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## Agricultural Education and Mathematics Performance among Secondary Students

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## Agricultural Education and Mathematics Performance among Secondary Students

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### Abstract

**Purpose:** The purpose of this study was to determine the effects of agricultural education, FFA involvement, and SAE participation on the mathematics performance of secondary students. **Method:** The study explored these factors using an ex post facto research design. Respondents in the study were secondary students enrolled in Agricultural Education program (N=80) and non-agricultural education students (N=59). **Findings:** Results revealed that agricultural education students had a higher mathematics mean score (M=12.15, SD=4.61) than non-agricultural education students (M=10.67, SD=3.63). **Conclusion:** There were positive statistically significant differences between mathematics performance of the students and their FFA involvement as well as SAE participation.

**Keywords:** Agricultural Education, FFA, SAE, Mathematics

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### Introduction

Mathematics and science achievement of United States (U.S.) students continue to straggle behind other technologically developed nations as revealed by The Third International Mathematics and Science Study, TIMSS (Mullis, Martin, Foy & Arora, 2012). This report further indicated though the U.S. average mathematics scores for grade four and grade eight were above TIMSS average score, the East Asian countries (Singapore, Korea, Hong Kong SAR, Chinese Taipei, and Japan) were the high performing countries at both the 4<sup>th</sup> and 8<sup>th</sup> grades. A number of reasons for this lag has been listed some of which include unimaginative instructional methods, inexperienced teachers and lack of connection between school mathematics and the day to day experiences of the students. A report by the National Centre for Education Statistics (1999) stated that:

U.S. twelfth graders scored below the international average and among the lowest of the 21 participating nations in both mathematics and science general knowledge (in The Third International Mathematics and Science Study, TIMSS). The U.S. outperformed only South Africa and Cyprus on both assessments (p.7).

Ladson-Billings (1997) suggested that agricultural education provides a context which students can explore key biological and mathematics concepts and skills. However, limited studies have been conducted concerning mathematics performance of high school students and the associations with FFA and SAE participation in The State.

### Contextual Learning

The application and transfer of knowledge, skills, and attitudes into real-world situations is the goal of learning (Phipps, Osborne, Dyer, & Ball, 2008). Upon graduation, students should

be able to apply theories and principles learned to solve real-life problems especially in their field or profession. Identifying the instructional methods that would enhance the transfer of knowledge and skills by students is, therefore, of utmost importance. The use of problem-based learning experiences promotes learning of concepts and principles and provides students with a deeper understanding of the usefulness and the application of their learning (Kolodner, et al., 2003).

Researchers suggested that the mathematics taught in American schools lacks the connection and the context required to be understood and applied effectively (Britton, et al., 1999; Hoachland, 1999; Von Secker & Lissitz, 1999). Less than one in every three high school students are able to do math at a proficient level as determined by bipartisan Board of Education experts (Drosjack, 2003). A study by Bayer Corporation (2003) found that 9 out of 10 Americans were perturbed by the lack of mathematical skills of today's students which are necessary to produce the excellence required for homeland security and economic leadership in the 21<sup>st</sup> century.

Mathematical literacy and knowledge is required for one to pursue most college degree programs and also to compete in the technology driven workforce. Most students will learn mathematics best when they see the connection between the concepts learned in school and their real-life applications (Theriot, Kortlik, & Jabor, 2009). Most life situations are not limited to one discipline and since contextual teaching and learning involves several disciplines, it assists students to understand how knowledge and skills learned in school apply to real-life situations (Berns & Erickson, 2001). These experiences enhance deeper understanding of learnt principles and concepts which enables the students to retain information longer and apply it to future situations.

Parr (2004) noted that agricultural education is a valuable educational resource with the potential of increasing the academic performance of students despite the fact that it remains untapped. Agricultural education provides connections between theories and principles taught in academic courses and practice taught in vocational courses (Parr, Edwards, & Leising, 2008). This resource can be utilized fully and effectively by the agricultural educators and mathematics teachers in bridging the gap that exists between content and context. Anderson and Driskill (2012) indicated that agricultural education is a content area that is rich in mathematics concepts. Agricultural education contributes to the development of the students' ability to solve problems which require the collection of data as well as interpretation.

