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A Comparative Analysis of College Readiness Assessment Results of Illinois High School Agriculture Students

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Abstract

Agricultural education is defined by a best practice three-component model of instruction that includes a classroom experience, leadership development and FFA involvement, and an experience-based activity through a Supervised Agricultural Experience program (SAE). Based on program of activities award criteria, each year state FFA associations recognize top chapters with gold or silver emblem designations. This quantitative study provides a comparison of eleventh grade Illinois agriculture students from Gold and Silver Emblem FFA chapters to all Illinois eleventh-grade students on college assessments. In addition, it provides a comparison of Illinois agriculture students from Gold and Silver Emblem FFA chapters to all juniors tested from the same schools. Student identification numbers were securely collected from agriculture instructors and principals at qualifying schools and data were compiled by the office of the state board of education. The assessment results were analyzed and compared to determine if there were statistically significant differences that emerged between selected agriculture students and their peers using the ACT assessment designed to measure college readiness. Results indicated that the selected group of agriculture students are as college ready as their peers. Further analysis indicated that female agriculture students perform at a higher level than their peers on college readiness assessments.

Keywords: college readiness; agricultural education; effective programs

Introduction

Due to extreme financial crisis, school districts in Illinois have been forced to make substantial programmatic and staffing cuts (Bock, 2013). As a part of this process, districts have had to weigh the academic validity of each program. Agricultural education has held firm its goal of creating successful students and leaders for agriculture, other industries, or for success in further education (Smithers, 2012). According to the Illinois State Board of Education (ISBE) in 2011, 81% of agriculture programs in Illinois offer academic course credit in the areas of math, science, social sciences, consumer economics, and/or language arts. In the midst of a financial crisis in

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Illinois, it is more important than ever to be able to assess the academic performance of all programs including agricultural programs.

Though connections of agricultural education and content have been documented, little has been done in the area of researching the level of core academic proficiency associated with agricultural education students. However, agricultural education in the US has a well-documented history of integrating academic content through a strong emphasis in science and core academic content (Enderlin, Petra, & Osborne, 1993; Hearst, 1928; Hillison, 1996, Stimson & Lathrop, 1942). According to Myers and Thompson (2009), "research findings indicate that integration of academics into the agricultural curriculum is an effective way to teach math, science, and reading" (p. 75). Roberts and Ball (2009) stated "Further, as the educational climate oscillated toward a school wide emphasis on core academic knowledge (i.e., math, language, science etc.), agricultural education programs have also adjusted" (p. 88). Even with this curricular integration, agricultural education is defined by a best practice three-component model of instruction that includes a classroom experience, leadership development and FFA organization involvement, and experience-based activity through a Supervised Agricultural Experience (SAE).

In the wake of the No Child Left Behind legislation, the idea of college and career readiness has emerged as a formidable target for students and academic institutions (U.S. Department of Education, 2010). A *Blueprint for Reform* (2010) stated, "We will set a clear goal: every student should graduate from high school ready for college and a career, regardless of their income, race, ethnic or language background, or disability" (p. 3). As college and career readiness begins to emerge as a method of measuring success for programs, schools, and students at the secondary school level, it is of value to measure the effectiveness of agriculture programs through the same lens.

Conceptual Framework

As a measure of college readiness, several studies have shown ACT scores as a valid indicator of early college success as defined by freshmen GPA and first to second year college retention rates (ACT, 2010; ACT 2012; Allen, Robbins, Casillas, & Oh, 2008; Noble & Sawyer, 2002; Robbins, Allen, Casillas, Peterson, & Le, 2006). ACT scores have proven to be good indicators of success in freshmen level college coursework as related to college readiness benchmarks (Allen & Sconing, 2005). In a separate study, Radunzel and Nobel (2012) delivered research to indicate that ACT scores are useful in predicting the long-term success of college students, providing "further validity evidence for using them as measures of college readiness" (Radunzel & Nobel, 2012, p. ii.). The state-testing model in Illinois requires that all juniors in high school complete the ACT exam. This provides an attainable, reliable, and valid measure of college readiness for the population of Illinois juniors and the specific population of agriculture students. The consideration of state-testing, student enrollment in agriculture, and level of involvement by local school-based FFA Chapters led to the conceptual framework for the study.

