

# SCIENCE ACHIEVEMENT OF HIGH SCHOOL STUDENTS IN COMPLETE PROGRAMS OF AGRISCIENCE EDUCATION

*John C. Ricketts, Assistant Professor*  
*Dennis W. Duncan, Assistant Professor*  
*Jason B. Peake, Assistant Professor*  
University of Georgia

## Abstract

*The purpose of this descriptive and correlational study was to describe the science achievement of participants in complete programs of agriscience in Georgia. A secondary purpose was to compare science achievement of agriscience students to the science achievement of college prep, dual track, and technology/career prep students. The findings indicate that agriscience students enrolled in an average of four agriscience education courses, have a high level of engagement in SAE, and a moderate level of engagement with FFA. The mean score for agriscience students on the science portion of the Georgia High School Graduation Test (GHSGT) was 511.24, approximately three points lower than college prep students ( $M = 514.85$ ). Nearly 78% of the agriscience students passed the test on their first attempt in comparison to 68% for the state average, and only 38% for technology/career prep students. Further findings indicate a low but positive correlation between science achievement among agriscience students and the number of agriscience courses taken. There was also a low but positive correlation between the level of FFA and SAE engagement for both student achievement in science and the first time passing rate for the science portion of the GHSGT.*

## Introduction/Theoretical Framework

Accountability in the public school system is critical in light of statewide implementation of standardized tests. State leaders across the United States are discussing ways to increase accountability in high schools and increase standards for high school graduates. The No Child Left Behind (NCLB) Act of 2001 considerably increased testing requirements, and teachers have considerably increased attempts at teaching students to “pass the test.” A recent editorial stated, “If ... Georgia truly intends to develop a world-class school system, it shouldn't be teaching students how to pass a biology test. It should be teaching them biology” (Tucker, Bookman, Wooten, King, & Tuck, 2005, p. A13). While the opinionated columnist's anecdotal comments seemed laudable, research (Chiasson & Burnett, 2001; Doolittle & Camp, 1999; Enderlin & Osborne, 1992; Enderlin, Petrea, & Osborne, 1993; Ross,

2001; Whent & Leising, 1988) may indicate that this or any other state seeking to develop a world-class school system should also teach agriculture – the world's oldest science.

Connors and Elliot (1995) published a conceptual model that placed agriculture/agricultural science courses beside biology and chemistry as an additional, equal, and necessary component to a complete secondary science education program. Should this be the position of agriscience education (additional, equal, and necessary), or does a complete program of agriscience education have more to offer students in terms of science achievement?

A Cornell study by Shelley-Tolbert, Conroy, and Dailey (2000) articulated the components of a complete Agriscience Education Program to be “(1) classroom and laboratory instruction, (2) experiential learning through supervisory experiences, and (3) leadership activities” (p. 52-53). The classroom and laboratory instruction

component should involve instructional strategies such as problem solving (Dyer & Osborne, 1996; Parr & Edwards, 2004), experiential learning (Knobloch, 2003; Mabie & Baker, 1996), and teaching agricultural content and science concepts through the use of contextual learning (Balschweid, 2002; Edwards, Leising, & Parr, 2002; Roegge & Russell, 1990). The experiential learning and leadership activities components of this model provide for enhanced contextual, informal, and social learning through engagement in Supervised Agricultural Experiences (SAE) (Cheek, Arrington, Carter, & Randell, 1994; Dyer & Osborne, 1996) and the FFA (Cheek, et al., 1994; Edwards, et al., 2002).

Doolittle and Camp's (1999) exposition of constructivist philosophy provides the theoretical basis of this study. These researchers summarized the crux of constructivism with the following tenets of the philosophy:

1. Knowledge is not passively accumulated, but rather is the result of active cognizing by the individual;
2. Cognition is an adaptive process that functions to make an individual's behavior more viable given a particular environment;
3. Cognition organizes and makes sense of one's experience, and is not a process to render an accurate representation of reality; and
4. Knowing has roots both in biological/neurological construction, and in social, cultural, and language-based interactions (Constructivism Section, p. 2).

In addition to the tenets of constructivism, this study of science achievement was also guided by the factors of constructivist pedagogy highlighted by Doolittle and Camp (1999). The following factors are essential to constructivist teaching and learning, but also important for understanding how a complete program of agriscience education is a theoretically effective instrument for science achievement (Doolittle & Camp):

- Learning should take place in authentic, real world environments;
- Learning should involve social negotiation and mediation;
- Content skills should be made relevant to the learner;
- Content skills should be understood within the framework of the learner's prior knowledge;
- Students should be assessed formatively, serving to inform future learning experiences;
- Students should be encouraged to become self-regulatory, self-mediated, and self-aware;
- Teachers serve primarily as guides and facilitators of learning, not instructors; and
- Teachers should provide for and encourage multiple perspectives and representations of content (p.18-35).