While contextualized learning may be beneficial, Warnick and Thompson (2004) identified barriers to integrating science concepts into agricultural education some of which include; lack of preparation time, lack of knowledge concerning how to integrate subject matter, lack of resources, and lack of administrative support.

### **Agricultural Education Curriculum**

According to the National FFA website (2013), a complete agricultural educational program has three integral parts: classroom/ laboratory instruction, FFA, and Supervised Agricultural Experience (SAE). The FFA motto, "Learning to Do, Doing to Learn, Earning to Live, Living to Serve," (National FFA, 2013, "FFA Mission and Motto", para. 2) embraces the experiential learning concept, and so does the Supervised Agricultural Experience (SAE) program of the FFA. Students who participate in FFA activities are provided with opportunities to develop

in leadership, personal growth and career success through agricultural education. Shinn et al. (2003) asserts that;

In the preparation of FFA Career Development Events (CDEs), students technical and academic content that integrates and relies on their understanding and applications of various mathematical terms, concepts, and operations in areas such as agricultural mechanization, including dimensions of Biosystems engineering, agronomy, environmental science, food science, horticultural science, plant science, and poultry science (p.19).

The other integral part of agricultural education is SAE. Supervised agriculture experience (SAE) programs give opportunities to agricultural education students to apply experiential learning. The programs provide firsthand exposure to how classroom knowledge and skills are used in the workplace, communication development and problem-solving skills as well as insight into various careers.

Agricultural education has great potential to deliver relevant curriculum which engages students with hands-on and minds-on learning environments which are rich with real life applications of mathematics (Shinn et al., 2003). How students are taught mathematics and problem-solving skills might have a great impact on the students' potential to solve mathematical problems. Shinn et al., (2003) cautioned:

Given a rapidly changing world, today's student success hinges on the students' abilities to organize and apply mathematics in the solution of meaningful problems. As family members, workers, and citizens, their informed and responsible decisions will impact food safety and security, sustainable natural resources, and a preserved global environment (p.4)

### **Mathematics Curriculum**

Mathematics curriculum is sequence oriented so as to build understanding. The mathematical content of the curriculum is divided into five major strands for school mathematics: numbers and quantity, algebra, functions, geometry, and statistics and probability (Fitzsimons, 2002). Some of the reasons identified by Fitzsimons for teaching mathematics are:

Contributing to the technological and socioeconomic development of a society; contributing to the political, ideological, and cultural maintenance and development; and providing individuals with the prerequisites which may help them to cope with life in the various spheres of education or occupation, private life, social life, or life as a citizen (p.37).

In a study about the mathematics achievement of African American students, Ladson-Billings (1997) identified the reasons for poor performance in mathematics as: incompetent mathematics teachers, uncreative instructional approaches, poor teacher time management, poorly constructed textbooks, routine mathematics practices, and teachers' assumptions of students' achievement (due to race, social class or personal economic backgrounds). The study suggests several ways of improving mathematics achievement which are: competent teachers, interesting instructional approaches, believing in students' abilities to perform well, scaffolding to help students bridge existing knowledge to new learning, providing students with challenging content, and intellectually demanding mathematics curriculum.

Success in mathematics is linked to higher graduation rates, higher education and high paying jobs. A study by Theriot, Kotrlik, & Jabor (2009) found a significant difference between mathematics scores of agriscience students and non-agriscience students. Agriscience students had a mean score of  $m=317.48$  while non-agriscience students had  $m=314.73$ . Non-agriscience students were outperformed on numbers and number relation, measurement, geometry, and data analysis. An and Gliem (1996) reported that students who had enrolled in applied mechanics course improved mathematical problem-solving competence and retained this competence for a long time.

### **Integrated Curriculum**

Integrating mathematics into agricultural mathematics instruction had a significant and positive influence on student performance (Parr, et al., 2006). Agricultural education promotes the use of hands-on learning activities to increase the understanding of abstract ideas. A well-integrated curriculum constitutes of four components: academic collaboration, hands-on approaches, innovation and convergent thinking. These elements assist students to attain high levels of achievement (Bednarz, 2007). Bednarz also reported that:

In an integrated curriculum, instructors can and should intrinsically motivate students. Students who are intrinsically motivated to learn find a need to learn content being taught. An integrated curriculum could result in the increased curiosity and improved attitudes of students towards the curriculum itself. (p. 15)

The use of agricultural education integrated curriculum thus enables agricultural educators to assist low-achieving students with the development of their critical thinking skills to attain higher levels of academic performance (Hoachlander, 1999). There is need, therefore, in determining the effect of integrating agricultural education in the high school curriculum not only to improve mathematics performance but also in fostering a better understanding of integrated agricultural and mathematics curriculum.