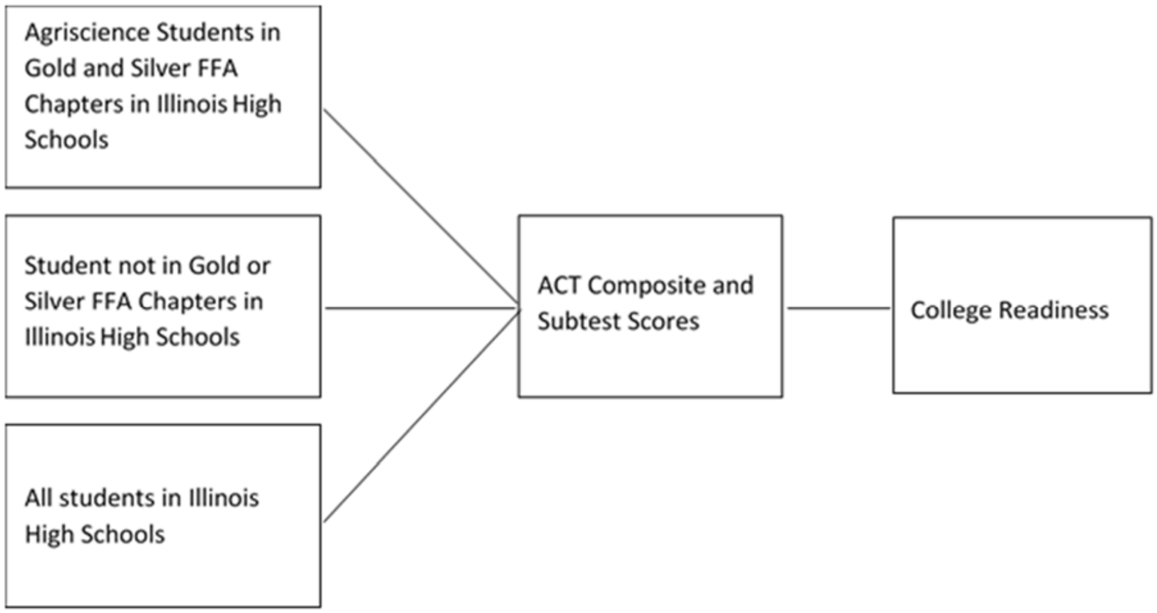

Figure 1. Conceptual Framework for the study.

With increasing emphasis on high-stakes testing performance, there may be a tendency to discount the value of performance in agriscience. The American Association for Agricultural Education research priority five (Thoron, Myers, & Barrick, 2016) stated priority questions central to this study through evaluating impacts of school-based agricultural education and by providing evidence-based investigations that indicated contribution to broader educational initiatives. Therefore, it is important to ascertain whether agriscience students are performing as well on standardized tests as other students not enrolling in or having the opportunity to enroll in agriscience which led to the purpose of the study.

Purpose/Objectives

Though much can be said about the progress and achievements of Illinois agricultural education through annual report data and anecdotal experiences associated with students, teachers, and industry leaders, no systematic investigation has been conducted to evaluate the academic validity of agricultural education programs or the academic performance of students served. To begin filling this void three specific student groups: Illinois agriculture junior students from Gold and Silver Emblem FFA chapters; all junior students from Illinois; and junior students from schools with Gold or Silver Emblem FFA chapters.

Method/Procedures

The study used a causal comparative design to identify the relationship between test scores and participating in the traditional three-part agricultural education program. "Some quantitative research designs have the purpose of explaining educational phenomena through the study of cause-and-effect relationships" (Gall, Gall & Borg, 2007, p. 306). In these designs, the cause of the phenomena would be considered the independent variable. The effect of the phenomena would be the dependent variable. Specifically, "Causal comparative research is a type of non-experimental investigation in which researchers seek to identify cause and effect relationships by forming groups of individuals whom the independent variable is present or absent or present at several levels—and then determining whether the groups differ on the dependent variable" (Gall, Gall, & Borg, 2007, p. 306).

This study examined whether the independent variable of being involved in an agriculture program, maintaining an SAE, and being involved in the National FFA organization consecutively in high school is related to the dependent variable of results on college readiness assessments as measured by the ACT. This led to the following research questions:

1. Is there a difference in ACT composite and subtest scores when Illinois agriculture students from Gold and Silver Emblem FFA chapters are compared with all Illinois students?
2. Is there a difference in ACT composite and subtest scores when Illinois agriculture students from Gold and Silver Emblem FFA chapters are compared with students from the same schools?

Population and Sample

This study examined three groups of students, each representing a slice-in-time sample of the larger populations. The first group (All Students) used for comparison in this study consisted of all juniors who completed the ACT in 2013 in Illinois. The second (Gold and Silver Ag) was those students at the Gold or Silver Emblem FFA chapter schools who participated in agricultural education. The final group (Gold and Silver All) was all juniors tested in 2013 who attended schools that held Gold or Silver FFA chapters. The data were collected through a survey of agriculture instructors at each of the qualifying high schools. Basic demographic factors were collected; however, no identifiable characteristics of students were attained, other than SIS numbers, to ensure complete student anonymity. All data for this study were taken from testing year 2012-2013.

