and informs educators of student ability and progress toward educational goals. It is also the primary gauge used by educators to guide the advancement of students through the education process (National Research Council, 1999). Students are tested for ability and comprehension as well as to assess placement in specific grade levels and/or courses. Achievement testing is increasingly being used to track and promote students. It is becoming more common for universities to require minimum scores on SAT or ACT tests as a condition for admission.

Standardized tests have become the primary evaluation method of individual student and school performance. Politicians, school boards, and the media utilize student and school scores on these tests to evaluate teachers, schools, and the U.S. education system (National Research Council, 1999). Louisiana's accountability program is designed to evaluate both individual student performance as well as school performance. Student performance is measured using the GEE, a criterion-referenced standardized test divided into battery-style tests designed to be administered at particular high school grade levels. School accountability scores are calculated utilizing student performance scores on the GEE's and Iowa Test of Basic Skills, failure rates, student attendance, and dropout rates (LDE, 2005).

Assessments of student science achievement often shows performance levels below the degree of scientific literacy demanded in the workplace or in our society (Frome, 2001; National Assessment Governing Board, 2000). Researchers have explained this phenomenon by suggesting that the science being taught in schools today is too abstract, lacks real world connection and relevant context for students to apply the science learned in school to the real world (Conroy, Trumbull, & Johnson, 1999; Shelley-Tolbert, Conroy, & Dailey, 2000).

Other researchers (Balschweid, 2001; Conroy, et al., 1999; Shelley-Tolbert et al., 2000) have concluded that students should be provided sufficient context for what they are learning. It is believed that contextual learning is the key for improving a student‘s ability to synthesize information from numerous sources, to increase understanding of new and often contradictory information, for assisting in making meaning, and for enhancing the ability of students to think critically and transfer their learning to real-life experiences. The National Research Council (1996) supports this theme in their conclusion that integrated and thematic approaches can be very powerful.

Agriscience education employs an appealing, robust curriculum using both formal and informal learning opportunities in which students learn scientific principles and concepts in a contextual fashion (Conroy et al., 1999; Johnson, 1991). Taylor and Mulhall (1997) concluded that agriscience education, using contextual relationships, acts as a unifying theme providing relevance and adding meaning for students. The use of SAEs and FFA activities are integral extensions of the agriscience education classroom, requiring students to utilize theories and concepts in real-world contexts involving agriculture (Noxel & Cheek, 1988).

McLure and McLure (2000) suggested that ―…higher science achievement scores are linked to participation in out-of-school science accomplishments" (p. 38). This is consistent with other science education researchers (Gerber, Marek, & Cavello, 1997) regarding the positive impact informal learning activities have on science achievement. This also coincides with the informal educational opportunities available to agriscience education students. Student learning in agriscience education takes place in both formal and informal settings utilizing classroom and laboratory instruction, community-based supervised agricultural experiences (SAEs), and FFA activities (Edwards et al., 2002). Many of the FFA‘s career development events are team activities in which cooperative learning is incorporated and students must work collaboratively to solve contextual, problem-based scenarios. The National FFA Organization also rewards students whose SAEs demonstrate science-related competencies (Edwards et al., 2002).

Science education researchers have concluded that science achievement is best for students whose learning experiences are contextual in design and incorporate both formal and informal learning activities (Edwards et al., 2002). Researchers posited that agriscience education provides students appropriate formal and informal learning contexts in the constructivist design for thinking critically and developing higher-order thinking skills which can be used in solving problems and increasing understanding and application of mathematics and science (Edwards et al.). Recently, Chiasson and Burnett (2001) supported this position empirically when they found that 11th grade agriscience students from all Louisiana schools achieved significantly higher overall scores than non-agriscience students on the science portion of the high school graduation exam. Agriscience education has the potential for countless contextual learning activities in mathematics and science for all students. This is supported by Bailey (1998), who stated that agricultural activities such as 4-H and the FFA have used the farm setting and students‘ interest in agriculture to teach varied skills. ―It only takes a little imagination to think of how to use the social, economic, and scientific basis of agriculture to motivate and illustrate skills and knowledge from all academic disciplines" (p. 27).