Complete agriscience education programs embody the necessary factors of constructivist pedagogy, providing for real, social, relevant, reflective, self-regulatory, and multiple venues for understanding science. With the epistemic belief that constructivist pedagogy is most effective for learning, the need for improved science achievement, and the structural resemblance between complete programs of agriscience education and this pedagogy, the question must be raised: "Does a complete program of agriscience education influence science achievement?"

Several studies (Chiasson & Burnett, 2001; Enderlin & Osborne, 1992; Enderlin et al., 1993; Roegge & Russell, 1990; Ross, 2001; Whent & Leising, 1988) have determined the level of achievement in science that students gain through agriscience. Whent and Leising compared agriscience students to students in general science classes and concluded that agriscience students achieved slightly better on biology tests than did bioscience students. Roegge and Russell also determined that students who were subjected to lessons that integrated biological with agricultural principles demonstrated higher overall achievement and biology achievement than students taught science traditionally.

Using a post-test only, control group design, Enderlin and Osborne (1991) studied student science achievement of middle school students, and discovered that agriscience students earned significantly higher science scores. In 1992, Enderlin and Osborne also reported that agriscience students scored significantly higher than traditional students, in part, because of the integrated [complete] curriculum of agriscience. In addition, Enderlin et al. (1993) verified the impact of agriscience on science achievement in 1993.

Two researchers from California and Florida (Mabie & Baker, 1996) found that using agriculture for instruction of basic science skills of elementary students improved their achievement in science. Furthermore, Conroy and Walker (1998) reported that students studying aquaculture in an agriscience program reported that their achievement in science classes was higher as a result of their participation in agriculture based on comparisons with their past performances in those classes.

A statewide study in Louisiana examined all 11<sup>th</sup> grade students enrolled in public schools who completed the state mandated exit examination in 1998 (Chiasson & Burnett, 2001). Again, agriscience students participating in a complete program of agriscience education had higher scores than non-agriculture students in the science portion of the exam. Specifically, agriscience students scored higher on the scientific method, biology, earth science, and physics subscales of the graduation tests. This Louisiana State University study also found agriscience students to be more likely to pass the test than non-agriculture students.

Ross (2001), a high school agriscience teacher in Tennessee, conducted a longitudinal static-group comparison over 10 years to compare ninth grade agriscience students to non-agriculture students on their achievement in subsequent upper level science courses. Agriscience students achieved higher grades than non-agriculture students in Biology I, Biology II, Chemistry I, Chemistry II, and Physics. Educators, legislators, teachers, and researchers should wonder if a complete agriscience education

program could produce similar results in their local school system.

### Purpose and Objectives

The purpose of this descriptive and correlational study was to describe the science achievement of participants in complete programs of agriscience in Georgia. A secondary purpose was to compare science achievement of agriscience students to the science achievement of *College Prep, Technology/Career Prep, and Average Student* (state average). To achieve these purposes the following objectives were drafted to guide this study:

1. Describe the level of FFA, SAE, and overall engagement of participants of comprehensive agriscience education programs;
2. Identify the *Georgia High School Graduation Test* (GHS GT) science scores for participants of comprehensive agriscience education programs and compare agriscience education students' scores to mean scores of college prep students, technology/career prep, and the average state student;
3. Identify the first time passing rate of participants of complete programs agriscience education; and
4. Determine if comprehensive agriscience education is associated with student achievement in science.

### Procedures

The research design of this study was descriptive and correlational in nature. The target population for this study was defined as all students (N = 3,482) participating in complete programs of agriscience education in Georgia who have taken at least two agriscience education courses and the GHS GT in 2004. The purposive sample consisted of 523 students from 23 schools. Three Regional Coordinators of Agricultural Education from the Georgia State Department of Education asked ten qualified schools from each of three regions to participate in the study. Teachers of agriscience programs were asked to

participate in the study if they met the following description of a complete program of agriscience education:

*A complete program of agriscience education is defined as a program which provides ample opportunity for students to participate in FFA and SAE activities in addition to engaging in interactive classroom and laboratory activities at a level that meets minimum standards for agriscience education programs according to the State Standards for Agricultural Education Program (Georgia Department of Education, 2005) as administered by the Georgia Department of Education.*

After teachers agreed to participate in the study, they were given a questionnaire and asked to submit information for each student who took the Science portion of the GHS GT in 2004 and who also had enrolled in at least two agriscience education courses. Teachers acquired the following information from the guidance counselor in their respective schools: score on the science portion of the GHS GT, whether or not the student passed the science portion of the GHS GT on the first try, the number of agriscience courses for each student, and whether or not the student was a special needs student. Teachers were also asked to rate each student's level of involvement in the FFA and the quality of each student's SAE using a scale from one (not involved in FFA/SAE) to five (very involved in FFA/SAE).