The top agriculture programs in Illinois indicated by Gold or Silver Emblem FFA Chapters, based on program of activity rankings as released by the Illinois FFA organization for the year of 2012-2013 were identified. These schools maintain top FFA programs as judged by the state FFA association each year based on a comprehensive program of activities. Schools that are designated in the top categories of Gold and Silver Emblem chapters have a high likelihood of having students who have completed an SAE and maintained an FFA experience throughout high school (J. Craft, personal communication, March 4, 2013). As noted in the literature, the SAE experience is becoming increasingly rare; therefore, identifying schools with a high likelihood of this best practice component is a necessity (Cheek, Arrington, Carter, & Randell 1994; Dyer & Osborne, 1996). In addition, many studies conclude that SAE programs, when implemented, are not implemented in a consistent manner in many agriculture programs (Dyer & Osborne, 1995; Dyer & Williams, 1997; Retallick & Martin, 2005; Steele, 1997). All schools with Gold and Silver Emblem FFA chapters in Illinois (N=122) were then surveyed for secure Student Identification System (SIS) numbers for twelfth grade students who took Illinois state tests in 2012-2013 as high school juniors (Gold and Silver Ag).

The three groups were compared to determine if differences exist among the groups on ACT scores. These data were used to illustrate whether or not involvement in agriculture programs is related to college readiness as determined by scores on the ACT.

Instrumentation

This study used the college assessment exam developed and scored by the ACT organization. The ACT examination series has been used for decades to predict the college preparedness of high school students (ACT, 2012). The ACT series includes assessments in the areas of science, reading, English, mathematics, and an overall composite score. The widely accepted validity associated with the ACT examination in relation to college readiness provides a solid foundation for comparisons of groups within this study.

The ACT technical manual reports a scale score reliability associated with each portion of the ACT examination series. According to the ACT (ACT, 2007), in 2005-2006 the median scale score reliabilities associated with English was .91, mathematics .91, reading .85, science .80, and a composite median of .96. The median Standard Error of Measurement (SEM) associated with each test area was English 1.71, mathematics 1.47, reading 2.18, science 2.0, and a composite median SEM of .94 (ACT, 2007).

According to Gall, Gall, and Borg (2007), validity is defined as "the appropriateness, meaningfulness, and usefulness of specific inferences made from test scores" (pg. 306). Higher education institutions seek methods of assessing college readiness by compiling information related to individual students that includes high school performance, rigor of coursework, and performance scores on standardized tests like the ACT (Clinedinst, Hurley, & Hawkins, 2011). Colleges, for the purpose of college admissions and course placements, use the ACT series (ACT, 2007). It is widely accepted that the ACT is a valid predictor of college readiness (ACT, 2010c; ACT 2012c; Allen, Robbins, Casillas, & Oh, 2008; Noble & Sawyer, 2002; Robbins, Allen, Casillas, Peterson, & Le, 2006). The ACT technical manual provides numerous examples of validity studies and arguments for the purpose of framing the validity of the examination series (ACT, 2007).

Data Collection and Recording

With the assistance of the office of the Illinois State Board of Education, and Facilitating Coordination in Agricultural Education (FCAE), test score information and basic demographic information were compiled for this study using the SIS numbers provided by the schools in the sample. After initial test scores were received from ISBE, survey material was compiled for agriculture instructors and principals from participating schools. Initially, an electronic contact was made by the principle researcher and by FCAE staff indicating that the study was going to take place, and schools were encouraged to monitor mail and electronic communications as well as to participate in the study.

To collect the data needed to complete this study, an instrument was sent via mail and electronically to every agriculture instructor and principal from each of the 122 schools that were designated 2012-2013 Gold and Silver Emblem FFA chapters. The agriculture instructor in each school was asked to work with school administration and counselors to record SIS numbers for each agricultural education student who met the criteria for the study. Names and identifying information of students were not recorded or shared to protect the anonymity of students related to this study. The SIS numbers were provided electronically from each school to complete a final set of SIS numbers for students from all schools that voluntarily participated in this study. Participants were allowed five weeks to complete the information needed with the study. After two weeks, a reminder e-mail was sent to each school that had not returned the initial survey. A second reminder was sent electronically to schools that had not completed the data set after three weeks. Upon final collection of data from Gold and Silver Emblem FFA schools, the SIS numbers were shared securely through password protected spreadsheets with ISBE.

SIS numbers for all agricultural education students from Gold and Silver Emblem FFA chapter schools that took the state-mandated ACT examination as juniors during the 2012-2013 school year were provided to the state board of education. Illinois State Board of Education compiled the test scores per the FOIA request and returned the data without the SIS numbers included, ensuring complete student anonymity. The researcher at no time could determine any identifiable information with any test score or SIS number. After test scores were returned, statistical analysis was conducted for each area of testing associated with the study.

Data Analysis

The average ACT scores for this sample of students were compared to the averages of the overall populations of all Illinois students, and the secondary populations of all juniors from schools that housed Gold and Silver Emblem FFA chapters. The data were analyzed using SPSS. Demographic data collected on the sample of agriculture students were analyzed. A profile of agriculture students was created and compared with the general Illinois (All students) population as well as with all junior students (Gold and Silver All) who attended schools with Gold and Silver Emblem designations. One-sample *t*-tests were conducted to compare agriculture students' (Gold and Silver Ag) test performance on ACT tests with students from the other two groups of (All Students), and all students from Gold and Silver Emblem FFA chapter schools (Gold and Silver All). The analysis was conducted using the ACT composite score and each of the subtest scores.