Variables Related to Achievement

African-American and Latino students are more likely to have lower standardized test scores than Caucasian students (Lareau, 2002; Steele & Aronson, 1998), although the gap in achievement among ethnic groups is narrowing (Campbell, Hombo, & Mazzeo, 2000; Cook & Evans, 2000; Hedges &

Newell, 1999). The achievement gap among ethnic groups varies across tests, grades and subject areas (Berends & Koretz, 1996; Koretz, 1986, 1992). Ethnicity is not the only variable to be considered. When Berends and Koretz controlled for family, socioeconomic, and school factors, the achievement gap between Caucasian and both African-American and Latino students was reduced.

Gender differences generally are small or non-existent with a few exceptions. For instance, Hedges and Newell (1995) found that in science and stereotypically male vocational domains, boys outperform girls, but girls have the advantage in reading and writing. Coley (2001) studied gender differences within ethnic groups. This study revealed more similarities than differences. On most measures, gender differences did not vary much from one ethnic group to another.

Some studies suggest that socioeconomic status (SES) is the strongest predictor of student achievement (Coleman et al., 1996; Lee, Bryk, & Smith, 1993). When income is examined, the research shows a consistent positive relationship between family income and student achievement. Hill and O'Neil (1994) found that increasing family income by $10,000 per year is associated with an increase in student achievement of 2.4 percentile points. Students classified as economically disadvantaged were predominately found to be in career and technical education programs such as agriscience education (Elliot, Foster, & Franklin, 2005).

Need for the Study, Purpose and Objectives

Since the application of principles and concepts is difficult to assess, it is difficult to determine if agriscience education provides students with an academic preparation equivalent to traditional academic courses. Therefore, one way to establish the quality of the academic education provided through agriscience education would logically be through determining the performance of agriscience education students in the state's standardized testing program.

The purpose of this study was to compare the academic achievement of Louisiana high school students by whether they were identified as an agriscience education student. The objectives that guided the study were: (1) Describe the 11th grade high school students who completed the GEE on age, grade level, gender, ethnicity, 504 status, SES, and agriscience education student status; (2) Describe academic achievement of 11th grade high school students as measured by scores on the science portion of the GEE; (3) Compare achievement, as measured by scores on the science portion of the GEE, of 11th grade students by whether or not they were identified as an agriscience education student; and (4) Determine if selected variables explain significant portions of the variance in science achievement as measured by scores on the science portions of the GEE. The variables used as potential explanatory variables in these analyses were age, grade level, gender, ethnicity, 504 status, SES, and agriscience education student status. For this study, agriscience education students include those who have taken at least Agriscience I and II.

Methods

Population and Sample

The target population and frame for this study was all Louisiana public high school students, except special education students. Special education students were omitted because the state database provided did not include information on the type of special education program in which these students were enrolled (e.g., gifted, mild mentally handicapped, etc.). The accessible population was defined as all 11th grade students except special education students enrolled in Louisiana public high schools who had taken part in the state mandated GEE in the spring of the 2004-2005 school year and had valid scores in the database of the LDE. There were 36,206 sets of student GEE test data in the database. Retesting of students whose scores did not meet minimum standards for graduation did occur. The extent of the retesting could not be determined. Since the extent of retesting could not be established, the testing effect cannot be determined. The researchers acknowledge this limitation. Also, although data was available for more recent years, the researchers determined that data would not be appropriate for this study due to the effects of multiple disasters in the state during the 2005-2006 school year that shut down entire school systems and displaced thousands of students. Therefore, the researchers reasoned that this data would not be as accurate as the 2004-05 data.