The Math-in-CTE model is a curriculum integration model that is designed and structured to enhance mathematics that is integrated in career and technical education (CTE) content. The model was developed by the National Research Centre for Career and Technical Education and it consists of seven components of a math enhanced (CTE) lesson (Stone, Alfeld, Pearson, Lewis, & Jensen, 2006). These elements are:

- The teacher introduces the CTE lesson and identifies the mathematics concepts
- The teacher evaluates the students' math ability to bridge CTE content and math
- The teacher works through the embedded example
- The teacher works through other related contextual examples and explains the math concepts
- Students attempt similar examples to boost their comprehension
- Students demonstrate mastery (connecting math to CTE content) and the teacher checks for understanding
- Formal assessment of students by the teacher e.g. CTE exams and project assessments

## **Student Achievement**

Several studies have been conducted to determine the relationship between students' achievement and agricultural education participation using standardized test scores. Payne (1997) defines standardized test as a measure of performance taken under controlled conditions and scored in a consistent manner according to the normative information to enable comparisons of performance of a student or a group of students. Researchers have identified variables which explain variations in students' achievement in mathematics. Home environment of the students, students' attitude, curriculum, instructional methods and context, and school factors are all variables that have significant effect on student achievement in mathematics (Theriot, Kotrlik, & Jabor, 2009). Contextual learning enables students to link mathematical knowledge learnt from school to the learning environments of school, home and community.

Chiasson and Burnett (2001) studied the impact of agriscience courses on the science achievement of high school students as measured by Louisiana exit examination. The data were analyzed using descriptive statistics of range, mean, mode and standard deviation and concluded that agriscience students scored higher than the non-agriscience students on the science part of the examination. Edney and Murphy (2010) studied the Exit-level Mathematics and Science scores of students enrolled in power, structural and technology systems courses in secondary schools in Texas. Data were collected from 43 students from 13 schools who participated in contextual mathematics enrichment activities and 56 students from 16 schools who did not participate in the enrichment activities. They concluded that the contextual mathematics enrichment activities improved the CDE and the mathematics achievement.

Ricketts, Duncan and Peake (2006) studied the Georgia High School Graduation Test scores of 523 students. The students were from 23 schools in Georgia with a complete agriscience programs as described by classroom and laboratory activities, FFA and SAE activities. The data obtained were analyzed using descriptive statistics of mean, percentages, and standard deviation as well as inferential statistics to determine if agricultural education courses are related to student achievement in science. They concluded that there was a positive correlation between GHSGT science scores and the number of agriscience classes, SAE programs, and FFA activities.

Another study was done by Rich, Duncan, Navarro, and Ricketts (2009) involving Georgia students from 51 middle schools with agricultural education programs and 51 middle schools without agricultural programs. The researchers concluded that the middle schools with agricultural programs had a significantly higher mean percentage of students meeting or exceeding the standards in Criterion-Referenced Competency Test (CRCT) science test than schools without the agricultural education program.

## **Theoretical Framework**

The theoretical framework for this study is grounded in the seminal works of John Dewey; Jean Piaget, Lev Vygotsky and Jerome Bruner; and Jean Lave and Etienne Wenger. Dewey (1938) is credited for the term experiential learning. Experiential learning is learning in real-life contexts and it involves learning doing tasks, solving problems or conducting projects. Kolb defined experiential learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41).