Results/Findings

Three distinct groups were part of the analysis in this study. These groups were all tested juniors in Illinois (All Students), Junior agriculture students from Gold and Silver emblem FFA chapters (Gold and Silver Ag), and all Junior students from schools that housed Gold and Silver Emblem FFA chapters (Gold and Silver All). Agriculture students had the lowest percentage of low-income students (15.4%), particularly in comparison to the overall state average of 49.9%. Table 1 lists demographic data on race, Limited English Proficiency (LEP), IEPs, and the number of low-income students as a whole for all Illinois students and students from the Gold and Silver Emblem FFA chapters. Demographics were listed for all students at all grade levels and were interpreted as representative of 11th grade students in the state.

Table 1

Demographic Data

	N	% Male	% White	% LEP	% IEP	% Low Income
All Illinois Students	2,054,155	51.1	50.6	9.5	13.6	49.9
Gold and Silver All	4,611	51.1	90.3	0.3	11.2	28.7
Gold and Silver Ag	527	60.3	98.7	0	9.5	15.4

Note. LEP = Limited English Proficiency; IEP = Students with an individualized Education Plan.

Prior to data analysis, a distribution of scores was created for each ACT test area as well as for the ACT composite score to confirm that the data met the normality assumption for a one-sample *t* test (Urdan, 2010, p. 31).

A one-sample *t* test was used to compare the ACT score composite and subset scores for all groups. A *p*-value of .05 was used as cutoff for statistical significance (Urdan, 2010). The results are listed for ACT composite and each subcategory. Both composite scores and subtest scores are important because the composite score is used to determine college entrance or scholarships (ACT, 2012) and the subtest scores provide a picture of students' academic strengths and weaknesses.

Table 2 shows 2013 ACT composite and subset scores for the sample of agriculture students. The ACT scores for these students indicates a mean score of 20.6 in reading, a mean score of 20.7 in math, a mean score of 20.5 in science, a 19.4 mean in English, and a composite mean score of 20.3 overall. These scores were then compared to the state averages for all juniors (see Table 3) using one-sample *t*-test for ACT composite test and each subtest (see Table 4).

Table 2

2013 ACT Scores of the Agricultural Education Students in Gold and Silver Chapter Schools (Gold and Silver Ag)

ACT	*N*	*Min.*	*Max.*	*M*	*SD*
Reading	527	9	36	20.62	5.69
Math	527	11	34	20.72	4.76
Science	527	7	35	20.48	4.94
English	527	7	35	19.41	5.87
Composite	527	10.75	33.75	20.31	4.83

Table 3 indicates 2013 ACT composite and subset scores for all junior students in Illinois. The ACT scores for these students indicate a mean of 20.2 in reading, a mean score of 20.4 in math, a mean score of 20.0 in science, a mean of 19.4 in English, and a composite mean score of 20.1.

Table 3

2013 ACT Scores for all Illinois Juniors (All Students)

ACT	*N*	*Min.*	*Max.*	*M*	*SD*
Reading	144,08[illegible]	1	36	20.19	6.23
Math	144,14[illegible]	1	36	20.42	5.49
Science	144,08[illegible]	1	36	20.01	5.53
English	144,02[illegible]	1	36	19.41	6.65
Composite	143,92[illegible]	1	36	20.14	5.54

As noted in Table 4, the results of the one-sample *t* test identified no difference between the groups for each of the subtest sections except for science. The analysis in ACT Science produced a significant *t* value (t (526) = 2.15, p =.032). There is a significant difference in ACT Science test scores when comparing the gold and silver agriculture students to all Illinois students. An analysis of means revealed that the sample (M = 20.48) had higher Science ACT scores than all Illinois students (M = 20.01). Cohen's *d* suggests the effect size is small.

Table 4

One-sample t test Comparing Gold and Silver Agriculture Students (Gold and Silver Ag) and All Illinois Juniors (All Students)

ACT	Gold & Silver Ag			All Illinois Juniors			*t*	*p*	*d*
	N	*M*	*SD*	*N*	*M*	*SD*			
Reading	527	20.62	5.69	144,080	20.19	6.23	1.74	0.082	0.08
Math	527	20.72	4.76	144,142	20.42	5.49	1.44	0.151	0.06
Science	527	20.48	4.94	144,082	20.01	5.53	2.15	0.032	0.09
English	527	19.41	5.87	144,024	19.41	6.65	0.003	0.998	< .01
Composite	527	20.31	4.83	143,929	20.14	5.54	0.8	0.425	0.03

Table 5 provides the ACT composite and subset results for all juniors from schools that held Gold and Silver Emblem FFA chapters (Gold and Silver All). The ACT scores for these students indicates a mean score of 20.8 in reading, a mean score of 20.5 in math, a mean score of 20.4 in science, a 19.9 mean in English, and a composite mean score of 20.4 overall.