Instrumentation and Data Analyses

The data for the study were copied directly from the archival data source developed by the LDE into a computerized recording form. Approval to conduct this study involving high school students was granted by the Institutional Review Board at Louisiana State University. The researchers also provided a written statement guaranteeing anonymity of all subjects in the data set. Descriptive statistics were used to describe the data for objectives 1 and 2. Inferential *t*-tests were used to conduct the analyses for Objective 3, and forward multiple regression analyses were used to conduct the analyses for Objective 4. The alpha level was set *a priori* at .05. The effect sizes for the *t*-tests and the multiple regression analyses were interpreted according to Cohen‘s (1988) guidelines.

Findings

Objective 1: Student Characteristics

The mean age of the students taking the science portion of the GEE was 17.46 years (*SD* = .66). The students‘ ages ranged from 14 to 21. Most of the students (*n* = 34,321, 94.8%) were in the 11th grade and were female (*n* = 19,871, 54.9%). Five ethnic groups were represented in the population. These five ethnic groups are not representative of the state population. Louisiana has a large private high school system that charges its students tuition to attend, which has increased the proportion of ethnic minority and economically disadvantaged students in the public high schools. The two largest groups by ethnicity were Caucasians (*n* = 19,931, 55.0%) and African-Americans (*n* = 14,691, 40.6%). These data are presented in Table 1.

Students with a 504 classification are regular education students who are provided specific educational accommodations such as tests read aloud, use of calculators permitted, etc. Students with a 504 classification are considered academically disadvantaged (LDE, 2005); however, they are classified as regular education students and are working toward a standard high school diploma. This group was a small portion of the overall population with 952 students (2.6%) classified as 504. Students were also described by the variable SES, which was measured by free/reduced/full lunch program status. Families have the opportunity to apply for this program at the beginning of the school year. Most students in the population (*n* = 21,371, 59.0%) paid full lunch price, over one-third received free lunch (*n* = 12,374, 34.2%), and a few (*n* = 2,461, 6.8%) paid a reduced price.

The final variable used to describe the population was whether students were identified as agriscience education students. Students who had taken at least Agriscience I and II were defined as agriscience education students. There were 2,485 (6.9%) students taking the science sections of the GEE who were identified as agriscience education students while the remainder of the population (*n* = 33,721, 93.1%) was identified as non-agriscience education students (Table 1).

Table 1
Description of Louisiana Students Taking the 2005 Graduate Exit Exam

Variable	Category	#	%
Age	11th grade	34,321	94.8
	10th grade	1,885	5.2
Gender	Female	19,871	54.9
	Male	16,335	45.1
Ethnicity	Caucasian	19,931	55.0
	African-American	14,691	40.6
	Asian	721	2.0
	Hispanic	629	1.8
	Native American	234	.6
504 classification	Not 504 status	35,254	95.4
	504 status	952	2.6
Free lunch status	Full price lunch	21,371	59.0
	Reduced price lunch	2,461	6.8
	Free lunch	12,374	34.2
Agriscience status	Non-agriscience education student	33,721	93.1
	Agriscience education student	2,485	6.9

Note. $N = 36{,}206$.

Objective 2: Academic Achievement in Science

Objective 2 was to describe the academic achievement of 10th and 11th grade high school students as measured by their scores on the science sections of the GEE. The scaled scores on the science sections are classified into one of five categories. These five categories are Unsatisfactory, Approaching Basic, Basic, Mastery, and Advanced. Students must attain at least the Approaching Basic level of achievement to pass each particular GEE. The minimum scaled scores to achieve the Approaching Basic level of achievement for the science portion of the GEE's is 267 (LDE, 2005). The scores ranged from 100 to 500. The mean scaled score of all students on the total science exam was 310.03. There were 5,728 students (15.82%) that did not attain at least the Approaching Basic level of Achievement on the science GEE (Table 2). The science portion of the GEE has five domains. These domain areas are life science, science as inquiry, physical science, earth and space science, and science and the environment. The score ranges and the mean raw score for each of the five domains are presented in Table 3.