According to Knobloch (2003), the four tenets of experiential learning in agricultural education are: learning through real-life contexts, learning by doing, learning through projects, and learning through solving problems. These tenets are aligned with the three criteria of authentic learning because experiential learning engages students in solving problems inductively, actively uses and explains knowledge through solving problems, and make connections in applying knowledge beyond the classroom, based on real-life situations. Kolb (1984, p. 41) proposed that experiential learning has six main characteristics:

1. Learning is best conceived as a process, not in terms of outcomes
2. Learning is a continuous process grounded in experience
3. Learning requires the resolution of conflicts between dialectically opposed models of adaptation to the world
4. Learning is a holistic process of adaptation to the world
5. Learning involves transactions between the person and the environment
6. Learning is a process of creating knowledge that is the result of the transaction between social knowledge and personal knowledge

Constructivism is a theory about learning and it suggests that learning involves language, real world situations, interaction and collaboration among learners (Fosnot, 2004). Piaget, Vygotsky, and Bruner viewed learning as a non-linear process which takes place in a meaningful context. A curriculum based on constructivism theory should enhance student's logical and conceptual growth. Doolittle & Camp (1999) forwarded the concept of constructivism. Constructivism posits that: learning should occur in genuine real life settings; learning should assimilate social interactions; subject matter should be relevant to students; content should be connected with previous skills; formative assessments should guide the design of future learning; students should become self-regulated learners in the process; teachers should act as facilitators; and teachers should encourage learners to represent content and learning in a diversity of ways. Constructivism emphasizes on acquiring new skills and knowledge and building on previous experiences.

The essence of the theory of situated learning developed by Lave and Wenger (1991) is that knowledge should be presented to learners in real context with settings and applications that would normally involve that knowledge. Knowledge is embedded in experience and therefore, instruction should situate learners in real-world contexts that involve collaboration and social interaction. Situated learning in mathematics education emphasizes the role played by the social, cultural and various technologies in shaping mathematical knowledge in and out of school.

Conway and Sloane (2006) suggested that situated learning "...puts an emphasis on viewing mathematics within the context of activities, language, social and educational expectations in and out of school (p.138)". They also indicated that situated learning and constructivism theory have the following in common: the learners and learning are viewed as active, knowledge is constructed by the learner in social and material contexts, and teaching and learning are influenced by the learners' capabilities.



### **Purpose of the Study/ Objectives**

The purpose of the study was to describe the mathematics achievement of high school agricultural education students and determine if the number of agricultural education courses passed, FFA involvement and SAE participation would significantly improve the performance of the students in mathematics when compared to non-agricultural education students.

The research has a great significance to the mathematics and agricultural education community since it will help agricultural educators understand the potential they have in assisting high school students improve in mathematics performance. The study will also help to justify the importance of Agricultural Education program, FFA, and SAE in the secondary school system. Specific objectives of the study were:

- To describe the mathematics performance of agricultural education students and non-agricultural education students
- To determine relationship between number of agricultural education courses passed and mathematics performance of agricultural education students
- To determine the relationship between FFA involvement, Supervised Agricultural Education (SAE) participation, and mathematics performance of agricultural education students
- Compare the mathematics performance of agricultural education students and non-agricultural education students

### **Methods/Procedures**

#### **Population and Design of the Study**

The research employed a posttest-only causal-comparative control group research designs also known as *ex post facto* (Leedy & Ormond, 2005). This is a two-group design which includes an experimental group and a control group. The students were self-selected into the experimental group, and the control group of non-agricultural education students as identified by their agriculture teacher. The target population for this research was students from a large comprehensive urban high school in The State. Data related to research questions were collected from two populations. The first population was students enrolled in Agricultural Education programs while the second population was students who were not enrolled in Agricultural Education courses.

#### **Research Participants**

This study took place in a large, comprehensive urban high school. This school was chosen due to its proximity to the University and because it offers agriculture courses. A convenience sample was used in the study. A total of five classes participated in the study; three agricultural education classes and two non-agricultural education classes. The classes had different number of students with an average of 27.8 students per class. One hundred and thirty-nine responses were collected. Seventy-three responses were from female students, 57 from male students, while nine students did not indicate their gender (Table 1). The age of the students ranged from 14 to 18 years (Table 2). Students in the study represented different ethnic groups as shown in Table 3. The demographics of both groups were comparable and therefore reported as one group.