Table 5

2013 ACT Data For All Students in High Schools With Gold and Silver Emblem Chapters Schools (Gold and Silver All)

ACT	*N*	*Min*	*Max*	*M*	*SD*
Reading	4,601	3	36	20.81	5.93
Math	4,602	11	36	20.48	4.92
Science	4,601	7	36	20.41	5.06
English	4,602	6	36	19.85	6.07
Composite	4,602	9.75	36	20.39	5.02

Table 6 lists the results of a one-sample *t* test comparing agriculture students from Gold and Silver Emblem FFA Chapters and junior students from the same schools. In each of the comparisons, there was no statistical difference between the agriculture student sample and the FFA student chapter students.

Table 6

One-sample t test Comparing Agriculture Student Sample with Gold and Silver Emblem

ACT	Gold & Silver Ag. Students			Gold & Silver All			*t*	*p*	*d*
	N	*M*	*SD*	*N*	M	*SD*			
Reading	527	20.62	5.69	4,601	20.81	5.93	-0.76	0.445	-0.03
Math	527	20.72	4.76	4,602	20.48	4.92	1.16	0.245	0.05
Science	527	20.48	4.94	4,601	20.41	5.06	0.308	0.758	0.01
English	527	19.41	5.87	4,602	19.85	6.07	-1.71	0.088	-0.07
Composite	527	20.31	4.83	4,602	20.39	5.02	-0.39	0.696	-0.02

Subgroup analysis was carried out because the sample and the comparison groups differ in student demographics. ISBE provided the State of Illinois assessment information as averages without the ability to delineate between various groups involving gender or socioeconomic status. This did not allow additional comparisons to be made between the sample and overall state subgroups. Demographics of the agricultural student sample data were similar to the FFA chapter schools, differing more in gender and low-income. Since the data associated with the agricultural student sample and all junior students from Gold and Silver Emblem schools could be analyzed into subgroups, comparisons were made on gender and low-income between agricultural student sample (Gold and Silver Ag) and all students from the same schools (Gold and Silver All) data. Other factors or subgroups were not analyzed due to lack of adequate sample size.

Table 7 indicates comparison of (Gold and Silver Ag) to (Gold and Silver All) students on the basis of sex.

Table 7

ACT Sex Comparisons: Agriculture Student Sample (Gold and Silver Ag) vs. All Students from Gold and Silver Emblem Schools (Gold and Silver All)

Sex	ACT	Gold & Silver Ag			Gold & Silver All			*t*	*p*	*d*
		N	*M*	*SD*	*N*	*M*	*SD*			
Female	Reading	209	21.80	5.71	2,254	21.11	5.81	1.74	0.08	0.12
	Math	209	21.20	4.68	2,254	20.34	4.75	2.66	0.01	0.18
	Science	209	21.18	4.90	2,254	20.30	4.82	2.59	0.01	0.18
	English	209	20.87	6.15	2,254	20.54	6.07	0.78	0.44	0.05
	Composite	209	21.26	4.91	2,254	20.57	4.90	2.03	0.04	0.14
Male	Reading	270	19.99	5.58	2,347	20.52	6.02	-1.55	0.12	-0.09
	Math	270	20.63	4.78	2,348	20.62	5.08	0.03	0.97	0.00
	Science	270	20.19	4.96	2,347	20.52	5.28	-1.11	0.27	-0.07
	English	270	18.62	5.48	2,348	19.20	5.99	-1.74	0.08	-0.11
	Composite	270	19.86	4.69	2,348	20.21	5.12	-1.25	0.21	-0.08

Female ACT results. The analysis of ACT reading and English scores for females produced a non-significant *t* value. The analysis in ACT math for females produced a significant *t* value ($t(208) = 2.66$, $p = .01$, $d = .18$) and in science ($t(208) = 2.59$, $p = .01$, $d = .18$). In addition, the ACT Composite Scores for females produced a significant *t* value ($t(208) = 2.03$, $p = .04$, $d = .14$). These results show that female agriculture students outperform all females from the same schools in the areas of math and science. Cohen's *d* suggests that differences between groups are small.

Males ACT results. Each area of the analysis for males indicated non-significant *t* values and thus no significant difference between gold and silver agriculture and gold and silver non-agriculture students were found.

Table 8 separates agriculture students into low and non-low-income categories and then compares their respective ACT Composite and subtest scores to the student scores from all FFA chapter students.