Data for this study were collected using an e-mailed questionnaire. Dillman's (2000) "Design Principles for E-mail Surveys" (p. 367) was used to collect data from 23 (77%) of the 30 purposively-selected schools for this study. To control for non-response error, late respondents were compared to early respondents on the variables: GHS GT science score, first time passing rate, and level of program participation. No significant differences were found.

The science portion of the GHS GT measures students' competency in science process/research skills, physical science, and biology, but teachers were only asked to report the total scaled score of their students, which ranged from 400 to 600. Five hundred is a passing score for the science portion of the exam.

The GHS GT was considered valid since teachers in every state high school were involved in developing items that were relevant to state Science standards and tested the appropriate levels of cognitive difficulty (Georgia Department of Education, 2004, p. 62). Kuder-Richardson-20 reliability of the 80-item science portion of the GHS GT has been reported to be .90 (Gruber, 2001). Cronbach's alpha for the rating scale to determine FFA, SAE, and overall agriscience education program engagement was established at  $\alpha = .92$ .

Means and standard deviations were used to describe science scores, passing rates, number of agriscience education courses, and level of program participation (FFA, SAE, and overall engagement). Inferential statistics which provide additional detail were calculated to determine if participation in a comprehensive agriscience education is associated with student achievement in science.

## Findings

Students in the sample enrolled in a mean of four agriscience education courses. Agriscience teachers were asked to rank their students' overall engagement in the agriscience program (1 = not very involved; 5 = very involved). As indicated in Table 1, teachers identified their students as having a high level of engagement in the overall program ( $M = 3.66$ ) and SAE ( $M = 3.63$ ), and a moderate level of engagement concerning FFA involvement ( $M = 3.54$ ).

Table 1  
*Level of Engagement in the Complete Agriscience Education Program (N = 522)*

|                            | <i>M</i> | <i>SD</i> |
|----------------------------|----------|-----------|
| SAE                        | 3.63     | 1.28      |
| FFA                        | 3.54     | 1.25      |
| Overall Program Engagement | 3.66     | 1.20      |

*Note.* Students were considered to have a low, moderate, or high level of engagement based on the following scale: Low = 1 to 2; Moderate = 2.1 to 3.5; High = 3.6 to 5.

As shown in Table 2, the mean score for agriscience students ( $M = 511.24$ ) was approximately three points lower than that of college prep students ( $M = 514.85$ ) on the science portion of the GHSGT as reported by the Georgia Department of Education

(C. Domaleski, personal communication, February 15, 2005). Nearly 78% of the agriscience students passed the test on their first attempt in comparison to 68% for the state average, and only 38% for technology/career prep students.

Table 2  
*Passing Rate and Mean Score of Agriscience Education Completers on the Science Portion of the GHSGT Compared to the Passing Rate and Mean Score of College Prep Students, Technology/Career Education Students, and the Average Georgia Student*

| Student Classifications                      | Passing Rate (%) <sup>a</sup> | <i>M</i> | <i>SD</i> |
|--|-------------------------------|----------|-----------|
| College Prep                                 | 79.20                         | 514.85   | 19.74     |
| Agriscience Education Completer <sup>b</sup> | 77.30                         | 511.24   | 16.68     |
| Average Student                              | 68.10                         | 509.30   | 20.94     |
| Technology/Career Prep                       | 38.70                         | 494.90   | 17.26     |

<sup>a</sup> Passing rate is based on the first attempt. <sup>b</sup> An agriscience education completer is a student who has taken three or more agriscience courses or is currently enrolled in a third course.

There was a “low” (Davis, 1971), but positive and significant relationship between the number of courses in agriscience a student participated in and science scores on the GHSGT,  $r(520) = .15, p < .01$ . Likewise, there was a low, but positive and significant relationship between the number of courses in agriscience a student participated in and first time passing rate of the GHSGT,  $r(520) = .14, p < .01$  (Table 3).

There was a low, but positive and significant relationship between level of FFA engagement and GHSGT science scores,  $r(520) = .29, p < .01$ . Level of FFA

engagement was also positively related to passing rate,  $r(520) = .29, p < .01$ .