Table 1

*Student Gender*

Gender	<i>f</i>	%
Male	73	52.52
Female	57	41.01
Not indicated	9	6.47
Total	139	100.00

Table 2

*Student Age*

Age	<i>f</i>	%
14	51	36.69
15	53	38.13
16	8	5.76
17	7	5.04
18	3	2.16
Not indicated	17	12.23
Total	139	100.00

Table 3

*Student Ethnicity*

Ethnicity	<i>f</i>	%
White	51	36.69
Hispanic	18	12.95
Black or African American	39	28.06
Others	31	22.30
Total	139	100.00

Students registered for agricultural education course served as the treatment group. Students who were not registered for agricultural education course served as the control group. Eighty of the students who participated in the study were members of the treatment group while fifty-nine were members of the control group (Table 4).

Table 4

*Treatment and Control Class Frequencies*

Class	<i>f</i>	%
Treatment (Ag Ed class)	80	57.55
Control (non-Ag Ed class)	59	42.45
Total	139	100.00

## Variables

This study contained both dependent and independent variables. The three independent variables related to the difference between the treatment and the control groups are; number of agricultural education courses passed, FFA participation, and SAE activities. The dependent variable is the mathematics score. Out of the 139 students who participated in the study, 80 were in the treatment group and 59 were in the control group.

## Instrumentation

The researcher developed the survey instrument for the study by creating mathematical questions that indicated competency on Mathematics Standards of the Common Core State Standards Initiative. The instrument was developed using Microsoft Word. The survey instrument contained two main parts. The first part contained questions addressing students' demographics. It also contained instructions on how to rate the student's SAE and FFA involvement. The rating scales were completed by the student with the guidance of their agricultural education teachers. In order to determine the level of participation for both FFA and SAE, the following instructions were included in the instrument. The SAE participation level of the students was rated from one to five for the following categories: a student with 10 or less hours per semester was a level one, 11 to 20 hours per semester a level two, 21 to 30 hours per semester a level three, 31 to 40 hours per semester a level four, and a student that worked 50 or more hours per semester on an SAE was a level five. The FFA participation of agricultural education students was also rated on a scale of one to five. A student that participated in one FFA activity was a level one, two FFA activities was a level two, three FFA activities was a level three, four activities was a level four, and five or more activities was a level five. (Examples of FFA activities are chapter meetings, CDEs, leadership camps, livestock competitions, etc).

The second part contained 25 mathematics questions in the following mathematics standards: 20% algebra, 20% number systems, 20% statistics and probability, 20% functions, and 20% geometry. The total number of students was 139 and the students had 1 hour 30 minutes to complete the test. Upon completion and grading the test, it was used to gather the data required to answer the research questions.

Objective 1 focused on the mathematics performance of the students depending on the standards addressed by the questions in the survey instrument. Objectives 2-4 focused on the components of agricultural education that are class instruction, FFA and SAE (Priest, 2008), to determine their relationship to mathematics performance. Objective 5 was used to compare the relationship between mathematics performances of students in agricultural education and non-agricultural education students. The dependent variable in the study is the mathematics scores of the students while the independent variables were the number of courses passed, FFA participation and SAE activities. The instrument was reviewed for content validity (Leedy & Ormond, 2005) by a panel of experts composed of faculty members in the Department of Agricultural and Environmental Sciences at a State University.

To establish the reliability of the survey instrument Cronbach's alpha was determined. The Cronbach's alpha for the 25 items was 0.7 which was reliable. Algebra consisted five items ( $\alpha=0.3$ ), number system consisted five items ( $\alpha=0.5$ ), statistics and probability consisted five items ( $\alpha=0.4$ ), functions consisted five items ( $\alpha=0.2$ ) and geometry also consisted five items ( $\alpha=0.4$ ).

The reader should use caution with these results as the questionnaire was pilot tested with college students at a State University for validation, but more administrations and data points are needed to improve test reliability.

### **Institutional Review Board (IRB)**

Research involving human subjects is approved by the IRB committee to ensure confidentiality and protection as per the federal regulations. To fulfill these requirements, the researcher submitted a complete Human Subjects Research Proposal form and all the other documents to the University's Office of Research and Sponsored Programs for assessment. The IRB concluded that the research presented minimal or no risks to the human subjects involved and approved the study.

### **Data collection and Analysis**

The survey packet contained an informed consent letter that introduced the researcher and explained the purpose of the survey, why the student was chosen and why their participation was important. To avoid reluctance of the respondents due to security reasons (Nichols & Sedivia, 1998), the confidentiality (Couper et al., 1999) and anonymity of the participants was assured.