Table 8

ACT Income Comparisons: Sample (Gold and Silver Ag) vs. All Students from Gold and Silver Emblem Schools (Gold and Silver All)

Income	ACT	Gold & Silver Ag			Gold & Silver All			*t*	*p*	*d*
		N	*M*	*SD*	*N*	*M*	*SD*			
Low income	Reading	81	18.64	5.41	1316	18.66	5.58	-0.03	0.98	0.00
	Math	81	19.21	4.59	1317	18.43	4.19	1.53	0.13	0.17
	Science	81	18.91	4.59	1316	18.39	4.75	1.03	0.31	0.11
	English	81	17.47	5.61	1317	17.17	5.65	0.48	0.63	0.05
	Composite	81	18.56	4.60	1317	18.16	4.56	0.78	0.44	0.09
Non low income	Reading	446	20.98	5.67	3285	21.67	5.84	-2.57	0.01	-0.12
	Math	446	21.00	4.74	3285	21.30	4.96	-1.36	0.18	-0.06
	Science	446	20.76	4.96	3285	21.22	4.95	-1.96	0.05	-0.09
	English	446	19.77	5.85	3285	20.93	5.90	-4.20	<0.01	-0.20
	Composite	446	20.63	4.81	3285	21.28	4.91	-2.88	<0.01	-0.14

ACT low-income. The analysis in all areas of the ACT produced non-significant *t* values, suggesting that low-income students from the group performed similarly to those from the FFA chapters.

ACT non-low-income. The analysis of non-low-income students produced a non-significant *t* value ($t(445) = -1.36$, $p = .18$) in the area of math indicating no significant difference in math scores when the sample is compared to all students from the same schools. However, the results indicated significant *t* values in the areas of reading, science, English, and the ACT composite test scores. Gold and Silver all students tended to score high than the sample of Agriculture students (Gold and Silver Ag) from the same schools.

Conclusions & Discussion

Based on the results of the study, four conclusions are posited.

Conclusion One: Agriculture students are as college-ready as their peers. The results indicate that agricultural education students performed similarly to their peers in the area of college preparedness as measured by performance on the ACT assessment in all areas, with the exception of science. Agricultural education students performed significantly better than their peers when compared to all juniors in Illinois who took the ACT science assessment. Agricultural education has taken pride in its integration of core curriculum areas, including English, math, and science (Case & Cloud 2007; Conroy, 2000). The integration of science in various aspects of agriculture may explain the difference in science scores in relation to other areas. This study indicated that the level of college readiness for agriculture students is statistically and practically similar to all students in Illinois, and all students from the FFA chapters in which the students attend.

Conclusion Two: Female agricultural students have higher ACT scores than their peers. In 2013, agricultural education served 29,202 students in Illinois of which 37% were female. Females have become increasingly involved in agricultural education in both the classroom and FFA leadership positions in the last three decades (ISBE, 2013). The results of the study indicate that female agriculture students scored statistically better than all females from the same schools in the areas of ACT math, ACT science, and over-all ACT composite scores. In addition, females had higher mean ACT scores in all areas including ACT reading and ACT English than all females from the same schools. The results indicated that when compared to all females from the same schools, female students from the agriculture sample were more college ready than their peers. Caution should be urged however, since Cohen's *d* is small suggesting the effect size is small.

Conclusion Three: Non low-income agriculture students are less college-ready than their peers; however, low-income agriculture students are as college-ready as their peers. One outcome of the study indicated that non-low-income agriculture students performed below all non-low-income students from the same schools in the areas of ACT reading, ACT science, ACT English, and over-all ACT composite scores. However, the same students performed similarly to all non-low-income students in the area of ACT math. Cohen's *d* is small suggesting the effect size is small. It was also noted that low-income agriculture students performed similarly to all low-income students from the same schools. Review of mean scores showed that they had higher average scores in math and science when compared to low-income students in the FFA chapter schools. The differences that emerged in terms of low-income status involved the negative disparity of ACT scores when non-low-income agriculture students were compared to their peers.

Conclusion Four: Agriculture students perform best in the areas of math and science. Throughout the study, indications were that agriculture students seemed to perform highest on the math and science portions of the ACT college readiness assessment. This supported the literature that agriculture education emphasizes a science- and core-based curriculum (Dyer & Williams, 1997; Shelley-Tolbert, Conroy, & Dailey, 2000). Specifically, agricultural education in Illinois has utilized a science-based curriculum developed through support from the agricultural education line-item funding (Smithers, 2012). Though not statistically significant in some cases, the means seemed to indicate that students from the agriculture sample were most proficient in math and science than other areas. In each comparison, the scores in math and science were consistently the highest across the board when agriculture students were compared to all students from the same schools.

Contributions to the Field

This study added to the body of research on the academic validity of agricultural education programs. To date, no studies have examined the overall effectiveness of agricultural education programs to produce college -ready students as measured by performance on the ACT examination on such a large scale. This study provides a quantitative set of data that agriculture teachers, FFA Advisors, school boards, principals, and district superintendents can use to justify the inclusion and support of local agricultural education programs in communities in Illinois and throughout the United States.

A large body of research exists on the inclusion of core content in the agricultural education curriculum. In addition, the function of a best-practice model of the three- component model of instruction for agricultural education involving classroom instruction, SAE, and FFA involvement is well documented (Dailey, Conroy, & Shelley- Tolbert, 2001; Dyer & Williams, 1997; National FFA Organization, 2012; National Research Council, Board on Agriculture, Committee on Agricultural Education in Secondary Schools, 1988; Smithers, 2012, Talbert, Vaughn & Croom, 2005). This study provides an analysis of the validity of both core curriculum inclusion and functionality of the best practice three-component model of agricultural education delivery. The outcome is a quantifiable analysis of the level of success that agricultural education is attaining toward college readiness for students.