Objective 3: Comparison of Agriscience and Non-Agriscience Student Achievement

The third objective was to compare science achievement as measured by the GEE science scores by whether they were identified as an agriscience education student. The researchers acknowledge that these two groups of students are not similar and that this is a limitation of this analysis. The comparisons utilized *t*-test procedures with an alpha level set *a' priori* at 0.05. Cohen's *d* was computed on scores that were statistically different to measure effect size and interpreted using Cohen's (1988) effect size descriptors for two independent groups.

Table 2
Student Achievement Levels on the Science Graduate Exit Exam

Science achievement level	*n*	%
Unsatisfactory	5,728	15.82
Approaching basic	8,909	24.61
Basic	14,376	39.71
Mastery	5,762	15.91
Advanced	1,431	3.95

Note. $N = 36,206$.

Table 3
Mean Score and Raw Scores by Domain on the Science Graduate Exit Exam

Test	*M*	*SD*	Min	Max
Total science mean score	310.03	48.64	100	500
Raw scores by domain				
Life science	8.95	2.07	0	12
Science as inquiry	8.41	2.56	0	14
Physical science	8.10	2.82	0	16
Earth and space science	4.83	1.59	0	8
Science and the environment	4.77	1.58	0	8

Note. $N = 36,206$.

No significant differences existed ($t = .33$, $p = .74$) between the total science score for agriscience and non-agriscience students. Agriscience education students had significantly higher mean raw scores on two domain tests, namely, earth and space science ($t = -5.65$, $p < .001$), and science and the environment ($t = -2.96$, $p = .003$). Non-agriscience education students had a significantly higher mean raw score on the physical science domain test ($t = 6.01$, $p < .001$). Although differences existed between agriscience education students and non-agriscience education students on the three domain tests, the Cohen's *d* effect size analyses (Cohen, 1988) revealed a negligible effect size in each of these domains. These data are presented in Table 4.

Table 4
Comparison of Mean Score and Mean Raw Scores Between Agriscience and Non-Agriscience Students on the Science Graduate Exit Exam

	Agriscience education students		*Non-agriscience education students*					
Test	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*	*d*
Total science score	310.31	42.83	310.01	49.04	.33	2,985	.740	
Domain								
Science as inquiry	8.50	2.46	8.40	2.56	1.87	2,896	.061	
Physical science	7.80	2.55	8.12	2.84	6.01	2,957	<.001	.12
Life science	9.02	1.92	8.95	2.08	1.78	2,932	.075	
Earth and space science	5.00	1.51	4.82	1.59	5.65	2,910	<.001	.11
Science and the environment	4.86	1.47	4.77	1.59	2.96	2,928	.003	.06

Note. Agriscience education n = 2,485. Non-agriscience education n = 33,721.

Objective 4: Explaining Variance in Science GEE Scores

Objective 4 sought to determine if selected variables explain significant portions of the variance in 10th and 11th grade high school student science achievement as measured by scores on the GEE science test. Forward regression analysis was used to analyze the data (Table 5). Seven potential explanatory variables were identified for this analysis: age, grade, gender, ethnicity, 504 status, SES, and agriscience education or non-agriscience education student. The variable ethnicity was dummy coded (0, 1) for each of the five ethnicities. The dependent variable was the student scores on the science test and the five domain tests of the GEE. The alpha level was set a' priori at 0.05. Cohen's guidelines (1988) were used to interpret effect size.

Prior to conducting the regression analyses, Pearson product-moment correlation coefficients were used to measure the relationship between the potential explanatory variables and the dependent variable. Potential explanatory variables with an r value at or above the 0.10 level were entered into the regression. The others were eliminated from the analyses since there was virtually no chance that any variable with a correlation less than .10 would have even a small effect size in the regression model (Cohen, 1988).