Level of SAE engagement was also associated with student achievement in science. There was a low, but positive and significant relationship between level of SAE engagement and GHSGT science scores,  $r(520) = .25, p < .01$ . Level of SAE engagement was positively related to passing rate,  $r(520) = .23, p < .01$ . Overall program engagement was moderately correlated to science score,  $r(520) = .31, p < .01$  and passing rate,  $r(520) = .30, p < .01$  (Table 3).

Table 3  
*Relationship Between GHS GT Science Score, Passing Rate, Number of Agriscience Education Courses Taken, and Engagement in FFA, SAE, and the Total Program*

| Variable   | Y <sub>1</sub> | Y <sub>2</sub> | X <sub>1</sub> | X <sub>2</sub> | X <sub>3</sub> | X <sub>4</sub> | M      | SD    |
|--|----------------|----------------|----------------|----------------|----------------|----------------|--------|-------|
| GHS GT Science Score (Y <sub>1</sub> )   | 1.00           | .65*           | .15*           | .25*           | .29*           | .31*           | 511.24 | 16.68 |
| <sup>a</sup> Passed Science portion of GHS GT on first attempt (Y <sub>2</sub> ) |                | 1.00           | .14*           | .23            | .29*           | .30*           | .75    | .43   |
| Number of agriscience education courses taken (X <sub>1</sub> )                  |                |                | 1.00           | .28            | .22*           | .23*           | 4.08   | 1.64  |
| SAE (X <sub>2</sub> )  |                |                |                | 1.00           | .71*           | .82*           | 3.63   | 1.28  |
| FFA (X <sub>3</sub> )  |                |                |                |                | 1.00           | .87*           | 3.54   | 1.25  |
| Overall Program Engagement (X <sub>4</sub> )                                     |                |                |                |                |                | 1.00           | 3.66   | 1.20  |

<sup>a</sup> Coding: failed on first attempt = 0; passed on first attempt = 1

\*  $p < .01$  (2-tailed)

### Conclusions/Recommendations/ Implications

This study supports past research conducted by Enderlin and Osborne (1991), Mabie and Baker (1996), Conroy and Walker (1998), and Chiasson and Burnett (2001), which determined that students achieved higher science scores due to participating in an agriscience course(s) or activity, in comparison with those who did not participate. Students in secondary education who participated in this study enrolled in an average of four agriscience classes and had a moderate to high level of engagement in the overall agriscience program which included FFA and supervised agricultural experiences (SAE's).

Students defined in this study as agriscience education completers had a first time passing rate of 77.3% and a mean score of 511.24 on the science portion of the GHS GT. Agriscience students outperformed technology/career prep and average students, and scored only slightly lower than college prep students who had mean scores of 494.90, 509.30, and 514.85 respectively.

The first-time passing rate for agriscience students was within two percentage points of college prep students, and agriscience students' first time passing rate was double that of technology/career prep students. Please note that agriscience students may have also been members of the college prep or the technology/career prep group.

Although there was only a "low" correlation between GHS GT science scores and the number of agriscience courses taken, FFA and SAE engagement, and a moderate correlation with overall program engagement, the relationships were positive (Davis, 1971). The correlation was positive as well for the first-time passing rate of agriscience students and the aforementioned variables. One may conclude that agriscience courses are indeed an important component of a student's secondary education, and, as evidenced by this study and earlier studies, agriscience courses and student involvement in FFA are related to one's knowledge and application of scientific concepts.

With the increasing pressure on public school systems to implement and/or improve state mandated tests in science and improve

students' performance on such tests, agriscience courses should be emphasized to increase students' knowledge and skills as they relate to science (biology, earth science, physics, etc.). It is recommended that other institutions of higher education perform similar studies to determine the impact of secondary agriscience programs on student performance. Positive results need to be shared at local, state, and national levels with those who have an impact on secondary education. With increasing pressure from state and national leaders to reduce and/or eliminate Perkins funding for vocational/technical education, it is the role of educators to share the impact agriscience education is having on young people across the country.

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JOHN C. RICKETTS is an Assistant Professor in the Department of Agricultural Leadership, Education, and Communication at the University of Georgia, 110 Four Towers Building, Athens, GA 30602. E-mail: [jcr@uga.edu](mailto:jcr@uga.edu).

DENNIS W. DUNCAN is an Assistant Professor in the Department of Agricultural Leadership, Education, and Communication at the University of Georgia, 106 Four Towers Building, Athens, GA 30602. E-mail: [dwd@uga.edu](mailto:dwd@uga.edu).

JASON B. PEAKE is an Assistant Professor in the Department of Agricultural Leadership, Education, and Communication at the University of Georgia, P.O. Box 748, Tifton, GA 31794. E-mail: [jpeake8@uga.edu](mailto:jpeake8@uga.edu).