Data collected were analyzed depending on the research question addressed. *Microsoft Excel* and *SPSS* were the computer software programs that were used to statistically analyze data collected for this study. The first part of the survey containing the demographic information of the students was analyzed using descriptive statistics. Descriptive statistics analyzes frequencies, means, and standard deviations (Bednarz, 2007). The researcher then carried out *t*-tests for the second part of the survey to determine the statistical significance of the results.

### **Results/Findings**

#### **Objective One: Describe and compare the mathematics performance of agriculture students and students not participating in agricultural education**

The mean mathematics score for all the students ( $N=139$ ) was  $M=11.53$ ,  $SD=4.27$ . Mathematics scores ranged from a low score of 3 to a maximum score 23 out of 25. The average score for agricultural education students was  $M=12.15$ ,  $SD= 4.62$ , while that of the non-agricultural education group was  $M=10.68$ ,  $SD=3.63$  with a medium effect size ( $d=.40$ ) (Table 5). According to Table 6, Algebra questions had the highest average scores  $M=2.9$ , while Statistics and Probability questions had the lowest average  $M=1.6$ . Agricultural education students had an average of  $M=3.1$  in Algebra and the non-agricultural education students had  $M=2.8$ . Statistics and Probability had the lowest average in both groups;  $M=1.8$  for agricultural education students, and  $M=1.4$  for non-agricultural education students. An independent samples t-test showed that the difference between the two groups was statistically significant [ $t(137) = 2.03$ ,  $p=0.04$ ] at an alpha level of 0.05.

Table 5

*Descriptive statistics for agricultural education (AgEd) and non-agricultural education groups*

Category	<i>f</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>	<i>d</i>
AgEd students	80	12.15	4.62	137	2.03	0.04	0.40
Non-AgEd students	59	10.68	3.63				

\**p*<.05, 2-tailed

Table 6

*Standards descriptive statistics for the respondents*

Standards	<i>M</i> (Respondents, n=139)	<i>M</i> (Control, n=80)	<i>M</i> (Treatment, n=59)
Algebra	2.9	2.8	3.1
Number System	2.5	2.3	2.7
Statistics and Probability	1.6	1.4	1.8
Functions	1.9	1.8	2.0
Geometry	2.5	2.3	2.6

**Objective Two: Determine the relationship between number of agricultural education courses passed and mathematics performance of agricultural education students**

Table 7 below gives  $r=0.26$  which shows that there was a low relationship between mathematics score and the number of agricultural education courses passed. However, the relationship was positive. According to the table, the relationship between mathematics score and the number of agricultural courses,  $r(78) = 0.26$ ,  $P < 0.05$ ,  $R^2 = 0.07$  which explained 7% of the variance. Miller (1998) indicated that a Pearson product moment coefficient ( $r$ ) of 0.01-0.09 represents a negligible relationship; 0.10-0.29 represents a low relationship; and 0.30-0.49 represents a moderate relationship.

Table 7

*Pearson product moment correlation between math score and agricultural courses (N=80)*

Variable	<i>r</i>	<i>df</i>	<i>p</i>
No. of Ag courses	0.26	78	0.02

\**p*< .05, 2-tailed

**Objective Three: Determine the relationship between FFA, SAE and mathematics performance of agricultural education students**

Out of the 80 agricultural education students, 13 were FFA members while 67 were not FFA members. The mathematics average score of FFA members was  $M=15.77$ ,  $SD=4.07$  (Table 8) while the mathematics average score of the agricultural education students who were not FFA members was  $M=11.45$ ,  $SD= 4.41$ . Using Cohen's  $d$  (Cohen, 1977), the effect size was large for this

difference was large ( $d = 1.06$ ). Table 9 gives  $r=0.35$  which indicates a moderate relationship between mathematics achievement of agricultural education student and FFA membership. This relationship is positive. The correlation between the mathematics score and FFA membership is  $r=0.35$   $p<0.05$ .  $R^2=0.12$  which means that twelve percent of the variance is explained by the model.

The study also sought to determine the relationship between SAE involvement and the mathematics performance of agricultural education students. Table 9 gives a Pearson product moment correlation,  $r=0.23$  which indicates that there was a low but positive relationship between mathematics score and SAE involvement of the agricultural education students. According to the table, this relationship between SAE and mathematics score,  $r(79) = 0.23$ ,  $p<0.05$ ,  $R^2=0.05$  explained 5% of the variance. The relationship was statistically significant an alpha level of 0.05.