Finally, as communities, school boards, and school administrators seek to determine programming for schools that meet the college and career readiness needs of their students, agricultural education should be considered a viable component in academic and workplace preparation. This research serves to promote the academic successes documented toward agricultural education providing increased college and workplace readiness, especially in the areas of mathematics and science. The academic validity of agricultural education programming has been supported by empirical evidence.

Recommendations for Further Research

Suggestions for further research related to this study include the need for the study to be expanded or replicated over multiple years. This study provided only a one-year slice-in-time comparison of students. A multiple-year analysis would help to validate the results attained. In addition, replicating the study in other states would be of benefit to determine if the results differ from state to state. Also, there are many concerns with collecting student data to ensure complete anonymity for students and confidential data. This study provided test score comparisons, but failed to provide any other information about the students in the sample other than their significant involvement in agriculture programs and basic demographics due to the priority of not collecting any identifiable information. If a researcher could find a way to glean more information about the students in the sample, such as grade point average, class rank, and other course selections, it might serve to provide an even clearer picture of the students and potential outcomes. Also, although every effort was made to have agriculture teachers and principals respond to the survey request in this study, the voluntary nature of the research allowed for several schools to be left out of the study. Though the respondents allowed for a clear set of data and results to emerge, a larger number of students and schools should be identified to increase sample size, if possible. Finally, it is recommended that other career and technical education areas replicate the study to determine if similar results emerge across career and technical education content areas.

Recommendations for Practice

Agriculture teachers. Agriculture teachers should use this study to help build upon the skills that emerged as strengths, and those areas that emerged as needing improvements. Recommendations for practice for agriculture teachers include supporting the inclusion of SAE programs as an integral part of every program for every student. This emphasis on math and science must be maintained and expanded. This research also provides room for improvement in the areas of reading and English for agriculture students. As literacy continues to be of great importance in the Common Core State Standards, agriculture teachers are encouraged to provide meaningful opportunities for agriculture students to improve reading and writing skills. Finally, agriculture teachers should share this research with stakeholders to facilitate support for their programs and efforts to maintain best practice models for agricultural education.

Superintendents and principals. Administrators should utilize this research to help facilitate discussions about the validity of supporting agriculture programs in their schools and communities. The results indicated that agriculture programs are a valid college and career ready delivery model for students. In addition, the delivery model of agricultural education can be expanded to other curricular areas by encouraging deep application of material and leadership opportunities for students across content areas. As administrators in Illinois are continually striving to offer impactful programming to students while under the pressure of decreased financial resources, this study provides an example of how agricultural education can be a valuable academic component for schools.

Boards of education. Boards of Education should utilize this research to validate support for existing programs and for the expansion of agriculture programs in local communities. The career readiness results should be of particular interest to school boards as they indicate that agriculture students attain a higher level of workplace readiness than their peers. This indicates potential educational and economic impact to local communities by supporting a homegrown, career-ready work force through supported local agricultural programming.

References

ACT. (2012). *The condition of college and career readiness 2012*. Retrieved from http://media.act.org/documents/CCCR12-NationalReadinessRpt.pdf

ACT. (2010). *What are ACT's college readiness benchmarks?* Iowa City, IA: ACT, Inc.

ACT. (2007). *ACT technical manual*. Iowa City, IA. Retrieved from http://www.act.org/qualitycore/pdf/TechnicalManual.pdf

Allen, J., & Sconing, J. (2005). *Using ACT sssessment scores to set benchmarks for college readiness.* (ACT Research Report No. 2005-3). Iowa City, IA: ACT, Inc.

Allen, J., Robbins, S., Casilla, A., & Oh, I. (2008). Third-year college retention and transfer: Effects of academic performance, motivation, and social connectedness. *Research in Higher Education, 49*, 647-664. Retrieved from http://dx.doi.org/10.1007/s11162-008-9098-3

Bock, J. (2013, March 22). *Illinois schools brace for more cuts in state aid.* St. Louis Post Dispatch. Retrieved from http://www.stltoday.com/news/local/education/illinois-schools-brace-for-more-cuts-in-state-aid/article_28a3c258-ea77-5649-b559-279b4189ec5c.html

Case, L. D., & Cloud, A. (2007). Agricultural education: Meeting needs of yesterday, today and tomorrow. *The Agricultural Education Magazine, 80*(3), November/December 2007.

Cheek, J. G., Arrington, L. R., Carter, S., & Randell, R. S. (1994). Relationship of supervised agricultural experience program participation and student achievement in agricultural education. *Journal of Agricultural Education, 35*(2), 1-5. http://dx.doi.org/10.5032/jae.1994.02001

Clinedinst, M. E., Hurley, S. F., & Hawkins, D. A. (2011). *2011 state of college admission*. Alexandria, VA: National Association for College Admissions Counseling.