The correlation between ethnicity African-American and ethnicity Caucasian was -.92, which indicated that the researchers should check for multicollinearity between the African-American and Caucasian ethnicity variables. An examination of the tolerance and variance inflation factors found that the tolerance was below .19 in each regression and the VIF [variance inflation factor] was above 5.3 in every regression. Correlations above .90 are an indication of multicollinearity (Hair, Black, Babin, Anderson, & Tatham, 2006), and "the two most common measures for assessing both pairwise and multiple variable collinearity are tolerance and its inverse, the variance inflation factor" (p. 227). "Thus any variables with tolerance value below .19 (or above a VIF of 5.3) would have a correlation of more than .90" (Hair et al., p. 230).

Since multicollinearity existed between ethnicity African-American and ethnicity

Caucasian, the researchers eliminated one of the ethnicity variables in each instance where they were both correlated with the independent variable at or above .10. The researchers chose to retain the ethnicity that was more strongly correlated with the independent variable. The variables identified using the process described above were entered into the model as a block (forced entry), and then the variable agriscience education student or non-agriscience education student was entered into the model using forward regression analysis. The R^2 change was examined to determine if including this variable explained a significant amount of additional variance after controlling for the other variables. If the R^2 change attributed to agriscience education was <.02, the researchers considered the effect size to be of low practical significance (Kotrlik & Williams, 2003). The probability of *F* to enter the model was set at .05.

Table 5
Forward Multiple Regression Models for the Analysis of the Total Scaled Science Score and the Five Science Domain Scores of the Graduate Exit Exam

				Adjusted		Change statistics		
Dependent variable	Model	*R*	R^2	R^2	*SEE*	R^2	*F*	*p* of *F*
Total scaled science score	1[a]	.488	.238	.238	42.45	.238	2,265.23	<.001
	2[b]	.491	.241	.241	42.38	.003	120.37	<.001
Science as inquiry domain score	1[c]	.433	.188	.188	2.30	.188	2,093.29	<.001
	2[b]	.434	.188	.188	2.30	<.001	14.56	<.001
Physical science domain score	1[d]	.398	.158	.158	2.59	.158	1,703.99	<.001
	2[b]	.401	.161	.161	2.58	.003	14.56	<.001
Life science domain score	1[e]	.380	.144	.144	1.91	.144	1,220.45	<.001
	2[b]	.381	.145	.145	1.91	.001	48.85	<.001
Earth and space science domain Score	1[f]	.365	.133	.133	1.48	.133	1,858.42	<.001
	2[b]	.366	.134	.134	1.48	.001	32.46	<.001
Science and the environment domain score	1[g]	.358	.128	.128	1.48	.128	1,065.44	<.001
	2[b]	.359	.129	.129	1.48	.001	31.917	<.001

[a]Includes gender, grade, age, SES, and ethnicity African-American as independent variables. Scaled science score is the dependent variable.
[b]Includes all variables in Model 1 plus agriscience education student status as independent variables.
[c]Includes grade, age, SES, and ethnicity African-American as independent variables.
[d]Includes grade, age, SES, and ethnicity African-American as independent variables.
[e]Includes grade, gender, age, SES, and ethnicity African-American.
[f]Includes gender, SES, and ethnicity African-American.
[g]Includes grade, gender, age, SES, and ethnicity African-American.

An outlier analysis was conducted for each multiple regression analysis (MRA). A normal P-Plot of regression standardized residuals and a scatter plot were prepared for each MRA. The examination of the plots based on Hair et al.'s standards (2006) showed the data was normally distributed with none of the outliers having a disproportionate effect on the regression analysis.

In each case, the variables listed in the note under Table 5 were entered into the model as a block in the first phase of the analysis (Model 1). Then, whether the student was an agriscience education student was entered into the model in the second phase of the analysis (Model 2) to determine the amount of variance explained by participation in agriscience education beyond the amount of variance explained by the variables in the block. Due to space limitations, the ANOVA tables and the statistical significance for the individual variables in each model are not presented. For the total science score and the five science domain scores, enrollment in agriscience education was a significant explanatory variable. However, in each case, the effect size was negligible according to Cohen (1988); this indicates that there was no practical effect (positive or negative) on any of the science GEE scores from participation in agriscience education.