Table 8

*Descriptive statistics of math scores for FFA and Non-FFA agricultural education students*

FFA	<i>f</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Yes (FFA members)	13	15.77	4.07	3.275	78	0.002	1.06
No (Non-FFA members)	67	11.45	4.41				

\* $p<.05$ , 2-tailed

Table 9

*Pearson correlation between FFA, SAE, and math score (N=80)*

Variable	<i>r</i>	<i>df</i>	<i>p</i>
FFA membership	0.35	78	0.00
SAE	0.23	78	0.04

\* $p<.05$ , 2-tailed

## **Conclusions/Discussion/Implications/Recommendations**

### **Conclusions and Discussion**

Objective one sought to describe and compare the mathematics performance of the respondents. Both the treatment and the control groups had the highest mean in Algebra questions and the lowest mean in Statistics and Probability questions. Agricultural education students had a mean of  $M=3.1$  in Algebra and 1.8 in Statistics and Probability while the non-agricultural education students had a mean of  $M=2.8$  and  $M=1.4$  in Algebra and Statistics and Probability respectively. The study compared the mathematics performance of agricultural education students and non-agricultural education students. Agricultural education students had a higher mathematics mean score ( $N=80$ ,  $M=12.15$ ,  $SD=4.62$ ) than non-agricultural education students ( $N=59$ ,  $M=10.68$ ,  $SD=3.63$ ). The study found a statistically significant difference between the two groups ( $p=0.04$ ) at an alpha level of 0.05.

This study also sought to determine the relationship between mathematics performance of agricultural education students and the number of agricultural education courses passed. A Pearson product moment coefficient revealed a low and positive ( $r= 0.26$ ) relationship between mathematics performance and the number of agricultural courses passed. This relationship was statistically significant ( $p=0.019$ ).

Objective three focused on determining the relationship between FFA, and specifically the intensity level of FFA activities, and the mathematics performance of the agricultural education students. FFA members ( $N=13$ ) had a mathematics mean score  $M=15.77$ ,  $SD=4.07$  and non-FFA members ( $N=67$ ) had a mathematics mean score of  $M=11.45$ ,  $SD=4.41$ . The FFA status of the students had a moderate positive correlation ( $r=0.348$ ) with mathematics performance. This relationship was statistically significant. The study also investigated the relationship between SAE involvement and mathematics performance. It was found that SAE participation and mathematics score had a low positive correlation ( $r=0.23$ ) which was statistically significant ( $p=0.04$ ) at an alpha level of 0.05.

### **Recommendations and Implications**

This study determined that FFA, SAE, and number of agricultural education courses passed improved the mathematics performance of high school students. Additional research is, however, recommended to examine the specific agricultural education courses that have positive effect on mathematics performance as well as overall academic achievement of students. More studies are required to determine the effects of each FFA activity on the performance of the students since this study investigated the activities as a group. SAE was found to have a positive effect on mathematics performance of the students but more research is required to determine if the quality of SAE projects affects the academic achievement of students.

The results of this study are limited to a comprehensive urban school in the State. Additional studies are recommended across The State and also across the nation. Another research design is also recommended for example, using a randomized sample. Though the Cronbach's alpha of the instrument was reliable ( $\alpha=0.7$ ), item analysis revealed that the reliability of specific constructs was low. Since this was the first time the instrument was used, a modification of the instrument is thus recommended. For example, deleted item 1 and item 23 from the instrument raised the Cronbach's alpha from  $\alpha=0.3$  to  $\alpha=0.4$ . These items can, therefore, be deleted and replaced with others in the same standards.

From the results, students had the lowest mean in statistics and probability as compared to algebra and number systems. Agricultural educators should, therefore, look for ways of integrating statistics and probability examples in agricultural education. This would help the students in contextualization of these standards. Based on this study, students who had passed more agriculture courses performed better than those who had few course. Agricultural education teachers should encourage students to enroll in as many agriculture courses as possible. They should also emphasize on FFA and SAE participation of the students since they have positive effect on the mathematics performance of the students

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