Conroy, C. A. (2000). Reinventing career education and recruitment in agricultural education for the 21st century. *Journal of Agricultural Education, 41*(4), 73-84. http://dx.doi.org/10.5032/jae.2000.04073

Dyer, J. E., & Osborne, E. W. (1995). Participation in supervised agricultural experience programs: A synthesis of the research. *Journal of Agricultural Education, 36*(1), 6-14. http://dx.doi.org/10.5032/jae.1995.01006

Dyer, J. E., & Osborne, E. W. (1996). Developing a model for supervised agricultural experience program quality: A synthesis of research. *Journal of Agricultural Education, 37*(2), 24-33. http://dx.doi.org/10.5032/jae.1996.02024

Dyer, J. E., & Williams, D. L. (1997). Benefits of supervised agricultural education programs: A synthesis of research. *Journal of Agricultural Education, 38*(4), 59- 67. http://dx.doi.org/10.5032/jae.1997.04059

Enderlin, K. J., & Osborne, E. W. (1993). Student achievement, attitudes, and thinking skill attainment in an integrated science/agriculture course. *Proceedings of the 19th Annual National Agricultural Education Research Meeting*, St. Louis, MO.

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). *Educational research, an introduction* (8th ed.). Boston: Allyn & Bacon.

Hearst, W. F. (1928). *The Organization and Methods of Teaching the Sciences Related to Vocational Agriculture*. Unpublished MA Thesis, Kansas State Agricultural College.

Hillison, J. (1996). The origins of agriscience: Or where did all that scientific agriculture come from? *Journal of Agricultural Education, 37*(4), 8-13. http://dx.doi.org/10.5032/jae.1996.04008

Myers, B., & Thompson, G. (2009). Integrating academics into agriculture programs: A Delphi study to determine perceptions of the national agri-science teacher ambassador academy participants. *Journal of Agricultural Education, 50*(2), 75- 86. http://dx.doi.org/10.5032/jae.2009.02075

Noble, J., & Sawyer, R. (2002). *Predicting different levels of academic success in college using high school GPA and ACT composite score.* (ACT Research Report No. 2002-4). Iowa City, IA: ACT, Inc.

Radunzel, J., & Noble, J. (2012). Predicting long term college success through degree completion using ACT composite score, ACT benchmarks, and high school grade point average. (ACT Research Report No. 2012-5). Iowa City, IA: ACT, Inc.

Retallick, M. S., & Martin, R. A. (2005). Economic impact of supervised agricultural experience in Iowa: A trend study. *Journal of Agricultural Education, 46*(1), 44- 54. http://dx.doi.org/10.5032/jae.2005.01044

Roberts, T. G., & Ball, A. L (2009). Secondary agricultural science as content and context for teaching. *Journal of Agricultural Education, 50*(1), 81-91. http://dx.doi.org/10.5032/jae.2009.01081

Robbins, S., Allen, J., Casillas, A., Peterson, C., & Le, H. (2006). Unraveling the differential effects of motivational and skills, social, and self-management measures from traditional predictors of college outcomes. *Journal of Educational Psychology, 98*, 598-616. http://dx.doi.org/10.1037/0022-0663.98.3.598

Shelley-Tolbert, C., Conroy, C., & Daily. A. (2000). The move to agri-science and its impact on teacher education in agriculture. *Journal of Agricultural Education, 41*(4), 51-61. http://dx.doi.org/10.5032/jae.2000.04051

Smithers, J. (2012, June 25). Interview by David Mouser [Personal Interview]. Interview of Illinois FCAE director.

Steele, R. (1997). Analysis of the continuing decline in use of supervised agricultural experience (SAE) in New York State. *Journal of Agricultural Education, 38*(2), 49-58. http://dx.doi.org/10.5032/jae.1997.02049

Stimson, R. W. & Lathrop, F. W. (1942). *History of agricultural education of less than college grade in the United States*. U.S. Office of Education, Washington, DC: Government Printing Office.

Talbert, A. B., Vaughn, R., & Croom, D. B. (2005). *Foundations of agricultural education*. Caitlyn, IL: Professional Educators Publications, Inc.

Tenney, A. W. (1977). *The FFA at 50; A golden past. A brighter future*. Alexandria, VA: National FFA Organization.

Thoron, A. C., Myers, B. E., & Barrick. R. K. (2016). Efficient and effective agricultural education programs. In Roberts, T. G, Harder, A., & Brashears, M. T. (Eds.), *American Association for Agricultural Education national research agenda: 2016-2020* (pp. 41-48). Gainesville, FL: Department of Agricultural Education and Communication.

Urdan, T. (2010). *Statistics in plain English (3rd ed.)*. New York: Routledge Taylor & Francis Group.

U.S. Department of Education. (2010). *A blueprint for reform. The reauthorization of the Elementary and Secondary Education Act.* Retrieved from http://www2.ed.gov/policy/elsec/leg/blueprint/blueprint.pdf