Conclusions

Most students pass the science GEE and the science domain tests. Without controlling for other variables that may explain variance in scores, agriscience education students score as well as non-agriscience education students on the total science GEE and all science domains. This conclusion is based on the finding that although significant differences were found between the tests scores of the agriscience and non-agriscience education students, Cohen's *d* revealed an effect size of low practical significance on the total science GEE and on all science domains.

Being enrolled in agriscience education courses does have a statistically significant positive effect on overall science achievement and on achievement in the five science domains when the variance for other variables that may explain variance in scores is controlled. However, this should be read with caution since the effect size is small, indicating there is no practical significance to contributions found for participation in agriscience education. This is a very positive and important finding since it indicates that the science achievement of agriscience education students is at least equal to that of non-agriscience education students.

Implications and Recommendations

Students learn best when taught using contextual methods (Balschweid, 2001; Conroy et al., 1999; Darling-Hammond & Falk, 1997; Shelley-Tolbert et al., 2000). Furthermore, research in agriscience education has indicated that real-world contextual activities are part of the curriculum (Cheek, Arrington, Carter, & Randall, 1994; Conroy et al.; Edwards et al. 2002; Johnson, 1991; Noxel & Cheek, 1988; Roegge & Russell, 1990; Taylor & Mulhall, 1997). The contextual teaching methods utilized in these courses have the potential to increase student achievement. This study's findings show that the science achievement of agriscience education students is equal to the science achievement of non-agriscience education students. Coupled with the other benefits of being enrolled in agriscience education such as fostering a learner-centered teaching environment through the use of SAEs and CDEs (Roegge & Russell), providing opportunities for informal learning through FFA activities (Cheek et al.; Conroy et al.; Edwards et al.; Johnson, 1991), or being a hands-on and minds-on curriculum stressing problem solving (Boone, 1990; Edwards et al.; Flowers & Osborne, 1988), it becomes clear that agriscience education contributes to student success. Since the science achievement of agriscience education students is equal to other students and agriscience education provides additional opportunities, more students should be encouraged to enroll in agriscience education courses.

For this to become a reality, courses must be available for students to enroll in them. Existing agriscience education programs often cannot accommodate all of the students seeking enrollment. Therefore, existing programs that are unable to meet current demand should expand by including more agriscience education instructors. Schools that currently do not have agriscience education should investigate the merits of adding agriculture course offerings to their curricula. The educational value of these programs is evidenced by the fact that

Louisiana students can receive science credit toward graduation as well as science credit for the Tuition Opportunity Program for Students (TOPS) by successfully completing certain agriscience courses. Students who take the courses required by TOPS and satisfy their other requirements receive 4 years of paid tuition at any university in the state.

Agriscience education instructors and program leaders need to educate local school counselors and administrators on the academic benefits of the program documented in this study. Counselors should be informed about the academic content in agriscience education courses, including how the content is related to student achievement. Counselors should also explain to students and their parents the state policy for using the Agriscience II course credit as a science credit for both graduation and TOPS science requirements. This would be especially beneficial for students planning to attend a 2- or 4-year college pursuing a major in agriculture.

Agriculture educators and state leaders need to examine their present curricula to continue including the latest areas of agriculturally related technology. This is vital to insure that the curriculum remains relevant in the face of constant technological advances. The researchers also recommend that additional research studies should be conducted in the following areas:

a. Further research on the impact of SES on Louisiana student achievement is needed. This study identified over one-third of the public high school population as economically disadvantaged. With such a large group of students at this level of the SES variable, a more thorough examination of the relationship between science achievement and SES is needed.
b. Further research concerning the role of FFA membership and supervised agricultural experiences (SAEs) on academic achievement is needed. Do FFA activities and SAE experiences influence academic achievement?
c. Further research is needed concerning agriscience education's impact on the academic achievement of special education and 504 students.

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